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Some soil parameters of shrimp culture ponds of Karapa, Kogodu and Atchutapuratrayam villages of East Godavari district, Andhra Pradesh

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Abstract
The soil composition and other sediment characteristics like pH, organic carbon, phosphates and nitrogen were estimated in the shrimp culture ponds of Karapa, Kogodu and Atchutapuratrayam villages of East Godavari district of Andhra Pradesh were studied. The soil pH ranged from 6 to 7 at Atchutapuratrayam ponds and 6.5 to 7.5 at those of Karapa and Kogodu villages. The percentage of sand, silt and clay varied from 24 to 31%; 28 to 40% and clay 30 to 50% respectively. The percentage of organic carbon was low (0.5-1.0%) at Kogodu and Atchutapuratrayam ponds and high (1.5-2.0%) in ponds of Karapa. Phosphates ranged from 1 mg/l (Atchutapuratrayam village) to 4 mg/l (Karapa village and Kogodu village). Nitrogen levels varied from 37.0 mg/l (Atchutapuratrayam village) to 113.8mg/l (Karapa village).

Keywords: Soil parameters, Shrimp ponds, East Godavari District

1. Introduction
Sediment and water quality plays a significant role in increasing the productivity of pond [1]. Bottom sediment constitutes one of the vital factors for the success of the aquaculture since the physico-chemical characteristics of pond water are very much influenced by the bottom sediments [2]. The bottom sediments provide food and shelter for the benthic organisms and also act as the reservoir of nutrients for the growth of benthic algae which constitute food for aquatic organisms [2]. The sediment functions as a buffer and governs the storage and release of nutrients into the water [3]. It serves as biological filter for the adsorption of organic residues of food, excretory products and algal metabolites. The microbial loads in the sediment help in the decomposition and mineralization of organic deposits at the bottom.
The structure and composition of bottom sediment are important criteria to determine the suitability of the site for aquaculture [4]. Information on physico-chemical parameters of sediment and water, the interaction between sediment and water and ecological interaction among the organisms is essential to understand the suitability for development and management of shrimp ponds. Some of the researchers who worked on these aspects include [5-16]. In the present study the soil composition and sediment characteristics like pH, organic carbon, phosphates and nitrogen in the shrimp culture ponds of Karapa, Kogodu and Atchutapuratrayam villages of East Godavari district of Andhra Pradesh have been studied.

2. Materials & Methods
Sediment samples were collected from ten different culture ponds at 3 villages – Karapa (3 ponds- Ka1-16°54’58.99”N, 82°10’34.37”E; Ka2-16°54’58.99”N, 82°10’34.37”E and Ka3-16°54’58.99”N, 82°10’34.37”E), Kogudu (2 ponds- Ko1-16°51’48.49”N, 82°07’05.44”E and Ko2-16°51’48.49”N,82°07’05.44”E) and Atchutapuratrayam (5ponds-Ap1-16°57’07.47”N, 82°10’24.31”E; Ap2-16°57’07.47”N, 82°10’24.31”E; Ap3-16°57’07.47”N, 82°10’24.31”E; Ap4-16°57’07.47”N, 82°10’24.31”E and Ap5-16°57’07.47”N, 82°10’24.31”E), East Godavari, Andhra Pradesh (Fig.1). The soil samples were collected from the four corners and the centre of the pond. All these sediment samples were mixed to form the composite sample of the respective ponds and packed in zip covers. In a similar way sediment samples were collected from 10 ponds and brought to the laboratory. The samples were dried in the shade and ground to powder.

The powdered soil sample is sieved through a 2mm sieve and finally through 80µ mesh sieve and packed in cloth bags for subsequent analysis [17].

The sediment composition was estimated by Carver [18]. A sample of the mud was dried and subjected to mechanical analysis. The larger particles were determined by sieve analysis and smaller by hydrometer or pipette method. After the estimation of three types of sand, silt and clay, the soil texture was determined from the soil texture triangle given by U.S. Dept. of Agric. Fraction System. The sediment composition is calculated as follows:

If weight of
Clay + silt = 'x' g
Clay = 'y' g,
% of clay = y X 250;
% of silt = (y-x) X 250
% of sand = 100-(x X 250)

The other parameters of soil *i.e.,* pH, phosphorus, nitrogen were estimated by following APHA [18] and organic carbon by Walkley and Black [19].

Fig 1: Sampling stations

3. Results and Discussion

Soil composition

Sand, silt and clay of the ponds of Karapa village were 30%, 40% and 30% in 1 and 2 ponds whereas in pond 3 they were 30%, 28% and 42% (Fig.2) respectively. At Kogodu village the soil composition was different. The percentage of sand was high (28%) in pond 2 and silt & clay were high (30% & 46%) in pond 1 (Fig. 3). At Atchutapuratrayam village the percentage of sand was high (31%) in pond 4 and low (20%) in Pond 2. High (32%) silt content was observed in pond 5 and low (28%) in pond 1. The percentage of clay was high (50%) at pond 2 and low (40%) in ponds 4 and 5 (Fig. 4).

pH

Soil pH in the ponds of Karapa village and Kogodu village ranged from 6.5 to 7.5. Maximum pH (7.0) was observed in the ponds 1 and 5 and minimum (6.0) in the pond 2 of Atchutapuratrayam village (Fig. 5).

Organic Carbon

The percentage of organic carbon was high (1.5 -2.0%) in ponds 1& 2 and low (1.0-1.5%) in pond 3 of Karapa village. High organic carbon (1.0-1.5%) was observed in pond 2 and low (0.5-1.0%) in pond 1 of Kogodu village. In ponds 1 and 5 of Atchutapuratrayam village high organic carbon (1.0-1.5%) was noticed whereas in the remaining ponds a low value of 0.5-1.0% was found (Fig. 6).

Phosphates

Phosphates in the sediments ranged from 1 mg/l to 4 mg/l with minimum in pond 3 of Atchutapuratrayam village and maximum in 2 & 3 ponds of Karapa village. 1 & 2 ponds of Kogodu village and 1 & 5 ponds of Atchutapuratrayam village were recorded high phosphate content. In pond 2 of Atchutapuratrayam village phosphates were not found (Fig. 7).

Nitrogen

Nitrogen levels varied from 37.0 to 113.8 mg/l. The minimum nitrogen level was recorded in the soils of pond 3 of Atchutapuratrayam village and maximum in pond 1 of Karapa village (Fig.8).

Quality of the pond sediment is one of the vital factors for the success of the aquaculture, since it influences the water and the live-stock. The bottom sediments are the reservoir of nutrients and provide food and shelter for the benthic organisms. It also serves as biological filter for the adsorption of organic residues of food, excretory products and algal metabolites. The sediment holds high bacterial loads which play an important role in the decomposition and mineralization. Organic cycling in the shallow brackish water ponds is governed by the rate of conversion of living tissues into detritus and secondarily the rate of conversion of detritus into dissolved organic and inorganic forms of nutrients.

The structure and composition of bottom sediment are important criteria to determine the suitability of the site for aquaculture. In this regard, information about physico-chemical parameters of sediment and water, the interaction between sediment and water and the interaction between the environment and culture organisms are essential understand the suitability for development and management of culture ponds [12].

Variation in the pH was not significant among the ponds. The normal range of pH required for brackish water shrimp culture is 6.5 – 7.5 [20]. In the present study, the soil pH of ponds is within the desirable limit. Praphruttham [21] has reported that decomposition in sediments would liberate hydrogen ions and decrease the pH during harvest period. In the present study, such incidences were observed at pond 2 of Atchutapuratrayam. Christopher *et al.* [9] have observed soil pH ranging from slightly acidic to slightly basic and the potential acidity ranged 14.7–21.42 meq H+ per100 g of soil in modified extensive culture of milk fish and semi intensive culture of shrimp ponds. According to them the mean organic matter content (%) in shrimp ponds is 1.90±0.6 and the phosphorous is more or less similar in milk fish and shrimp culture ponds.

The organic carbon content is an important factor to determine the fertility status of the soil. The organic carbon in the present investigation was found to be between 0.5% to 1.5% which are similar with those of Panigrahi [22] and Burford [23]. Banerjea [24] has reported that aquaculture production is positively related with the soil organic carbon with low production at less than 0.5% organic carbon, average at 0.5 to 1.2%, high at 1.5 to 2.5% and low again at greater than 2.5%. Mantoura [25] has stated that brackish water pond soils are poor in organic carbon.

The phosphorous content of the water depends on its concentration in the sediments either in organic or inorganic form. The phosphorous in brackish water ponds is comparatively higher than the fresh water ponds [26]. In the present investigation, the range of phosphates has been recorded between 1 to 4 mg/l. This is in agreement with the observation of Panigrahi [22]. Benarjea [24] has classified culture pond potential based on phosphate concentration with low production at < 30mg/l, average at 30-60mg/l and high at > 60mg/l. In the present study nitrogen content of soil samples varied from 37.0 to 113.8 mg/l. According to Henriksen and

Kemp [27] nitrification rates of estuarine pond sediments range from 15 to 25 mg/l. Varadaraju *et al.* [6] have reported the significant influence of soil parameters like pH and electrical conductivity on the growth of the shrimps

Pankaj Kumar *et al.* [11] have found a significant monthly variations and a positive correlation between water temperature and salinity, salinity and primary productivity, primary production and dissolved oxygen, dissolved oxygen and nitrate, nitrate and total available phosphorous, soil salinity and soil organic carbon and a negative correlation between soil organic carbon and pH. According to them the overall mean values of the nutrients in the sediment and water are suitable for shrimp culture. Gunalan *et al.* [10] have investigated that total carbon, total nitrogen and calcium have increased considerably in almost all the ponds of TamilNadu (TN), Andhra Pradesh (AP) and Orissa.

Wei Sun and Boyd [13] have found that the difference between the inputs and outputs of phosphorous represent adsorption by bottom soils and for nitrogen it has been caused by accumulation of organic nitrogen in bottom soil, denitrification and ammonia volatilization. Devi *et al.* [14] have suggested the control of ill effects caused by imbalance in the quality of water and soil for survival of aquatic animals. Muhammad *et al.* [15] have recorded that the brackish water soil quality in Mangara Bombang coastal areas is suitable for promoting shrimp farming. Zafar *et al.* [16] have concluded that the soil quality parameters such as pH, organic carbon and total nitrogen have shown no significant difference between the shrimp & prawn farms but the phosphorous is significantly higher in shrimp & prawn farms and is negatively correlated with pH and organic carbon of farm sediment in the southwest region of Bangladesh.

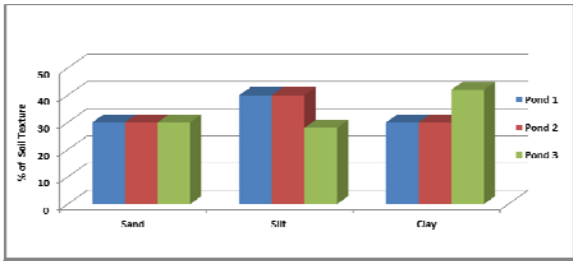

Fig 2: Soil texture in ponds at Karapa village

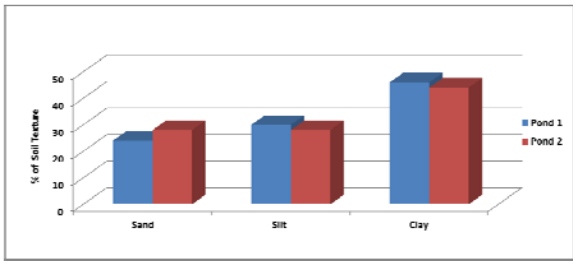

Fig 3: Soil texture in ponds at Kogodu village

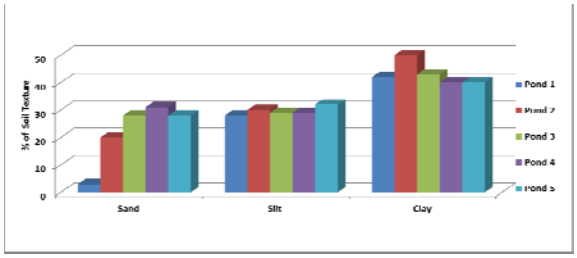

Fig 4: Soil texture in ponds at Atchutapuratrayam village

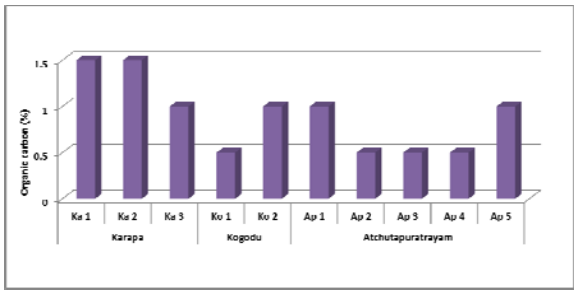

Fig 5: Organic carbon in pond soils of Karapa, Kogodu and Atchutapuratrayam villages

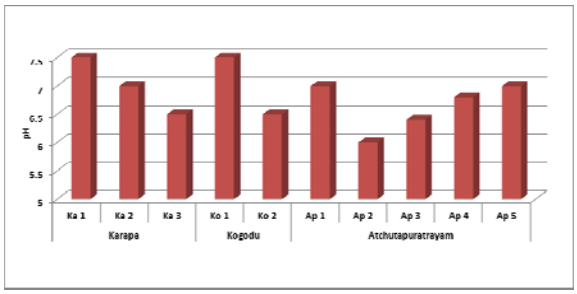

Fig 6: pH in pond soils of Karapa, Kogodu and Atchutapuratrayam villages

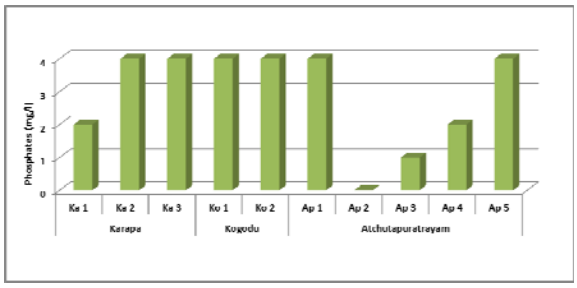

Fig 7: Phosphates in pond soils of Karapa, Kogodu and Atchutapuratrayam villages

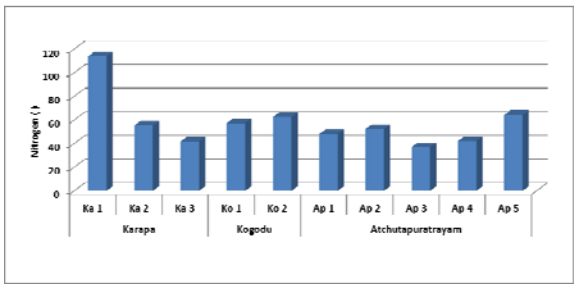

Fig 8: Nitrogen in pond soils of Karapa, Kogodu and Atchutapuratrayam villages

4. Conclusion

Sediment quality plays an important role in increasing the productivity of pond provide nutritionally balanced and healthy environment to cultured animals. In the present study sediment composition, pH, organic carbon and nutrients have been estimated in different ponds and their importance with the contemporary works has been discussed. The parameters recorded in the ponds are quite suitable for shrimp culture and higher yields may be expected.

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