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Assessment of various oceanographic parameters and inter comparison of primary production estimates around Chennai coast – Tamil Nadu, India

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ABSTRACT

In this research work, the primary production along the Bay of Bengal is estimated from the field data collected from 21 stations, between 2013 and 2015 from different algorithms and compared with primary production determined experimentally in laboratory. Other important oceanographic parameters such as chlorophyll a, nutrients, suspended matter, dissolved oxygen and salinity are also evaluated in the water samples. The study resulted with observed primary production values of 339.94 g C m^2 yr^{-1} or 225.16 g C m^3 yr^{-1} by averaging five different algorithms. Using the relationship between primary production and fish production, the common fish catch predicted inside the study vicinity is estimated with the aid of Eppley et al. technique (1985) as 87.29 ± 47.90 kg/ ha. The total yearly fish production for the estuarine, coastal and offshore regions was calculated using empirical relations as 14549 tons. In light of the determined primary production values the fish biomass was assessed by writing conditions given in literatures and the fish standing biomass estimated for the study stretch is 0.15 tons/km^2 for the Bay of Bengal region. From the Chlorophyll a measurements, about 76% of the sampling locations are categorized in to ultra-oligotrophic state (average chlorophyll a values ≤1 mg/m^3), 14% of the sampling stations are grouped in to oligotrophic state (average chlorophyll a values ≥1 and ≤2.5 mg/m^3) and 5% of the locations are classified in to mesotrophic state (average chlorophyll a values ≥2.5 and ≤8 mg/m^3) and eutrophic state (≥8 and ≤25 mg/m^3).

1. Introduction

Anthropogenic activities distort the makeup of the earth's ambiance, contributing to warming from excess carbon dioxide (CO_2) along with trace-gases like CFC, CH_4 and NOx [1]. In view of different findings the CO_2 discharges every year is expanded because of the non-renewable energy source ignition or from burning of timberland assets for agribusiness leads to the addition of 7 petagrams (Pg) of carbon (C). Out of the 7 Pg, ~42% C accumulates in the top atmospheric layers every year due to anthropogenic CO_2 emissions and the rest is deposited with in the terrestrial lands and sea waters. Nearly all the CO_2 consumed by the phytoplankton is reclaimed close to the surface leaving a substantial fraction of 30%, which descends into the deeper waters before being renewed by oceanic microorganisms into CO_2. Photosynthetic carbon attraction by marine algae is a major regulator of atmospheric CO_2 and primary production, especially the phytoplankton forms an acute source to estuarine food chains [2–4]. The capacity of biomass created by photosynthetic process in organisms determines the size of the coastal habitats. Phytoplankton contributes 90% photosynthesis in marine water whose production is mostly coupled to the foremost taxonomic groups include Diatoms, Dinoflagellates, Coccolithosphores and Silicoflagellates. As cited by Schiermeier in 2010 [5] 40% drop in algal biomass was observed on account of ocean warming and in his studies, he quoted Boris Worm's research outcome which reveals annoying downwards trend in productivity of the coast for the past 100 years. When overlaid on short-term variability he found that mean global phytoplankton intensity in the top surface ocean declines by 1% each year. Upsurge in population growth and exhaustive agriculture along the drainage basins leads nutrient loading which in turn stimulates the productivity of phytoplankton and macro algae, resulted with eutrophication along estuarine and sea waters for decades [3,6,7].

Significant research on marine pollution (Toxins & Contaminants) shows evidence that excess nutrients impact marine

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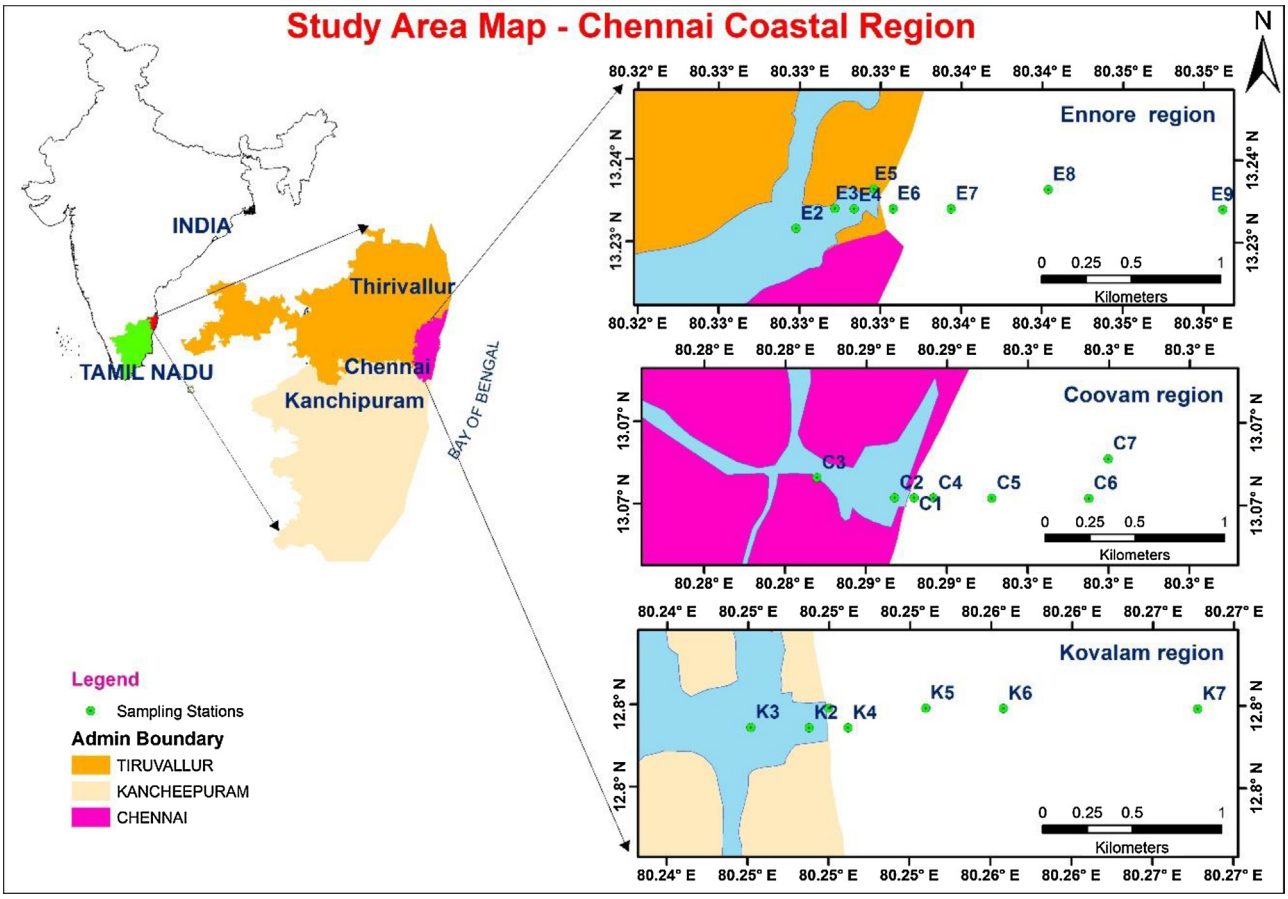

Fig. 1. Sampling Location and Study area – Chennai Coast.

ecosystem. Biogenically prearranged habitats seem vulnerable to nutrient addition in marine-estuarine systems. The growing nutrient input to the marine system is the greatest threat to the oceanic ecosystem [6,8]. Though nitrogen and phosphorus is the base of the growth of phytoplankton, micro algae creates problems with an overabundance [9]. The foremost contributor aimed at phytoplankton is nitrogen in the form of ammonium (NH_4), nitrite (NO_2) and nitrate (NO_3) and phosphate (PO_4). Enrichment of nutrients by anthropogenic activities leads the change in phytoplankton biomass on continental shelves and a carbon sink amounting to ~2Gt C/year along the continental margins or Interior Ocean [10]. If ocean productivity is changing, biological process might have sizeable impact on anthropogenic CO_2 levels. Consequently this examination expects to assess the marine primary production along three different regimes 1) Estuary, 2) Near-shore, 3) Deep oceans to appraise the changes in primary production patterns using remote sensing and field information. Further this study is focused to analyze the physico-chemical and biological parameters of coastal waters around Chennai as shown in the Fig. 1, to compute the chlorophyll a concentration and estimate the biomass using field and satellite data along with exposing the consequence on maritime habitats (fishes) due to varying water quality.

2. Description of study area

The study focused on three important transects and the marine water samples collected at 21 stations covering 3 different locations i.e. Ennore (E – Station 1), Coovam (C – Station 2) and Kovalam (K – station 3) stretching ~70 Km from south to north. The sampling location and study area are shown in Fig. 1.

Ennore: The northern stretch of the study area covers the Ennore coast, which gets untreated sewage from Royapuram outfall, treated/untreated effluents from Manali Industrial zone, which comprise petrochemical, sugar, fertilizer industries, and petroleum based crude oil refineries etc. Above all the coastal sector acquires fly ash and thermal releases from adjacent Ennore thermal power station. In accumulation to the above facts, fishing and navigational activities take place in the area.

Coovam: The middle stretch covers the Coovam River which flows from West to East, confluence in to Bay of Bengal, this region witnesses coastal and catchment degradation due to; i) Intense agriculture practices with chemical pesticides and fertilizers ii) Raw waste water and sewage inflow along with let-out of municipal discharges and effluents from industries. iii) Illegal and arbitrary dumping of solid waste. iv) Cropping up of unlawful constructions along the river banks and its levee plains. Further, the opening of the river is subjected to frequent blockages by development of sand bars developed from northerly coastal littoral drift, affecting the tidal exchange in downstream channels.

Kovalam: Kovalam beach, the southern tip of the Chennai coastal region is connected with a fishing village located about 40 km south of Chennai, which is slightly clean and has various recreational boating and surfing activities, are presently polluting the coastal region.

3. Methodology

Set of 21 water samples had been accrued from three unique areas i.e. Ennore (E – Station 1), Coovam (C – Station 2) and Kovalam (K-station 3) at surface and different depths from the coastal, estu-