

Research Article**Study on physico-chemical parameters and sediment analysis of coastal area samples of Visakhapatnam Coast, Andhra Pradesh, India.****Mohan Sai. P¹ and P. R. C. Ganesh²**Dept. of Marine Living Resources, Andhra University, Visakhapatnam, Andhra Pradesh, India
e-mail: ganeshmbt@gmail.com**Corresponding Author: Mohan Sai. P**

Abstract: The primary objective of this study was to study the impact on quality of sea water by intrusion of sewage water and also to evaluate and assess the health of coastal ecosystem by analysing sediment samples. For this study eleven sampling stations namely Bheemili Beach, Uppada Beach, Thotlakonda Beach, Rushikonda Beach, Sagar Nagar Beach, Tenneti Park Beach, Ramakrishna Beach, Varun Beach, Rock Beach (Harbour), Yarada Beach and Appikonda Beach along the coast line of Visakhapatnam were selected, which were the best tourist attractions places. At each station sites were selected, one was a normal unpolluted area whereas the other was area where a drainage outlet seeps into the sea. The analysis of different parameters namely- pH, temperature, salinity, total suspended solids, turbidity, dissolved oxygen, biological oxygen demand, conductivity, sediment composition and organic carbon were carried out as per standard methods. Results were assessed according to national and international water quality criteria and the water quality parameters in some stations were found to be over these criteria levels. The major observation is that Turbidity, Total Suspended Solids, Biological Oxygen Demand increased in sewage samples when compared to clean water samples. pH, Salinity, Conductivity, Dissolved Oxygen is more in clean water samples than in sewage water samples. There is no significant difference between temperatures of clean and sewage water samples. Organic carbon was more in Sagar Nagar beach and Yarada beach. Sand content is more in Ramakrishna beach where as silt and clay are more in Bheemili beach. On the basis of the examined parameters in this investigation it was concluded that the pollution of sea water has increased and the coastal water quality of Rushikonda beach and Appikonda beaches has been decreased.**Keywords:** Beaches, Visakhapatnam, Water quality, sediment, Coastal waters

Introduction:

Marine eco-system is influenced by human activities in multiple ways. The flow of nutrients from natural and anthropogenic input and weather condition can change the coastal water quality, which has many potential impacts on marine eco-system. Therefore, monitoring of the physical and chemical parameters of water and soil in a continuous manner is very much essential for assessing the coastal water and soil quality. These changes may cause significant damages to the coastal and inheritance of nearby areas. Therefore, regular monitoring of water and soil quality is required to know the status of coastal eco-system. As there are many beaches in the coastal city, Visakhapatnam and these are visited by many people daily and are famous as

tourism spots in the city, the water and soil are the main components of the sea. These are tested and checked by using various parameters such as Dissolved oxygen, Biological oxygen demand, Total suspended solids, pH, conductivity, turbidity and salinity of water and organic carbon, sediment analysis in soil, whether all these parameters are in the optimum levels or not. If any deviations are observed from their optimum levels those are noted and said to be contaminated or polluted.

Kumar (1998) examined the sediment transport and deposition processes that occur on sandy beaches around the world. Liyanage and Kodikara (2005) analyzed the composition and characteristics of coastal sediment in Sri Lanka using heavy mineral analysis. Gabellini et al., (2006) assessed the quality of sediment in a coastal lagoon in Italy using a variety of chemical and biological indicators and used sediment analysis to identify sources of pollution and assess the potential impact on local ecosystems. Sarojini (2012) studied the impact of festival idols immersion in coastal waters at three stations along the coast of Visakhapatnam. Yamani et al., (2012) examined the seasonal variations in the chemical composition of seawater in the Arabian Gulf. Nagamani et al., (2014) evaluated the water quality parameters in seawater along the Visakhapatnam coast. Marques et al., (2014) examined the physicochemical properties of sediment from the Brazilian continental shelf. Vijaya Pratap and Ramesh Babu (2015) studied the seasonal variations in physico-chemical parameters of Sarada and Varaha estuarine complex, East coast of Andhra Pradesh. Karaca et al., (2015) assessed the quality of sediment from the Mediterranean coast of Turkey using both physicochemical parameters and toxicity tests. Pawan and Raja Sekhar (2015) aimed at monitoring the water quality of coastal waters of Visakhapatnam coast.

Sreelatha et al., (2016) investigated the seasonal variations in the physicochemical parameters of seawater along the Visakhapatnam coast. Ali et al., (2016) examined the spatio-temporal variability of seawater quality in the Gulf of Aqaba, Red Sea. Dinesh Kumar et al., (2017) studied the physicochemical properties of seawater along the Indian coast. Manjunatha et al., (2018) assessed the water quality index and heavy metal contamination in coastal waters of Visakhapatnam. Sarma et al., (2018) investigated the dissolved oxygen (DO) levels in the Bay of Bengal. Swarnalatha et al., (2018) investigated the spatial and seasonal variations of physicochemical parameters in seawater along the Bay of Bengal coast. Jayakumar et al., (2019) assessed the physicochemical properties of seawater at selected locations along the Visakhapatnam coast. Jayakumar et al., (2019) examined the physicochemical properties of seawater in the Gulf of Mannar, India. Rajesh et al. (2020) used remote sensing and GIS techniques to assess the water quality parameters in coastal waters of Visakhapatnam. Hence the present study is concentrated on the quality of sea water and also to evaluate and assess the health of coastal ecosystem by analysing sediment samples.

Material and Methods

The present study was carried out at eleven sampling stations along the coast line of Visakhapatnam. The sampling stations selected were the best tourist attractions. Sampling stations include Bheemili Beach, Uppada Beach, Thotlakonda Beach, Rushikonda Beach, Sagar Nagar Beach, Tenneti Park Beach, Ramakrishna Beach, Varun Beach, Rock beach (Harbour), Yarada beach and Appikonda beach. At each station two sites were selected, out of which one was a normal unpolluted site whereas the other was where a drainage outlet seeps into the sea, and they were named as 'A' and 'B' respectively.

Bheemili Beach:

Bheemili Beach is a tourist's attraction beach located in the Bheemunipatnam town of Visakhapatnam district in Andhra Pradesh, India. This beach is known for its serene beauty, blue

waters, and golden sands. The site A is situated at 17.8881840 N 83.4550560 E where most of the tourist activities occur. The site B is located at 17.885447⁰ N 83.451970⁰ E and is approximately 800 m away from site A. At site B the sewage from the rural households enters the sea.

Uppada Beach:

Uppada Beach is situated at a distance of about 25 km from the city of Visakhapatnam. The beach is relatively less crowded than other popular beaches in the region. Site A is located at 17.850034⁰ N 83.41321⁰ E where fish drying activity takes place. Site B is nearly 1km away from site A and is situated at 17.841720⁰ N 83.409946⁰ E. At site B Gambheeramgedda merges with the sea. Effluents and sewage are being released along with the stream.

Thotlakonda Beach:

The Thotlakonda beach is located at the foot of the hill on which the monastery is situated. This beach is also called as rock arch beach, named after a natural rock formation that resembles an arch. The site A is a rocky shore which is sited at 17.8262034⁰ N 83.4164972⁰ E, which is much popular for its scenic beauty and is always crowded by tourists throughout the year. The site B is located at 17.8110162⁰ N 83.4101383⁰ E, where most of the hatcheries were located. Effluents from all those hatcheries were being released into the sea. The colour of the water was completely changed and many carcasses of turtles were found there.

Rushikonda Beach:

Rushikonda Beach is a popular beach situated about 8 km from the city center. The beach is surrounded by lush green hills and the Bay of Bengal. The site A is situated at 17.7823686⁰ N 83.3852109⁰ E which is a popular destination for locals and tourists. It is also known for its water sports and activities. Site B is few meters away from site A and is located at 17.7903911⁰ N 83.3893174⁰ E where sewage water was released into the sea. There was a strong foul odour at this site.

Sagar Nagar Beach:

The beach is known for its pristine beauty and calm waters. Though it is popular, the visitor count is less compared to other popular beaches. The site A is located at 17.7589061⁰ N 83.3565579⁰ E, exactly opposite to the zoo park entrance. Site B is situated at 17.7547938⁰ N 83.3536024⁰ E near YSR sea view point. Here sewage from the households of Jodugullapalem merges into Bay of Bengal.

Tenneti Park Beach:

The Tenneti park beach overlooks Bay of Bengal and is located on Jodugullapalem's beach road down to Tenneti park. A 3,000 - tonne Bangladeshi cargo vessel MV Maa drifted from the anchorage point and ran aground near Tenneti park beach in Visakhapatnam. So, it became a favourite tourist spot for Vizagites. The site A is located at 17.7486011⁰ N 83.3503046⁰ E. The samples were taken where tourist intervention was more. As there was no entry of sewage into sea near this location Site B was not taken into consideration.

Ramakrishna Beach:

It is popularly known as RK Beach, and is one of the most well-known beaches in the city. It is known for its long stretch of golden sand and picturesque views of the Bay of Bengal. It is the most visited beach in Visakhapatnam. The site A is located at 17.7153528⁰ N 83.3267837⁰ E which is one of the most visited beaches in Visakhapatnam. The waters were clear and mostly turtles visit this region to lay eggs. Site B is situated at 17.7142162⁰ N 83.3244921⁰ E where sewage outlet from Pandurangapuram seeps out into the sea.

Varun Beach:

Varun beach is a popular beach with its soft sands and gentle waves. But there are many sewage outlets in this station. The Site A is located at 17.7115640° N 83.3196215° E, which is a semi rocky shore and visitor count is high. Site B is situated at 17.7105618° N 83.3180028° E which is exactly opposite to Novotel Hotel where a sewage outlet releases sewage into the sea.

Rock Beach (Harbour):

It is located near to Jalaripeta adjacent to the harbour. The site A is selected at C- shaped sea located at 17.7011991° N 83.3059181° E where fish remains are being washed away from harbour to this region. There are deposits of oil over the beach sands. Site B is located at 17.7028903° N 83.3082372° E just beside the tide breakers. There is a sewage outlet at this site with strong foul odour.

Yarada Beach:

Yarada Beach is situated at a distance of around 15 km from the main city. The beach is relatively less crowded than some of the other popular beaches in the area and is surrounded by lush green hills on three sides. Site A is located at 17.6516392° N 83.2637678° E with white sand and clear turquoise waters. Site B is located about one km away from site A and is situated at 17.6575672° N 83.2757875° E. The sewage from the rural household seeps into the sea at this site.

Appikonda Beach:

Appikonda beach is situated around 25km from the main city of Visakhapatnam and is known for its pristine beauty. It is named after the hill Appikonda which is adjacent to waters of Bay of Bengal. Site A is located at 17.5703878° N 83.1704347° E from where local traditional boats depart for fishing. Site B is situated at 17.5686417° N 83.1708873° E where a channel of industrial effluents and sewage seeps into the sea along the hillside.

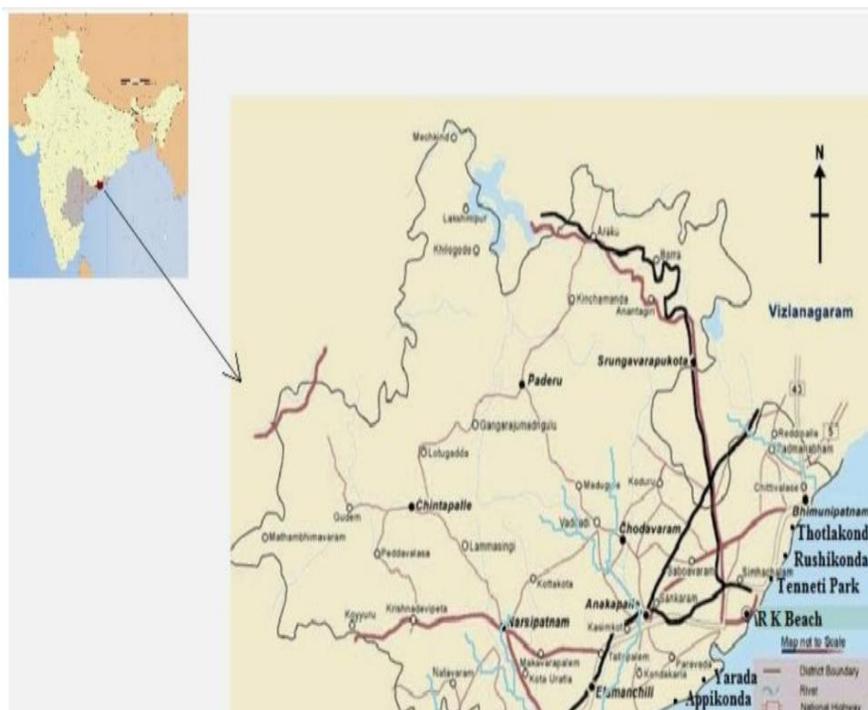


Fig: 1: Map showing the sampling stations.

The collected samples of sea water and soil were tested for the following physical and chemical parameters which include Temperature, Turbidity, Total Suspended Solids (TSS), pH, Salinity, Electrical conductivity, Dissolved Oxygen (DO), Biological oxygen demand (BOD) (APHA, 1985) and the sediment for sand, silt and clay using the pipette method (Carver, 1971). Organic carbon of the sediment has been assayed by Walkley and Black (1934).

Results and Discussion

Hydrographical parameters

Temperature: The clean water temperature ranged from 29°C to 30°C and the highest value (30°C) was recorded in Uppada Beach, Sagar nagar Beach, Tenneti park Beach, Varun Beach, Rock Beach, Appikonda Beach and the lowest value (29°C) in Bheemili Beach, Thotlakonda Beach, Rushikonda Beach, Yarada Beach. The air temperature ranged from 26°C to 29°C and the highest value (29°C) in Uppada Beach and the lowest value (26°C) in Bheemili Beach, Yarada Beach.

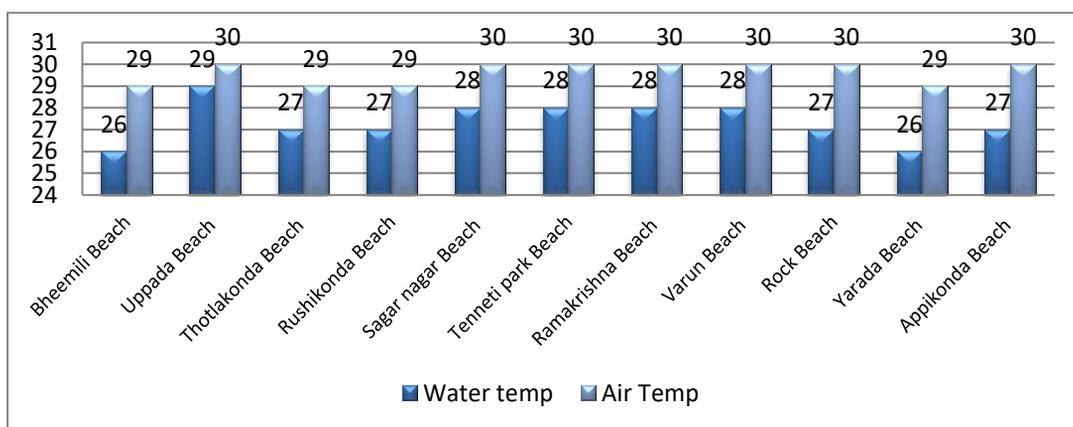


Fig. 2: Water temperature and air temperature of clean area samples.

The sewage water temperature ranged from 28.5°C to 29.5°C and the highest value was 29.5°C recorded in Uppada beach, Rock Beach and the lowest value(28.5°C) in Thotlakonda Beach and Appikonda Beach. The air temperature ranged from 29°C to 31.5°C and the highest value was 31.5°C in Ramakrishna Beach and the lowest value is 29°C in Thotlakonda Beach and Rushikonda Beach.

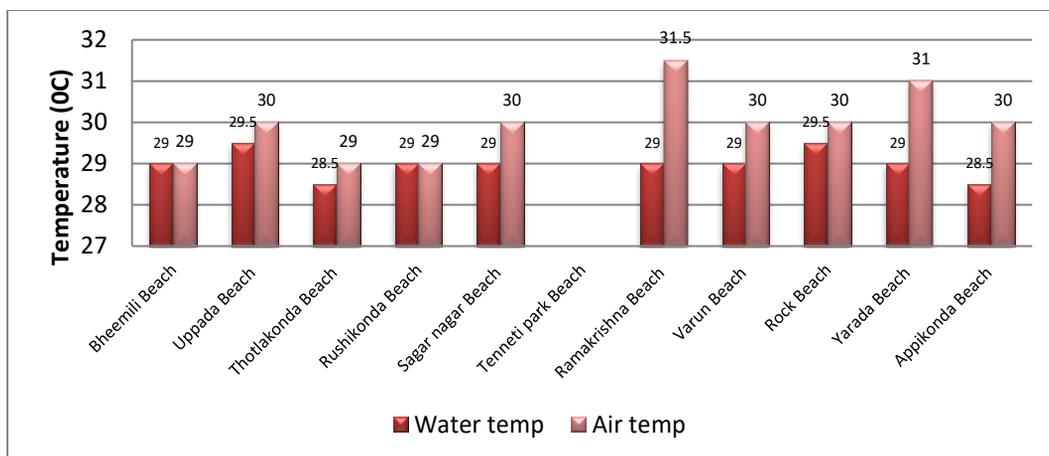


Fig. 3: Water temperature and air temperature of sewage area samples.

Turbidity: The turbidity of the sewage water sample ranged from 7.5 NTU to 49 NTU and the highest range of turbidity recorded in Appikonda beach (49 NTU) and the lowest range was recorded in Varun beach and Rock beach. Whereas the uppada beach, thotlakonda each, rushikkonda beach, Ramakrishna beach and Yarada beach recorded zero.

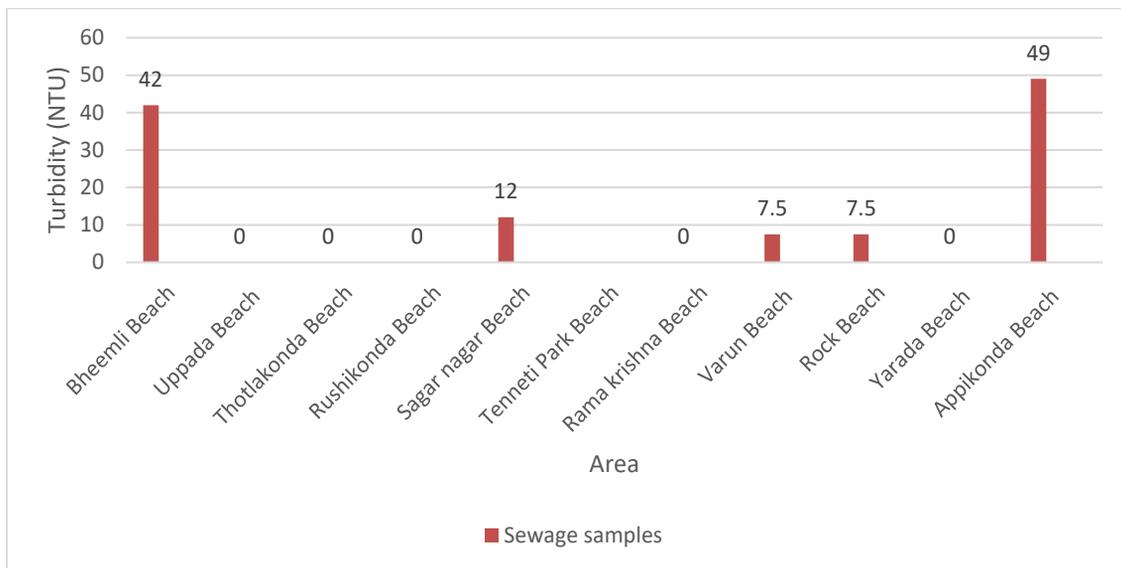


Fig.4: Turbidity of clean and sewage water samples.

Total suspended solids: Total suspended solids of clean sample ranged from 0.06 mg/l to 1.21mg/l and the highest (1.21mg/l) range of suspended solids present in Rushikonda beach and the lowest (0.06mg/l) range of suspended solids present in Varun beach. Total suspended solids present in the sewage sample ranged from 0.06mg/l to 1.59 mg/l and the highest value (59 mg/l) recorded in Bheemili beach and the lowest value (0.06 mg/l) was recorded in Yarada beach.

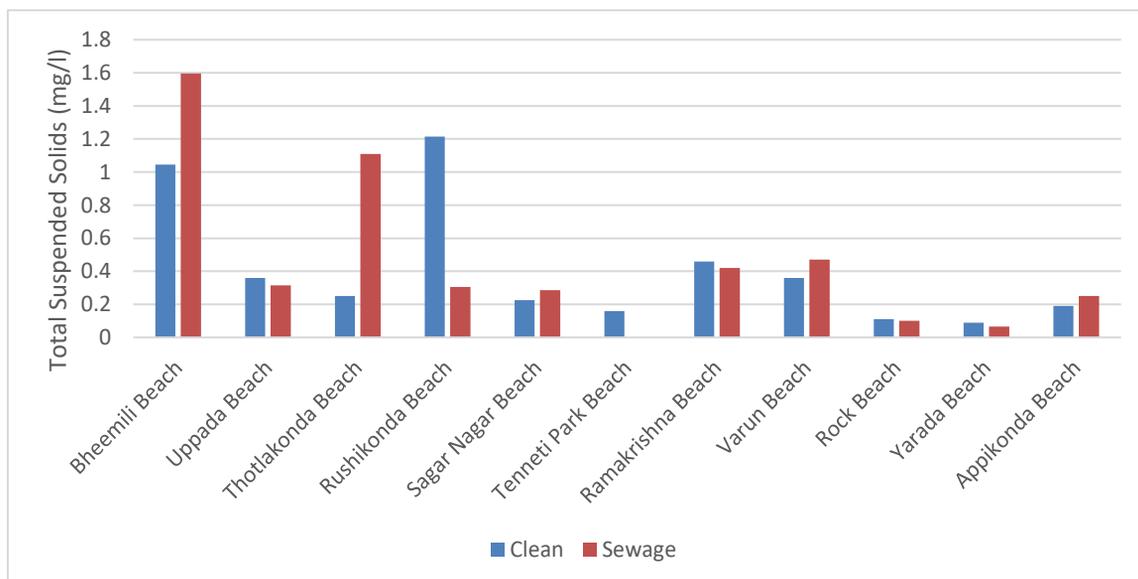


Fig. 5: Total suspended solids of clean and sewage water samples.

pH: The pH of clean area water samples ranged from 7.6 to 8.46 and the highest pH value is present in Appikonda beach i.e, 8.46 and the lowest value (7.6) was recorded in Uppada beach. The pH value of sewage water sample ranged form 7.41 to 10.02 and Appikonda beach has the highest pH (10.02) and the Bheemli beach and Ramakrishna beach has the lowest pH (7.41).

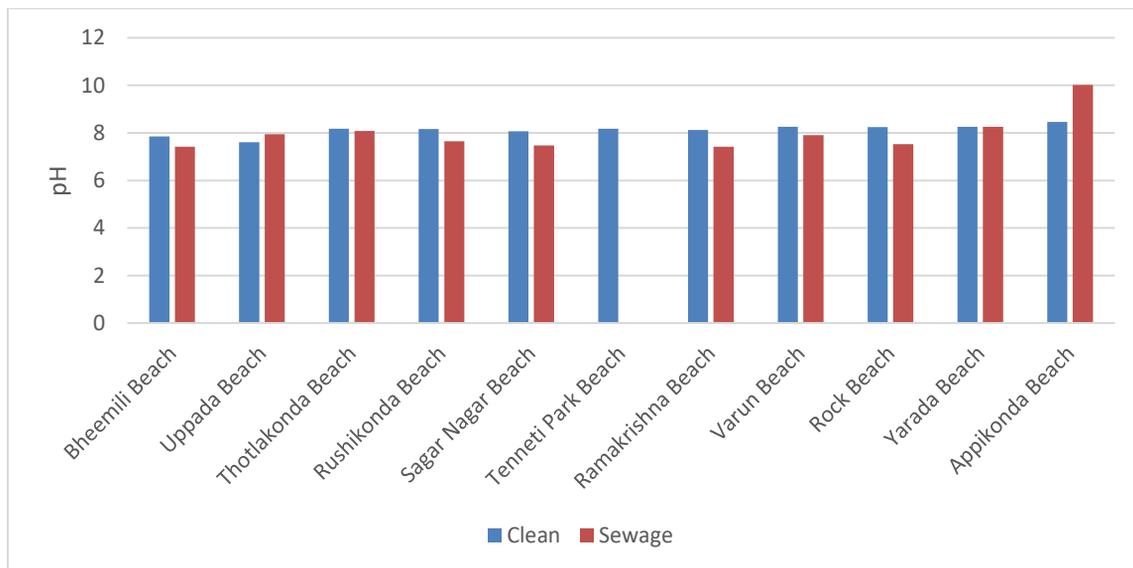


Fig. 6: pH of clean and sewage water samples

Salinity: The salinity of the clean water sample ranged form 23 ppt to 30 ppt and the highest salinity concentration is in Bheemili beach and the lowest salinity concentration is in Appikonda Beach. The salinity of sewage water sample ranged from 0 to 29 ppt and the highest concentration was 29 ppt in Uppada Beach and the lowest concentration was 18 ppt in Sagar Nagar Beach and the Rushikonda Beach and Appikonda Beach have recorded zero salinity.

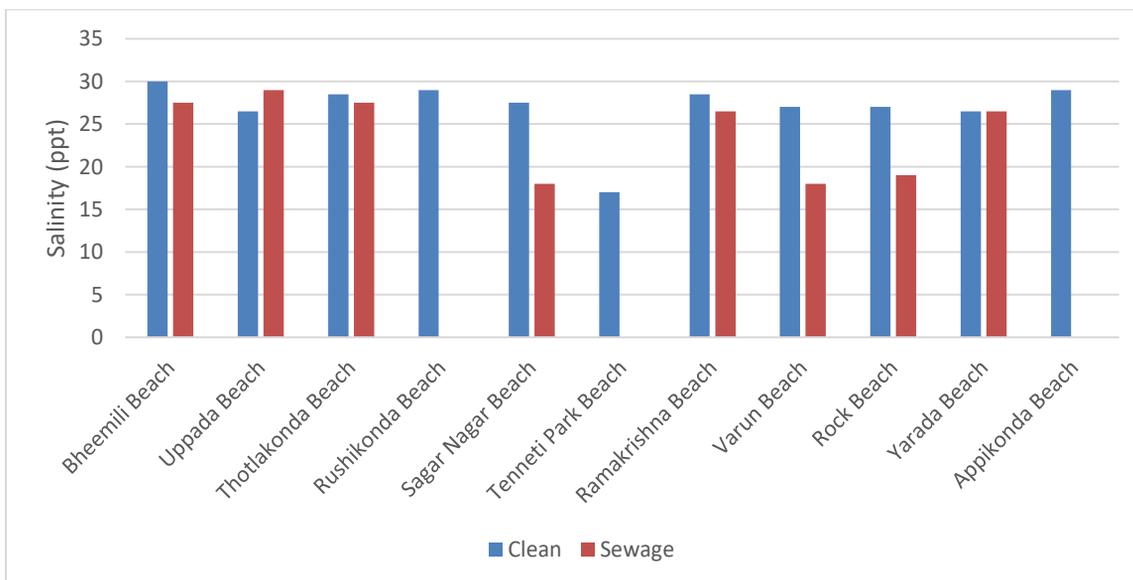


Fig. 7: Salinity of clean and sewage water samples.

Conductivity: The conductivity of clean water sample ranged from 22.95 mS/cm to 26.55 mS/cm and the highest range of conductivity was recorded in Rocky beach and the lowest range of conductivity was recorded in Appikonda Beach. The conductivity of sewage sample was ranged from 0 to 27 mS/cm and the highest range of conductivity was recorded in Uppada Beach and the lowest value is 1.85 mS/cm was recorded in Appikonda Beach.

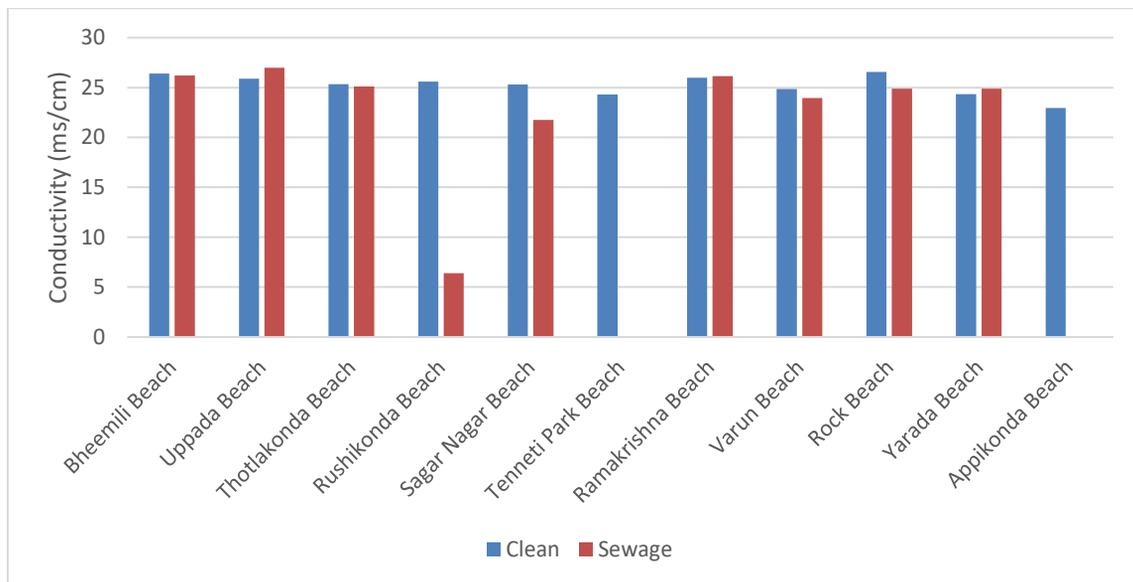


Fig. 8: Conductivity of clean and sewage water samples.

Dissolved oxygen/ Biological Oxygen Demand: The DO of clean water samples ranged from 1.97 mg/l to 5.44 mg/l. The highest DO (5.44 mg/l) was recorded in Bheemili Beach and Thotlakonda Beach and Lowest DO was 1.97 mg/l recorded in Rock Beach. The BOD of clean water samples ranged from 0.83 mg/l to 2.54mg/l. The highest BOD (2.54 mg/l) was recorded at Varun Beach and the lowest BOD was 0.83 mg/l recorded at Ramakrishna Beach.

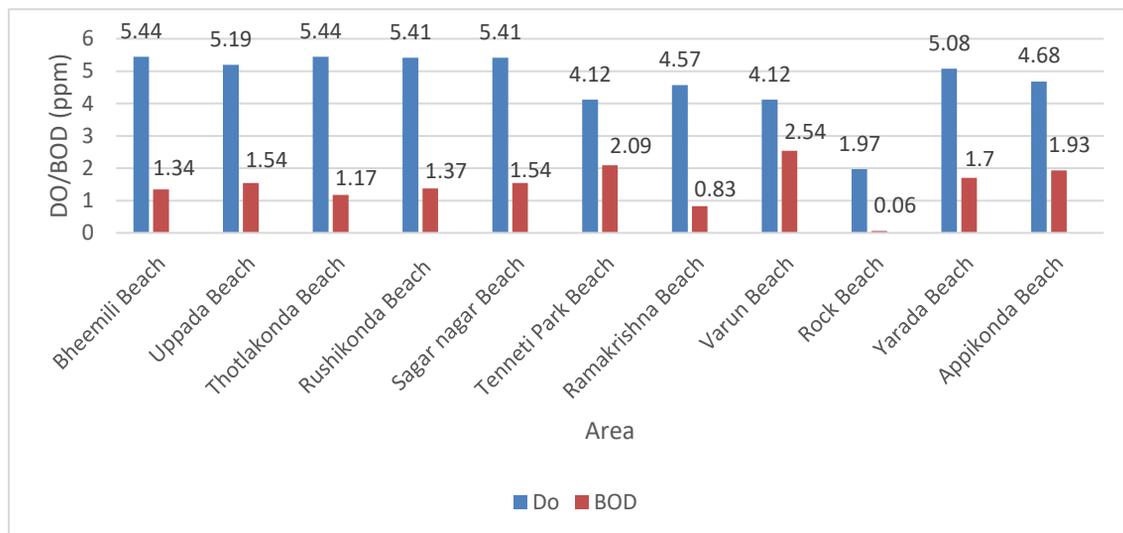


Fig. 9: DO/BOD of clean water samples.

The DO of sewage water samples ranged from 0.62 mg/l to 5.44 mg/l. The highest DO (5.44 mg/l) was recorded in Thotlakonda Beach and Lowest DO (0.62 mg/l) was recorded in Rock Beach. The BOD of sewage samples ranged from 0.62mg/l to 4.71mg/l. The highest BOD was 4.71 mg/l recorded at Bheemili Beach and the lowest BOD (0.62 mg/l) was recorded at Rock Beach.

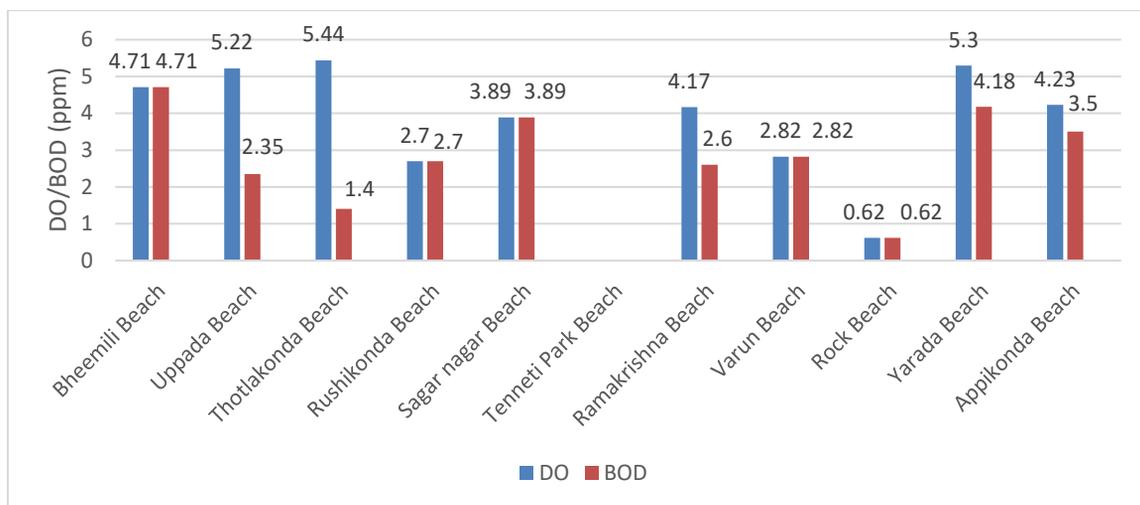


Fig. 10: DO/BOD of sewage water samples.

Sediment composition:

The composition of sand ranged from 94.8 % to 98.39%. The highest value was 98.39% recorded in Ramakrishna Beach and the lowest value is 94.85% was recorded in Bheemili Beach. The composition silt ranged from 0.26% to 2.56%. The highest value was in Bheemili Beach and lowest value is found in Tenneti Park Beach. The composition of clay ranged from 0.47% to 2.59%. The highest value was recorded in Bheemili Beach and the lowest value in Tenneti Park Beach.

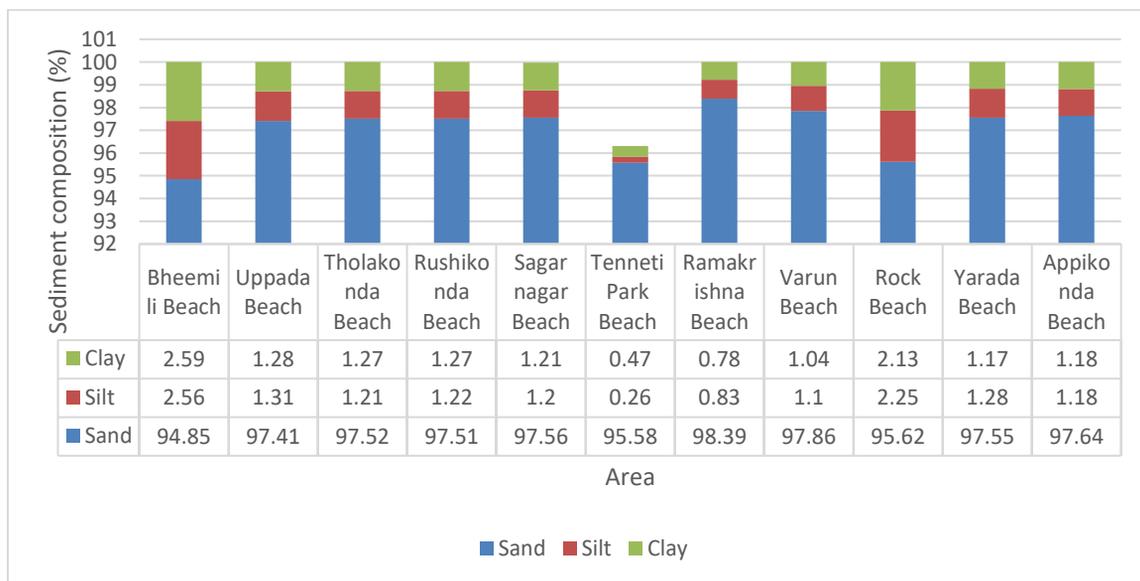


Fig.11: Sediment composition of samples.

The composition of sand ranged from 95.06% to 99.06%. The highest value was 99.06% in Ramakrishna Beach and the lowest value was 95.06% in Bheemili Beach. The composition of silt ranged from 0.43% to 2.64%. The highest value (2.64) was recorded in Bheemili Beach and lowest value (0.43%) was found in Ramakrishna Beach. The composition of clay ranged from 0.51% to 2.3%. The highest value was recorded in Bheemili Beach and the lowest value was recorded in Ramakrishna Beach.

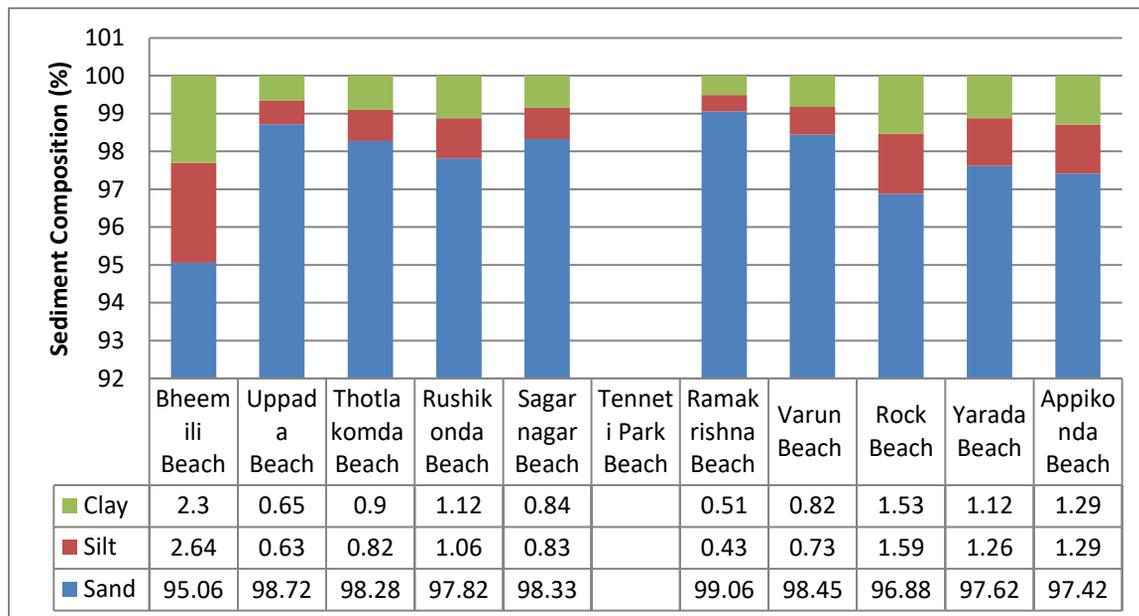


Fig. 12: Sediment composition of sewage samples.

Organic carbon: The organic carbon of clean area water sample ranged from 0.55mg/L C to 1.37 mg/L C. the highest value was recorded in Varun Beach and the lowest value was recorded in Uppada Beach. The organic carbon of sewage area water sample ranged from 0.16mg/L C to 1.34mg/L C. The highest value was recorded at Sagar Nagar Beach and the lowest value was recorded at Rock Beach.

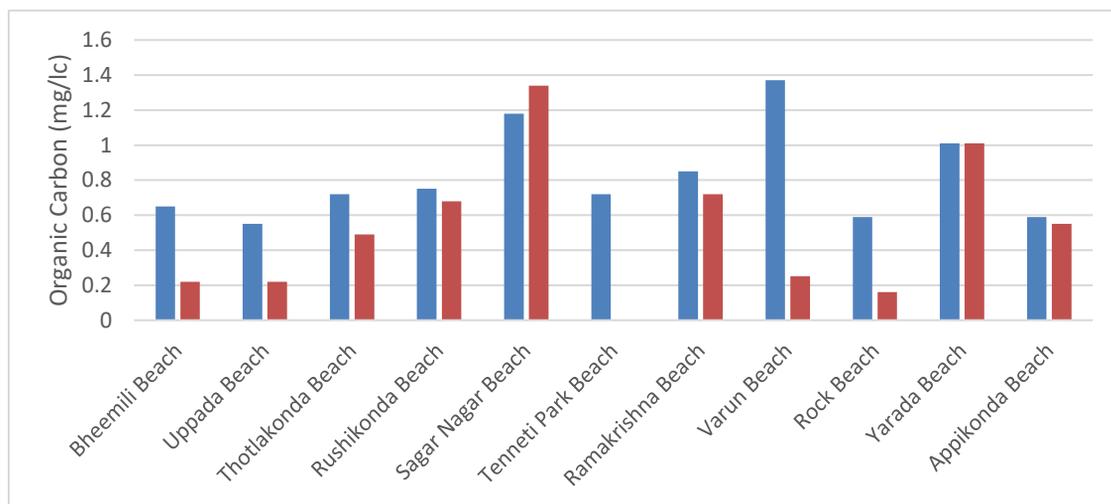


Fig. 13: Organic carbon of sediment samples.

Temperature of almost all the clean water samples shown an average sea water temperature of 27°C. The atmospheric temperature is 2-3°C greater than the sea water temperature minute variation is observed due to difference in time of collection of samples, latitude (the sun's rays are more direct at lower latitudes, so the water temperature is warmer), tidal currents (tidal currents can mix the water column, which can help to distribute heat more evenly), ocean currents can transport warm or cold water to a particular location. The Bay of Bengal is influenced by the south Asian monsoon current, which is a warm current. etc., In sewage water samples the sea water temperature has almost raised by 2°C on average compared to the sea water temperature of clean water samples this might happen when pollutants such as sewage and industrial waste are discharged into the water. These pollutants can contain chemicals that absorb heat from the sun, which can then warm the water. The atmospheric temperature is high in Ramakrishna beach in sewage area because of concentrated domestic sewage is dispersed into the sea water, Toxicity is increased due to domestic waste, and automobile pollution is concentrated in Ramakrishna Beach.

Based on the previous study on impact of the tropical cyclonic storm 'hudhud' on northeast coastal waters of Visakhapatnam (Ramesh Babu et. al., 2014). Temperature in Ramakrishna Beach illustrate an increasing trend, principally due to sampling time, which were collected in the morning hours at 8.00 AM. The temperature was ranged from 25.7°C to 26.1°C during pre-cyclone, whereas 26.5°C to 27.8°C during the post cyclone period. Usually, surface water temperature is influenced by the intensity of solar radiation, evaporation, freshwater influx and cooling. In the present scenario the average temperature in Ramakrishna Beach is 30oC this variation is due to the climatic changes, air pollution and concentrated pollutant levels near the beach.

The waters are clear and transparent without any turbidity in all clean samples. In sewage water samples Sagar Nagar beach, Varun beach, Rock beach a little turbidity ranging from 7.5-12NTU but there is greater spike of turbidity at Appikonda 49 NTU and Bheemili beach 42 NTU in the sea. So, the reason for that high turbidity may be dredging, upwelling and introduction of sediment and other pollutants into the water, which can decrease water clarity and increase turbidity. There are several reasons why the turbidity, or the cloudiness or haziness, of seawater can increase. the common factors that contribute to the increase in turbidity are sedimentation, runoff and pollution, coastal erosion and certain industrial and mining activities, such as dredging, mining operations, or discharge of effluents, can introduce sediments and pollutants into the marine environment. These activities can significantly increase turbidity in the surrounding seawater. It's important to note that turbidity levels can vary significantly depending on location, season, and specific environmental conditions. Monitoring and understanding turbidity levels are crucial for assessing water quality, as it can impact marine ecosystems, visibility for aquatic organisms, and the effectiveness of light penetration for photosynthesis.

The total suspended solids in almost all the clean water samples approximately ranges from 0.06mg/l to 0.46 mg/l except Bheemili and rushikonda Beach which showed TSS of 1.04 mg/l and 1.21mg/l respectively. There are several reasons that can contribute to an increase in Total Suspended Solids (TSS) levels in seawater in Visakhapatnam coastal erosion, runoff from land and construction activities. These activities can disturb sediments and result in the release of particles into the ocean, causing an increase in TSS levels. In sewage water samples, the total suspended solids shown as high in Bheemili Beach (1.59 mg/l), Uppada Beach (0.81 mg/l) and Thotlakonda Beach (1.13 mg/l). The reason for the higher TSS may be industrial discharges,

which can significantly increase TSS levels in the seawater if proper management and treatment practices are not in place and also sewage discharge, untreated or poorly treated sewage discharge can introduce organic matter, suspended solids, and other contaminants into the marine environment. This can lead to an increase in TSS levels in seawater, particularly in areas close to sewage outfalls or heavily populated regions.

pH of most of the clean samples ranges between 8.18 to 8.46 but it was below 8 pH at Bheemili Beach and Uppada Beaches. There might be increase in atmospheric CO₂ levels which lower the pH of sea water below normal levels. pH of sewage samples has shown a slight decrease in pH then compared to clean samples so, there might be release of nitrogen and sulphur compounds from fossil fuel burning and agricultural fertilizers. which can react with sewage to form nitric acid and sulphuric acid respectively which can lower the pH. but there is increased levels of pH at Uppada Beach and Appikonda Beach. There might be formation of carbonate and bicarbonate which can increase pH of sea water. Based on previous study on assessment of coastal water quality through weighted arithmetic water quality index around Visakhapatnam, Bay of Bengal, India (Vishnupriya et al, 2015).

Based on the above comparison we observed that there is a slight increase in pH levels, There are several reasons for the increase in alkalinity of seawater which may be carbon dioxide absorption, weathering of rocks, inputs from ground water and rivers, biological processes, upwelling and anthropogenic influences, such as coastal construction, agriculture, and industrial processes, can introduce alkaline substances into the marine environment through the discharge of treated wastewater or effluents. These inputs can contribute to the overall alkalinity of seawater. It's important to note that while the alkalinity of seawater is influenced by these factors, it is also regulated by various buffering systems within the ocean, which help maintain a stable pH level. The increase in seawater alkalinity, particularly due to the absorption of carbon dioxide, is a concern as it can affect marine ecosystems and contribute to ocean acidification.

Salinity of all clean samples were lesser then the optimum range. In sewage samples the salinity at Sagar Nagar Beach as decreased significantly (18) whereas sewage samples at Rushikonda Beach and Appikonda Beach showed zero salinity due to Continuous influx of drainage water in excess amounts. It was observed that there is an increase in salinity levels but there is a slight decrease in Appikonda beach but variation is negligible. There are a number of reasons for the increase in salinity in sea water which include - climate change, overpopulation, deforestation, industrial pollution, upwelling and anthropogenic activities such as industrial processes, agriculture, and urban development can result in the discharge of saline effluents or seawater into coastal waters, which can raise salinity levels. It is worth noting that salinity levels can vary naturally due to local and global factors, and regular monitoring is necessary to understand the specific reasons behind any observed increase in salinity in the seawater. Local environmental conditions, geographical features, and human activities all play a role in determining salinity levels in a particular area.

Conductivity of clean sample at Appikonda Beach has recorded lowest when compared to other stations. This might be because of low salinity levels at Appikonda Beach. In sewage samples conductivity was least recorded at Rushikonda and Appikonda Beach. In Appikonda beach the salinity was very least and turbidity was too high and thus it showed low conductivity Rushikonda beach showed low conductivity due to low salinity. Based on previous study on assessment of coastal water quality through weighted arithmetic water quality index around Visakhapatnam, Bay of Bengal, India(Vishnupriya et.al, 2015). During the study it was observed that there is a slight decrease in conductivity levels. There are a few possible reasons for the

decrease in conductivity in seawater. One possibility is that the seawater is becoming less salty. This could be due to a number of factors, such as increased rainfall, which dilutes the salt content of the seawater, or decreased evaporation, which prevents the salt from accumulating in the seawater. Another possibility is that the seawater is becoming more polluted. This could be due to the discharge of industrial waste or sewage into the seawater, or the runoff of agricultural chemicals from nearby farms. There may be some of the specific reasons for the decrease of conductivity in sea water, which are pollution, evaporation and natural causes. The decrease in conductivity of seawater can have a number of negative impacts on the environment and the local economy. For example, it can make it more difficult for fish to survive, which can impact the fishing industry. It can also make it more difficult to extract freshwater from seawater, which can impact the water supply.

There is a significant difference between DO/BOD in clean water samples but in sewage samples BOD is almost equal to DO increase in BOD levels in sewage water might be occur due to discharge of waste water from homes, industries, or sewage treatment plants contain high levels of organic matter. Based on previous study on assessment of coastal water quality through weighted arithmetic water quality index around Visakhapatnam, Bay of Bengal, India (Vishnupriya et.al., 2015). It was observed that there is a slight decrease in DO levels except appikonda beach where the DO has increased by 1.88mg/l. There are several reasons that can contribute to a decrease in dissolved oxygen (DO) levels in seawater, which may be temperature, algal blooms, eutrophication, stratification, pollution and reduced mixing. Natural mixing processes, such as wind-driven currents or tides, help to distribute oxygen throughout the water column. If there is a reduction in mixing due to calm weather conditions or human activities like construction of structures that impede water flow, it can lead to decreased oxygen levels in the surface water. These factors, alone or in combination, can contribute to a decrease in DO levels in seawater. Monitoring and addressing these issues are important for maintaining healthy aquatic ecosystems and mitigating potential impacts on marine life. Based on the observations, only Appikonda Beach has shown increase in BOD levels. There are several reasons that can contribute to an increase in BOD levels in seawater. BOD is a measure of the amount of dissolved oxygen needed by aerobic microorganisms to break down organic matter in water. When BOD levels are high, it indicates the presence of large amounts of organic pollutants or excessive nutrients in the water, which can have detrimental effects on marine ecosystems. The possible reasons for the increase in BOD levels in seawater may be due to agricultural runoff, industrial discharge, sewage discharge, oil spills etc.,

The clean area water samples of Bheemili Beach, Tenneti Park Beach and Rock Beach has recorded the less percentage of sand content but the difference is minimal compared to other samples less amount of soil erosion might be a reason for this. Silt content is more in Bheemili Beach and Rock Beach There are several reasons why beaches may have higher silt content: Natural Erosion: The erosion of rocks, cliffs, and landforms by wind, water, and ice can release fine particles of silt. These particles are then transported by rivers, streams, and currents to the nearby coastal areas, where they can accumulate on the beaches. Human activities such as construction, mining, dredging, and land development can disturb the natural balance of sediment in coastal areas. These activities often result in increased erosion and sediment runoff, which can contribute to higher silt content on beaches. Climate change can affect weather patterns, sea levels, and ocean currents, leading to changes in sediment transport. Sometimes increased rainfall and more intense storms can cause greater erosion and sediment runoff, while rising sea levels can result in increased coastal erosion. These changes can influence the silt content of beaches. It's important to note that the specific factors contributing to silt content can vary depending on the location and local conditions of a beach. Additionally,

while some silt is a natural component of beaches, excessive amounts can impact beach health and affect the ecosystem.

The silt content is extremely low in Tenneti park Beach i.e. 0.26 %. There are several reasons that can contribute to a decrease in silt content in beaches which include wave action, currents and tides, sediment source, human activities and natural processes like storms, hurricanes, and longshore currents can significantly impact sediment distribution on beaches. These events can cause erosion or deposition of sediment, including silt, depending on the specific conditions, leading to changes in silt content. It's important to note that the specific conditions and characteristics of each beach can vary, and multiple factors can influence silt content simultaneously. Therefore, understanding the local coastal dynamics and sediment transport processes is essential for determining the reasons behind the observed decrease in silt content on a particular beach.

The clay content was high in Bheemili Beach (2.59%) and Rock Beach (2.13%). The presence of clay content in beaches can be influenced by various factors. The reasons why some beaches may have a higher clay content are the geological composition of an area plays a significant role in the types of sediments found on beaches. Clay minerals are formed from the weathering and erosion of rocks rich in aluminum and silica. If the surrounding geological formations contain a high proportion of clay-rich rocks, the resulting sediments on the beach will likely have a higher clay content. Beaches located near areas with significant clay deposits, such as clay pits or clay-rich soil formations, are more likely to have a higher clay content. Over time, erosion and natural processes can transport clay particles from these nearby sources and deposit them on the beach. The low clay content was observed in tenneti park Beach (0.47%). Beaches with a higher proportion of coarser sediments, such as sand and gravel, may have less clay content. Coarse sediments are typically heavier and have different transport characteristics compared to fine clay particles. In areas where the predominant sediment type is coarser, the clay content on the beach is naturally lower. The presence of clay on beaches is often influenced by the proximity of clay-rich sources. If a beach is located far from clay deposits, the chances of clay particles being transported and deposited onto the beach are reduced. In such cases, the beach may have lower clay content compared to areas closer to clay sources. High-energy wave and current environments are more effective at removing and sorting finer sediments, including clay particles. When beaches experience strong wave action and powerful currents, the energy can dislodge and carry away fine clay particles, leaving behind sediments with a lower clay content.

In sewage samples the highest percentage of sand was recorded at Ramakrishna Beach (99.06%) the reason might be sediment deposition from the sewage outfalls, which are the discharge points for sewage treatment plants, are typically located in coastal areas. Over time, the continuous flow of sewage from these outfalls can result in sediment deposition around the outfall area. This sediment, which often contains sand and other particles, can contribute to the increased sand content in the vicinity of the outfall, including the beach. The highest silt percentage present in Bheemili Beach (2.64 %) and the lowest silt content present in Ramakrishna Beach (0.43%) reasons might be sewage discharge which often contains suspended solids, including silt, that are present in wastewater. When sewage is discharged into the ocean or coastal areas, these suspended solids can settle and accumulate, leading to increased silt content. In urban areas, storm water runoff and erosion can contribute to silt accumulation. When rainfall occurs, it washes away loose soil and sediment from roads, construction sites, and other surfaces, carrying it into storm drains and eventually into the ocean. This runoff can increase the silt content in sewage discharged areas, particularly if the drainage systems are not adequately designed to trap sediment. Reason for low silt content may

be Sedimentation and settling, these processes allow the heavier particles to settle at the bottom of treatment tanks, resulting in cleaner effluent being discharged into the environment.

The highest percentage of clay present in Bheemili Beach (2.3%) and the lowest percentage present in Ramakrishna Beach (0.51%) which may be due to urban runoff. In urban areas, storm water runoff from roads, parking lots, and other impervious surfaces carries sediments, including clay particles, into the sewage system. When sewage is discharged into the ocean or near the beach, these sediments can be deposited, resulting in higher clay content. Inadequate Treatment: If the sewage treatment facilities in the area are not equipped to effectively remove fine sediments such as clay particles, they can be discharged along with the treated wastewater. Insufficient treatment processes or outdated infrastructure can contribute to the presence of clay in sewage discharge areas. Along coastal areas, soil erosion can occur due to natural processes or human activities such as construction, deforestation, or improper land management practices. This erosion can introduce clay particles into nearby water bodies, including sewage systems, which eventually find their way to the beach during sewage discharge and the reasons for the low clay content are effective sewage treatment, separate sewer systems and sedimentation basins. These sedimentation processes allow the removal of sediment before the wastewater is discharged, resulting in reduced clay content.

In clean area samples organic carbon was recorded above one at varun beach (1.37 mg/L C), Sagar Nagar Beach (1.18mg/lc) and Yarada Beach(1.01mg/lc). The increase of organic carbon in beaches can occur due to several reasons which may be natural processes where organic carbon is derived from decaying organic matter, such as dead plants and animals. In coastal areas, the deposition of organic material from marine plants, seaweeds, and other organisms can lead to an accumulation of organic carbon on beaches. Erosion of terrestrial vegetation, including forests, marshes, and dunes, can introduce organic matter into nearby water bodies. This material may then be transported by runoff or currents and eventually deposited on beaches. Increased erosion and runoff, often caused by factors such as heavy rainfall, deforestation, or land-use changes, can result in higher organic carbon content on beaches. Human activities can contribute to the increase of organic carbon on beaches. Pollution from sources like industrial discharges, agricultural runoff, or sewage can introduce organic material into coastal waters. Additionally, litter and debris, such as leaves, grass clippings, or other organic waste, can accumulate on beaches, raising their organic carbon levels.

In sewage area samples organic carbon was recorded above one in Sagar Nagar Beach (1.34 mg/lc) and yarada Beach (1.01 mg/lc). There are several reasons why sewage-discharged beaches may have higher levels of organic carbon compared to other beaches which may be due to sewage contamination, nutrient enrichment, reduced oxygen levels and sewage discharge can lead to a decrease in oxygen levels in the water due to microbial decomposition of organic matter. Oxygen is consumed during the breakdown of organic carbon by bacteria, resulting in hypoxic or anoxic conditions. In such oxygen-depleted environments, organic carbon can accumulate in the sediments rather than being efficiently broken down and mineralized.

Conclusion

The major observation was turbidity, TSS, BOD, increased in sewage samples when compared to clean water samples. pH, salinity, conductivity, dissolved oxygen was more in clean water samples than in sewage water samples. There is no significant difference in temperatures of clean and sewage water samples. Sediment quality plays an important role in increasing the productivity, provide nutritionally balanced and healthy environment to animals. In the present study organic carbon was more in Sagar Nagar beach and Yarada beach. Sand content is more in Ramakrishna beach where as silt and clay are more in Bheemili beach. On the basis of the

examined parameters in this investigation it can be concluded that the pollution of sea water has increased and the coastal water quality of Rushikonda and Appikonda beaches has been decreased.

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