Abstract:

In the present investigation, this paper aims to mapping and analysis of algal blooms using remote sensing techniques, creating the database in Geographical Information System (GIS), producing the map for chemical parameters and indicating the algal bloom in Tuticorin area and to provide suggestion for future remediation. The proposed project work is to collect the water samples on the various areas along the Tuticorin area, during pre-monsoon and post-monsoon periods. At the present moment, the following parameters are pH, EC, Total Suspended Sediments (TSS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) Nitrate, Nitrite, and Phosphate, Ammonium and Silicate. To Geo-referencing and Digitizing topographical map by Arc GIS and created the database using Arc GIS software. The Remote Sensing data plays a vital role in algal bloom monitoring and analysis. The Geographic Information System and Remote Sensing facilitate to analyze various sources of effluents such as Industrial, sewage and human effluents. The IRS P4 satellite image will be useful to visualize the algal bloom in Tuticorin area.

Keywords: GIS, Remote Sensing, ArcGIS, OCM, IRS

1. Introduction:

An algal bloom is a rapid increase or accumulation in the population of algae (typically microscopic) in an aquatic system. Algal blooms may occur in freshwater as well as marine environments. Typically, only one or a small number of phytoplankton species are involved, and some blooms may be recognized by discoloration of the water resulting from the high density of pigmented cells. Algae can be considered to be blooming at concentrations of hundreds to thousands of cells per milliliter,
depending on the severity. Algal bloom concentrations may reach millions of cells per milliliter. Algal blooms are often green, but they can also be other colors such as yellow-brown or red, depending on the species of algae.

Bright green blooms are a result of cyanobacteria (colloquially known as Blue-green algae) such as *Microcystis*. Blooms may also consist of macroalgal (Non-phytoplankton) species. These blooms are recognizable by large blades of algae that may wash up onto the shoreline. (Figure.1)

![Image of algae bloom](image)

**Figure.1. Algal blooms can present problems for ecosystems and human society**

Harmful Algal Blooms (HABs), which are algal bloom events involving toxic or harmful phytoplankton such as dinoflagellates of the genus *Alexandrium* and *Karenia*, or diatoms of the genus *Pseudo-nitzschia*. Such blooms often take on a red or brown hue and are known colloquially as red tides.

### 1.1 Red Tides:

Red tide is a term often used to describe HABs in marine coastal areas, as the dinoflagellate species involved in HABs are often red or brown, and tint the sea water to a reddish colour. The more correct and preferred term in use is harmful algal bloom, because:

1. These blooms are not associated with tides.
2. Not all algal blooms cause reddish discoloration of water.
3. Not all algal blooms are harmful, even those involving red discoloration.

There are many different species of algae that can form HABs, each with different environmental requirements for optimal growth. The frequency and severity of HABs in some parts of the
world have been linked to increased nutrient loading from human activities.

In other areas, HABs are a predictable seasonal occurrence resulting from coastal upwelling, a natural result of the movement of certain ocean currents. The growth of marine phytoplankton (both non-toxic and toxic) is generally limited by the availability of nitrates and phosphates, which can be abundant in coastal upwelling zones as well as in agricultural run-off.

The type of nitrates and phosphates available in the system are also a factor, since phytoplankton can grow at different rates depending on the relative abundance of these substances (e.g. ammonia, urea, nitrate ion).

A variety of other nutrient sources can also play an important role in affecting algal bloom formation, including iron, silica or carbon. Coastal water pollution produced by humans and systematic increase in sea water temperature have also been suggested as possible contributing factors in HABs.

1.2 Objectives:
1. To analyse the characteristics of study area through field survey and visual interpretation of satellite images.
2. To study and identify the algal bloom in Tuticorin area using Remote Sensing Techniques.
3. To analyze the physical and chemical parameter of water samples.
4. To identify the Hazards Algal Area in Tuticorin region.

1.3 Study Area Description:
Tuticorin coast has a major port and it is rapidly developing area. The study area falls in the latitudinal and longitudinal extensions of 8° 40’- 8° 55’ N and 78° 0’ -78° 15’ E on the Tamil Nadu. India has a coastline of about 7,500 kms. The coastline of Tamil Nadu has a length of about 1076 kms constitutes about 15% of the total coastal length of India and stretches along the Bay of Bengal and Indian Ocean. The coastline of Tuticorin has a length of about 163.5 kms. Tuticorin is port town with several industries and saltpan activity, its population is around 0.4 million. There are no treatment facilities for the sewage; all of it is disposed of in canals that
eventually reach the sea. Industries around Tuticorin include a refinery, aquaculture, chemicals and fertilizers, caustic soda and a thermal power plant. The total volume of waste discharge from these industries. The effluent characteristics from these industries include suspended solids, ammonia, nitrate, BOD compounds, oil and grease, and trace quantities of heavy metals such as chromium. Municipal waste contains high BOD compounds (putrefied organic matter), nutrients and bacteria. Major Industries such as Southern Petrochemical Industrial Corporation, Thermal Power Plant, Tuticorin Alkali Chemicals and Heavy Water Plant are also present in this area. Due to the accelerated development activities the coastal area experience significant changes. (Fig.2)

1.4 Site Selection:
1. Thermal Power Plant Station.
2. Tuticorin Beach
3. Therespuram

2. Materials and Methods:
The adopted methodology is depicted in (Figure 3).

2.1 Data Used:

2.1.1 Topographic map
A topographic map is a type of map characterized by large-scale detail and quantitative representation of relief, usually using contour lines. The topographic maps used are 1: 50000 scale.

2.1.2 Remote sensing data
IRS-P4 is the first Indian satellite to meet the data requirements of the
oceanographic community. IRS-P4 is planned to be launched by PSLV (Polar Satellite Launch Vehicle) in March 1999. The payload to be flown onboard IRS-P4 are: (a) OCM (Ocean Colour Monitor) operating in eight narrow spectral bands in the visible / near-infrared region of the electromagnetic spectrum and with high revisit time (2 days), and (b) MSMR (Multi-frequency Scanning Microwave Radiometer) operating in microwave bands 6.6, 10.65, 18 and 21 GHz in dual polarisation mode. The multifrequency scanning microwave radiometer is envisaged to provide information on physical oceanographic parameters such as sea surface temperature, wind speed and atmospheric water vapour. The IRS-P4 spacecraft will be a polar orbiting satellite in sun synchronous orbit with nominal altitude of 720 km, providing revisit time of 2 days for OCM.

**Georeferencing**

To georeference something means to define its existence in physical space. That is, establishing its location in terms of map projections or coordinate systems. When data from different sources need to be combined and then used in a GIS application, it becomes essential to have a common referencing system. The study area was georeferenced using the geographical coordinates (lat, long) by keeping topographic map as a reference.

**Digitization**

Digitization is the process of capturing the spatial data on a map manually and storing them into a computer file. The spatial features, namely points, lines, polygons that constitute a map, are converted into x and y coordinates. The GIS software used for digitization and spatial analysis in the present study are ArcGIS 9.3.

**Collection of water samples**

The existing water quality value used for find the algal bloom. Collecting Water Samples in each effluent like Thermal power plant, Threspuram and Beach. Water Samples are collected through the field survey. (Table.1.)

**Database Creation**

Database was created for the
chemical parameters are pH, EC, Total Suspended Sediments (TSS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Nitrate, Nitrite, Phosphate, Silicate, Ammonia.

**Map generation**

Map was generated for all chemical parameters and analyzed the range of the parameters which are Bad, Very bad, Moderate, Good and Very good. (Fig.4)

**Analysis**

Interpretation is the processes of detection, identification, description and assessment of significant of an object and pattern imaged. The method of interpretation may be either visual or digital or combination of both. The ability to recognize objects in aerial and satellite photographs From knowledge of a landscape and its interpretation keys, the interpretation rules keys such as color, form, size, texture or context.

**3. Results and Discussion:**

The chemical parameters for the water samples at three locations are Threspuram, Thermal power plant station and Tuticorin Beach were analyzed and a database was created in Arc GIS and the spatial variation maps for the parameters are produced.

**4. Conclusion:**

Algal blooms are the result of an excess of nutrients, particularly some phosphates. The excess of nutrients may originate from fertilizers that are applied to land for agricultural or recreational purposes. They may also originate from household cleaning products containing phosphorus. These nutrients can then enter watersheds through water runoff.

Excess carbon and nitrogen have also been suspected as causes. When phosphates are introduced into water systems, higher concentrations cause increased growth of algae and plants. Algae tend to grow very quickly under high nutrient availability, but each alga is short-lived, and the result is a high concentration of dead organic matter which starts to decay.

The decay process consumes dissolved oxygen in the water, resulting in hypoxic conditions. Without sufficient dissolved oxygen in the water, animals and plants may die off in large numbers.
Blooms may be observed in freshwater aquariums when fish are overfed and excess nutrients are not absorbed by plants. These are generally harmful for fish, due to algal blooms fish mortality will occur. (Fig.5)

5. References:


Figure 3. Methodology:

DATA COLLECTION

- SATELLITE IMAGE
  - ENV 4.7
  - VISUAL INTERPRETATION
  - IMAGE CLASSIFICATION
  - IDENTIFY THE ALGAL BLOOM

- TOPOSHEET
  - ArcGIS SOFTWARE
  - GEO-REFERENCING AND DIGITIZATION
  - GIS DATABASE
  - CREATE ALGAL BLOOM SITE MAP

- SELECTED AREA FIELD SURVEY
  - GROUND TRUTH AND MEASURING GEO-COORDINATES
  - WATER SAMPLES COLLECTION AND LAB
  - ANALYSIS OF CHEMICAL PARAMETERS
Table.1. Results of the tested samples in Tuticorin region:

- **Samples:**
  1. Thermal Power Plant Station.
  2. Tuticorin Beach
  3. Therespuram.

**Water Analysis Report (October)**

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<thead>
<tr>
<th>Parameters</th>
<th>Sample 1</th>
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<th>Sample 3</th>
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<td>pH</td>
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<td>8.3</td>
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<td>EC (ms/cm)</td>
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<td>Nitrate (µg/l)</td>
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<td>Nitrite (µg/l)</td>
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<td>Silicate (µg/l)</td>
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<td>5.19</td>
<td>1.5</td>
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</tbody>
</table>

Figure.5. Fish Mortality due to Algal Bloom
Figure 4. Spatial Variation of Maps

- **pH**
- **Dissolved Oxygen**
- **Electrical Conductivity**
- **Biological Oxygen Demand**