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Seasonal Variation of Nutrients in Fishing Harbour Water, Southeast Coast of India

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physical-chemical parameters, harbour, Chinnamuttom, Colachel, Muttom, fishery harbour.

Abstract:
The objective of the current study is to determine the harbour water quality indicators for the quantity of fertilizers and other pollutants entering the marine environment. Combining mathematical and statistical techniques with conventional hydrographic data has been used. The water samples were taken from the fisheries harbour in Chinnamuttom, Colachel, and Muttom, and they were examined for a number of physicochemical factors. It has been discovered that seawater has a substantial impact on water quality. The present study's findings showed that anthropogenic impacts had a significant impact on the spatiotemporal variability of water quality measures. To reduce the risk to the population's health and the negative effects on the aquatic ecology, it is necessary to continuously check the harbour water quality.

1. Introduction

One of the most significant and plentiful components of the environment is water. Water is a necessity for the life and development of every living thing on Earth. Only Earth has 70% water on the globe as of yet. Environmentalists have been pushed to ascertain the chemical, physical, and biological features of natural water supplies because of the rising demand for water brought on by population expansion, agriculture, and building construction. (Regina & Nabi, 2003).

The development of commercial harbour, the fishing harbour, landing facilities, river training and outfall schemes, transportation, communications, recreational facilities, and tourism have all contributed to the economic importance of coastal areas. Controlling waste management and coastal water pollution is becoming more and more important because of the rapid urbanization and industrialization of coastal regions, which result in significant increases in the total quantity of garbage produced (CZMP, 1990). Along the Mediterranean coast, there are more than 200 petrochemical, energy, basic chemical, and chlorine plants. In addition, there are river basins that are contaminated by at least 40 major oil refineries, as well as cement plants, steel plants, tannery plants, food processing facilities, textile mills, and pulp and paper factories (Marquina, 2004). Nutrients are a necessary component for organisms to develop and live (Wang et al., 2019). Eutrophication, a phenomenon marked by a rise in nutrient content in ecosystems, is a result of human activity. (Chislock et al., 2013).

More than 90% of sewage and 70% of industrial wastes are dumped into the ocean without being cleaned in some coastal areas. These wastes affect benthic organisms and increase the risk of eutrophication. (Creel 2003). Monitoring the environment can reveal changes in natural processes, which are closely tied to the impacts and degree of impact of pollution on species. (Newton et al. 2003) Other significant factors, such as nutrients, that affect enhanced development include excessive water movement, changes in salt concentrations, a lack of dissolved oxygen, and stability deprivation.

Oxygen levels in aquatic systems may quickly rise to 200% of solubility saturation levels when primary production is high, or they can drop to zero when bacterial respiration is intense. Dissolved oxygen levels are decreased by sewage intake as well as organic matter decomposition. (Duursma & Boisson 1994)

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A concentration of DO of less than 2 mg/l is exceedingly dangerous, and one of 2 to 4 mg/l will result in severe stress. Nitrite can enter a water supply system because it is used as a corrosion inhibitor in industrial process activities. Ammonia is the only source of nitrogen that may be relevant to phytoplankton, even though species composition is partially dependent on the diversity of inorganic species of nitrogen that are accessible. This will result in an increase in cell numbers and a loss in species diversity. (Valsaraj & Rao1994)

Depending on local rainfall, tidal incursions, various abiotic and biotic processes, and the quantity of freshwater input impacting the nitrogen cycle of different coastal environments, they frequently show considerable seasonal changes in nearshore waters and estuaries (Choudhury & Panigrahy, 1991). Environmental monitoring can show alterations in natural processes, which are strongly related to the effects and severity of pollution on various species. In truth, using mineral fertilizers, especially those based on nitrate, helps increase yields while simultaneously damaging the ecology. Over time, several studies have shown that the majority of areas with intensive agriculture are vulnerable to soil and water contamination.

Fishing harbours are complex hubs of potential waste-generating activities and are thus regarded as hotspots of coastal pollution (Niroshana et al., 2013). The most frequent causes of epidemics and illnesses associated with seafood are frequently the pollution of harbour waters brought on by the discharge of untreated sewage in nearby waters and the harbour basin. Human activity has a significant impact on the quality of the harbour water, both inside and outside the harbour complex. Because the fisheries harbour and the seas around it are in the coastal zone, harbour pollution immediately impacts the coastal zone and vice versa. (Scoiortino, 2010).

Living organisms are affected by the ecotoxicity of heavy metals, including both necessary and non-essential elements (Storelli et al., 2015). Lead, nickel, cadmium, mercury, chromium, and arsenic are listed as hazardous owing to their poisonous nature to the environment, even though metabolic functions in organisms need some metals like iron, copper, manganese, zinc, etc. (E.C., 2001; USFDA, 1993).

The marine fish of the contaminated environment serves as a conduit for the transfer of heavy metals to humans. The amount of these heavy metals in the coastal ecology must be measured and tracked, though (Namminga & Wilhm, 1976). Although various inorganic substances are required for the life-sustaining processes in marine coastal ecosystems, Nitrogen, phosphorous, and silicon are believed to be more important than the others since they are found in higher concentrations in the ocean. Although various inorganic minerals are essential for the life-sustaining processes in marine coastal ecosystems, nitrogen, phosphorous, and silicon are regarded as more vital than the others as they are crucial for phytoplankton abundance, growth, and metabolism. (Grant & Gross, 1996)

2. Study Area

Chinnamuttom lies at the southernmost point of the Indian subcontinent in the Kanyakumari district at 8.0954°N, 77.5623° E. It is the only coastline that lies on the eastern coastal plains. The Muttom fishing harbour in the Kanyakumari district is located along the west coast of the district at 8.1244°N, 77.327°E. There are no berthing options for fishermen for up to 60 kilometres. Colachel is considered a natural harbour about 20 m deep. Both the western and eastern breakwaters approach the commercial fishing harbour. It is coordinated by 8.1734°N and 77.2503°E. In this study, Chinnamuttom is considered S1, Colachel S2, and Muttom S3.

3. Sampling and analysis

The water samples from three stations were collected from October 2019 to September 2020 using 100-ml polyethylene terephthalate (PET) bottles. The bottles are washed with the sample water three times before collecting water for analysis. The samples were collected without air bubbles and were labelled for identification. After collection, samples are immediately sent to the laboratory for safeguarding and investigation. The study period covers about three seasons.

4. Results and Discussion

The coastal environment's water quality affects the ability of all marine species to survive. Water quality is one of the fundamental techniques for outlining the

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ecological or environmental state of a water body and for streamlining the presentation of the result. (Fatima Hayat Shaheen Zafar, 2018) The temperature usually has some indirect impacts on aquatic species' development; however, this is not always the case. One cause of thermal stratification in the waters may be temperature (Elahi et al. 2015). According to Alabaster and Lloyd (1980), the typical temperature range to which fish are suited is between 8°C and 30°C. The temperature of the water is often determined by the surrounding ambient temperature. The maximum monthly wise mean atmospheric temperature of 33.7°C was observed in the pre-monsoon month of February, while a minimum monthly wise mean atmospheric temperature of 28.5°C was recorded in the monsoon month of June. (Fig.1)

For some species, such as trout or salmon, which need cold water and high oxygen levels, a high-water temperature might be lethal. The amount of dissolved oxygen decreases as the water gets hotter. Water cools more slowly than air because its temperature does not vary as rapidly as air. In actuality, water has a greater thermal capacity than air. The processes of water evaporation and condensation are also involved in how the temperature of the air changes. (Tonue et al. 2017) At station II, the water temperature (Fig.2) shows peaks in the premonsoon and troughs in the monsoon. There aren't many differences across the sites in terms of the air and water temperatures. The water temperature ranged from 25°C to 28°C at every location.

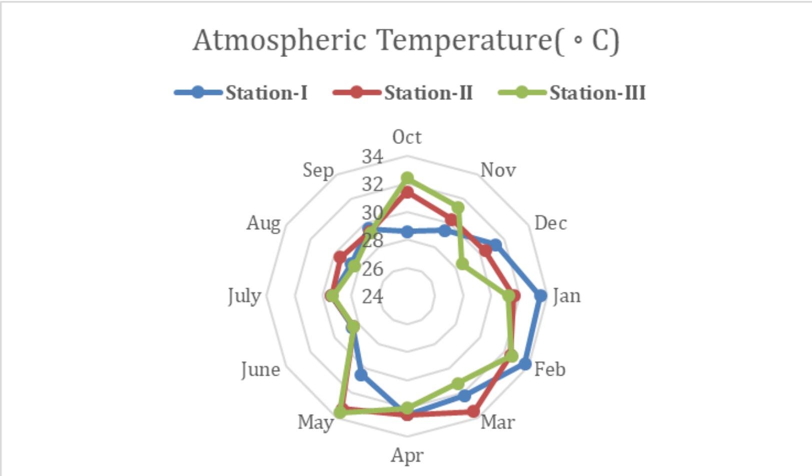

Figure.1 Monthly variation of atmospheric temperature (◦C)

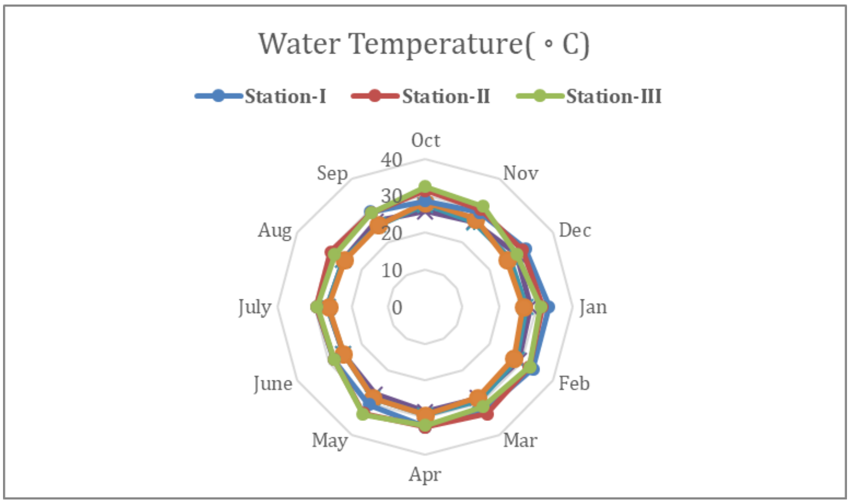

Figure.2 Monthly variation of water temperature (◦C)

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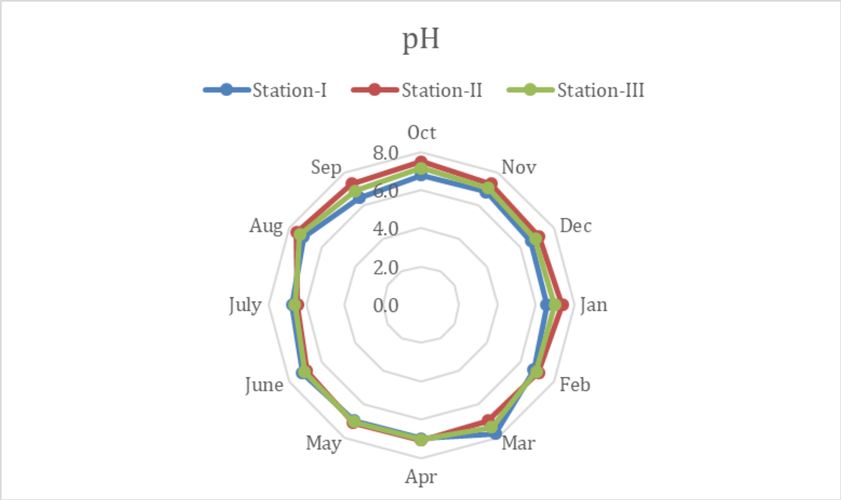

Figure.3 Monthly variation of pH

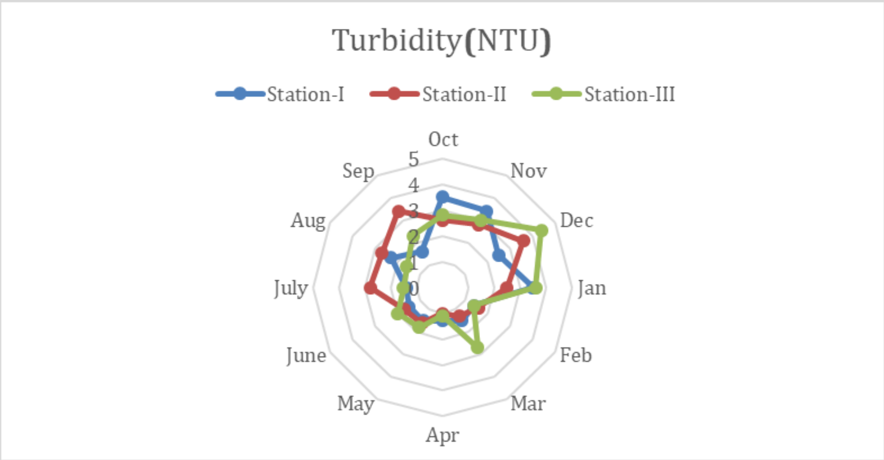

Figure.4 Monthly variation of turbidity (NTU)

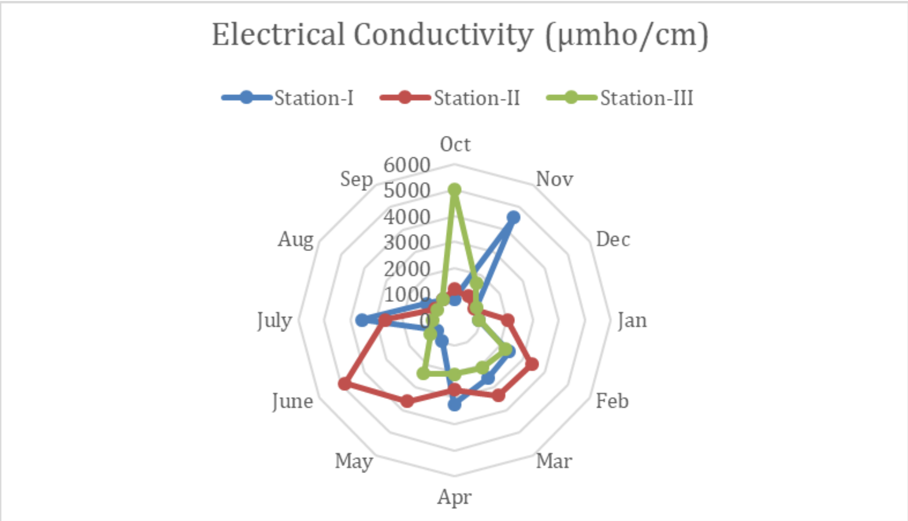

Figure.5 Monthly variation of electrical conductivity (µmho/cm)

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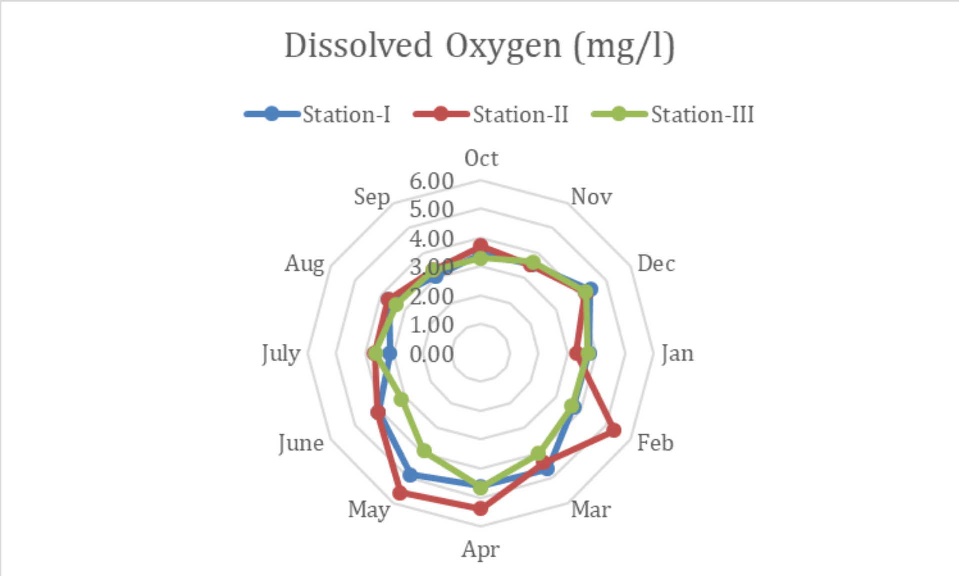

Figure.6 Monthly variation of Dissolved Oxygen (mg/l)

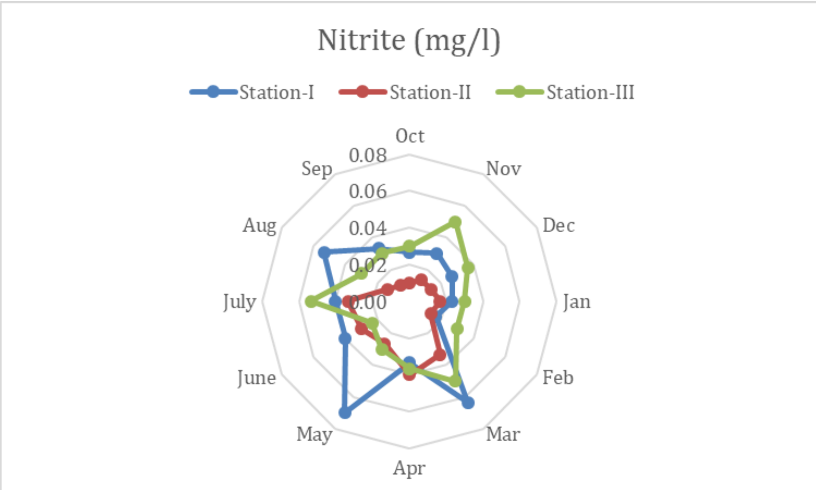

Figure.7 Monthly variation of nitrite (mg/l)

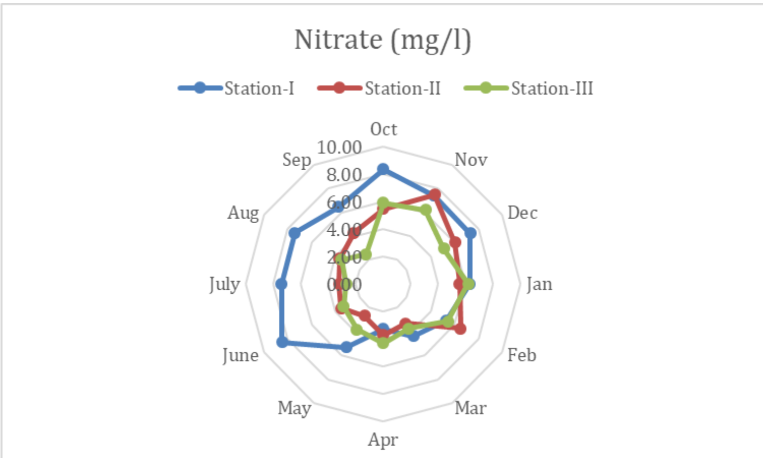

Figure.8 Monthly variation of nitrate (mg/l)

The pH, which regulates the acidic or basic values, is an essential part of any aquatic environment since it greatly influences both the retention of physical and chemical properties of the water as well as all biochemical activities. (Grant & Gross, 1960). The pH (Fig.3)was greatest during the monsoon season, while station I had the lowest pH throughout both the post- and pre-monsoon seasons. The diluting impact of rainfall may be to blame for the pH value's small decline.

The Tyndall effect, which describes how light is dispersed by suspended particles in water, is what gives turbidity its name. Depending on the size, shape, and refractive index of these particles, the light will scatter. (Renu Nayar, 2020) The variation in surface water temperature at all stations along various transects may be caused by variable solar radiation intensity, evaporation, water column turbidity, and other reasons. Dredging could harm habitats, increase water turbidity (cloudiness), or put endangered and vulnerable species at risk of extinction. Also, there is a possibility that it will disrupt and unleash undiscovered poisons.

In April, during the premonsoon, all stations recorded the lowest value of 1 NTU, and the greatest value during the post-monsoon. (Fig.4) The increase in turbidity may be caused by seasonal rains. The quality of the water can be affected by the quantity of sediment, silting (non-biological turbidity), which is often brought on by surface runoff, or the presence of phytoplankton and zooplankton (biological turbidity).

Insufficient mixing of the freshwater inflow from the river may be the cause of the high conductivity at station I during the premonsoon (Fig.5). Value was low because to rain and increased river water mixing during the monsoon season. The conductivity (Fig.6) levels decreased as the amount of rainfall increased. The water was considerably diluted by the growing amount of water throughout the wet season. During the post-monsoon season, the greatest value of 5027 mho/cm is recorded in S3. This may be due to the mixing of freshwater into the harbour basin following rainfall. 6.45 mg/l of nitrate (Fig.8) was recorded in station S3 as the average value for the whole year. During the monsoon season, the nitrate values are reported to be lower.

Nitrite may have been released into the water column by turbulence and mixing brought on by strong winds prevalent during the rainy season, (Fig.7) which may have contributed to the high concentration of nitrite in S2. (Rajasthaner, 2003) The greater dissolved oxygen content seen during the monsoon season may have been caused by higher wind speeds paired with significant rainfall and the resulting freshwater mixing. Freshwater flow and the terrigenous influence of sediments are principally responsible for seasonal fluctuations in dissolved oxygen levels. Warm water emitted from industrial outlets, flowages, or storm sewers may cause dissolved oxygen levels to drop. Aquatic life in warm lakes and reservoirs may depend heavily on dissolved oxygen to survive during the summer. The amount of DO (Fig.6) in the water decreases as the temperature rises, leaving less DO available for respiration.

5. Conclusion

In warm lakes and reservoirs, dissolved oxygen may be crucial to aquatic life's survival in the summer. When the temperature rises, less DO is available for respiration because the amount of DO in the water drops. Because fishing harbours are so important to the expansion of the economy, it is urgently necessary to preserve the quality of the water. The current research made the three-station water quality metrics available. The S3 had a lot of nutrients, which may be because people started using the region. The increase in turbidity brought on by fishing in harbour areas may result in a drop in the concentration of dissolved oxygen. The effects on aquatic life are significant. Further study is needed, for the regular monitoring of the nutrient levels around the fishing harbour and its surroundings.

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