

Summary and Conclusion

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Malvan is considered as one of the uprising place for tourist and tourism business and growing in alarming rate. Along with this, increase in human settlement, roads, and smallscale fish industries and bridge developmental projects lead to deterioration of water quality of sea and estuaries. Increase in fish demand and unplanned fishing process has been directly and indirectly affecting estuarine water quality. Lack of knowledge and unawareness about water quality and its consequences, perhaps may be the main cause and danger in future. Improper provision of solid and liquid waste disposal from local government has been dangerous for aquatic life.

After studying various physico-chemical parameters in and around malvan, it was concluded that these parameters are varied depending upon location and seasons and has some significant relation between them. All the physico-chemical parameters and heavy metals studied at selected sites are variated seasonally. Monsoon season has been strongly affected on physico-chemical parameter of estuarine water, whereas low tide situation is also equally important for variation in parameters. Inflow of river water has been changing the water parameter in estuarine system.

Tarkarli is an upcoming tourist spot in Malvan, due to its picturesque value, climatic condition, watersports and high fishcatch. It is observed in past few years that the tourist flow towards Tarkarli has been increased. Winter season is most preferred by tourist, which results in low dissolved oxygen level and increase in BOD. It is been suggested that two parameter alter due to high organic load and other anthropogenic activities. This was prominently observed in Tarkarli upstream site, which can prove harmful to the aquatic life. Oil and Grease found at Tarkarli upstream site could be indication of oil contamination from transportation and surrounding domestic source. This contamination affects aquatic flora and fauna.

Kolam being small creek, low fishing activities are observed as compared to the other estuaries. The inflow of fresh water is less, whereas seawater inflow is more in the Kolam creek, which lead to high Chloride, COD, TDS, and Salinity. High inflow of seawater and low inflow of fresh water in Kolam estuary resulted in increased Chloride, COD, TDS and Salinity values at upstream site and very few changes were observed in monsoon season.

Seasonal variation in physico-chemical parameters was observed at Achara site parameters are varied seasonally. The parameters such as COD, BOD, Chloride and DO were found constant. This area is also developing its tourism recently. The human settlements, bridge and roads around estuary could have its effect on aquatic habitat.

Various changes were observed in the parameters at different sites. The changes observed can be due to various reasons, are as follows.

1. Temperature of estuary water was found constant in summer season, fluctuated in winter and decreased during rainy season. High temperature was recorded during Apr 07 to May 07, whereas lower during Jun 07 to Jul 07. Highest temperature was recorded at Kolam downstream site in May 07.
2. pH of estuary water was found significantly increased towards downstream site. Alkaline pH was found in summer and winter season, whereas neutral during monsoon. Highest pH was found at Tarkarli site.
3. Salinity has shown variation in different seasons. It showed significant increase at downstream site due to high salt-water influx. Salinity was observed high in winter and summer while low in monsoon season. It is observed that any change in salinity results in fluctuation of other

parameters. Kolam estuary showed less variation in salinity. High salinity was recorded at Tarkarli and low at Achara site.

4. During this study it was observed that dissolved oxygen is high during monsoon season, low during winter and summer. Dissolved oxygen was significantly increased towards downstream site, whereas low values were observed at upstream, which may be due to disposal of domestic sewage from surrounding area at this site. Decreased DO in winter season can be indirectly correlated to increase the tourist flow during this particular period. Constant range of dissolved oxygen found at Achara site.
5. Biochemical Oxygen Demand was significantly increased at upstream site of river. High BOD was observed at upstream site of Tarkarli and lower BOD was observed at Achara. High BOD may be due to disposal of organic waste at upstream. This site being a tourist spot can also be considered responsible for increase in BOD. BOD being important parameter directly affects aquatic life.
6. Chemical Oxygen Demand at all downstream site showed high range, whereas decreased during rainy season. Tarkarli upstream site recorded high COD which may be due to high inflow of salt water. Lower COD was observed at Achara upstream. COD recorded at different sites was high due to presence of chlorides in water.
7. Total Dissolved Solids were found in high range at all sites. It showed increased values at downstream site due to high mixing of salts. It was observed that during rainy season TDS was decreased due to high inflow of fresh water. Tarkarli showed high TDS, which was due to high inflow of seawater at this site, whereas Achara Sites has low TDS.

8. Total Suspended Solid was high during rainy season due to sediment collected by river water and was low during winter and summer. Tarkarli upstream showed high TSS as compared to other sites.
9. Chlorides were found higher at upstream of all sites, thus higher chlorides can be indicator of inflow of seawater. Chlorides are observed low during rainy season and very few alterations in chloride were observed at Kolam site.
10. Nitrates were observed constant at all the sites studied but were comparatively high towards upstream. Winter was the season, where high nitrates were found which can be related to tourist flow. Tarkarli recorded highest nitrate whereas, Achara recorded lowest.
11. Oil and Grease were found high during winter season at Tarkarli upstream site, which was the period of increased tourist flow. Increase in oil and grease may be due to water sports, fishing boats, trawlers, water scooter and also through hotels and resorts. Rainy season showed decreased values of oil and grease due to dilution by fresh water.
12. Heavy metal estimation was done seasonally, which shows that different element proves their existence under influence of water flow. The toxic heavy metals were found almost negligible, which proves that no heavy metal by industrial source from near the selected area. The elements were constant during winter and summer but rainy season showed some fluctuation i.e. some elements were decreased, while some were increased due to water flow.
13. Copper, Iron and Magnesium were found more at upstream site . They were more observed during rainy season due to high siltation. The element Copper and Zinc estimated more towards upstream site due to source domestic and agricultural. Lead, Nickel, Zinc were found to be

constant during summer and winter, whereas negligible during monsoon season. Sodium, Potassium and Calcium were found in increasing order at upstream of all sites respectively. This may be due to increasing seawater flow towards upstream.

14. Various heavy metal estimation made it clear that element prominently present at upstream were found very less towards downstream. The element found at upstream may be due to natural or anthropogenic activities.

15. Communication with residential people of selected sites it was clear that people living around estuary are unaware about water quality. People at Tarkarli are well educated compared to the other sites. Tarkarli is also known for high organic disposal into estuary. About 90 % fisherman dispose their waste into estuary and sea. The hotel owners being well known about water pollution but not following the rules and misuse the estuary for their basic needs. Males are more educated than females and thus this also influences a lot on water pollution and its parameter..

It gets clear from the above investigation that BOD, TSS and Nitrates were found to be increased at upstream and pH, COD, Chlorides, TDS, DO and Salinity were prominent at downstream. At Tarkarli estuary inflow of sea water and fresh water inflow was high. Achara estuary showed almost all the parameter constant. All the parameter showed higher variation during rainy season, which makes it clear that seasons have their impact on different parameter. Considering all these it can be said that tourism has some influence of change or fluctuation in parameters. Heavy metals showed constant values, with very less alterations in rainy season. Heavy metal including Cu, Ni, Zn, Pb found constant and increased at downstream site. Sodium and Potassium found higher towards upstream site. Dissolved oxygen and biochemical oxygen demand found higher at Tarkarli upstream site. Presence of oil in water is a indication of oil contamination from surrounding

environment. Higher range of TDS and Chloride in fresh water is indication of salt-water inflow, which is high. From the social survey it is clear that lack of knowledge in people about environment and its consequences may result into permanent loss of aquatic flora and fauna in future.

From the foregoing, it can be concluded that all the physico-chemical parameters are in a particular range and varied seasonally. Parameters found at upstream site are at their extremes and can be harmful to aquatic life. Local government should provide good provision for disposal of wastes and create awareness amongst the people about environmental concern. This data generated for a period of one year in future will be useful for planning and management of the estuaries.