

HEALTH OF THE BEACHES : NEGATIVE INFLUENCE OF HUMAN USE—
A COMPARATIVE STUDY.

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ABSTRACT

Beaches of the south-west coast of India are subjected to varying degrees of human use. Vizhinjam in the south and Moplah Bay in the north receive high quantity of organic, especially human waste. These bays also provide anchorage for fishing craft. They are compared to their respective adjacent beaches viz. Kovalam and Cannanore which are predominantly used for recreational purposes. General environmental features being comparable, presence and persistence of pathogens and water quality, the two major criteria for assessing the status of population, differed considerably.

Annual average of water quality criteria like BOD₅ and COD were about an order of magnitude higher in these two bays. Bacteriological data however, show more clearly the predominance of human sources of pollution, as indicated by FC/FS ratios and visual pollution counts at Vizhinjam and Moplah Bay. These varied considerably between the two pairs of environments. Human influence on them was further supported by the high incidence of indicator bacteria and occurrence of *Salmonella* in beaches. Ezhumala, a clean beach is introduced as a possible datum point for comparison and assessment of the pollution status of beaches of this coast.

INTRODUCTION

Health of the beaches of India with a vast coastline of about 6000 kilometres has to be assessed from the pollution status of the estuaries, beaches and inshore waters. This rationale to the study of the coastal zone in India may contribute considerably to the knowledge of the health of the ocean as well. It was in this line that the National Institute of Oceanography of India initiated studies with stress on problems of pollution of the environment along the Indian coast. Southwest coast from Cape Comorin to Mangalore with 10 estuaries and 20 beaches including surf zone were covered during the past decade (Fig. 1). Emphasis was more on bacteriological and water quality parameters. Analysis of the data round the season has highlighted some aspects of immediate concern. One such problem of the beaches subjected to varying degree of human use is the scope of this paper.

Coastal zone is the most thickly populated region of Indian subcontinent, especially its southwest coast. Consequently the bordering beaches are heavily utilized for a variety of purposes and are under considerable human influence. Debris and waste from different sources find their way to and accumulate in these environs. Wastes from fishing and processing as well as ill-organized dense settlements nearby arise from the immediate vicinity of the beaches and settle there. Sewer system, holidaying crowd of fair weather season and recreational pursuits, bring-forth wastes from a wide area of the hinterland and deliberately introduce these on to the beaches. Rafts of salvinia are common in the monsoon season and contribute to the debris load. A variety of wastes, perishable to persistent, thus arrive at the beach and coastal environs during all times of the year.

Evaluation and assessment of the acceptability of coastal environs in regard to possible health hazards, water quality and aesthetic considerations is thus a serious contemporary problem. It becomes all the more important in view of the recent upsurge in holidaying

and recreation by the sea-side and the need to develop seaside resorts to meet this. The inherent health hazards in intimate contact with a contaminated environment and ingestion of sea food that passes through it, also warrant scientific monitoring and enquiry.

Relevant published investigations include those of TENKER (1976), REGNIER & PARK (1972), BERGER *et al*, (1963), MOORE (1964), MOORE (1954), BONDE (1967), GRUNET *et al*, (1970) BONDE (1968), SHUVAL *et al*, (1968), BREZENSKI & RUSSOMANNO (1969), BREZENSKI (1971) and YOSPHEPURER & SHUVAL (1972). The Indian works however, are

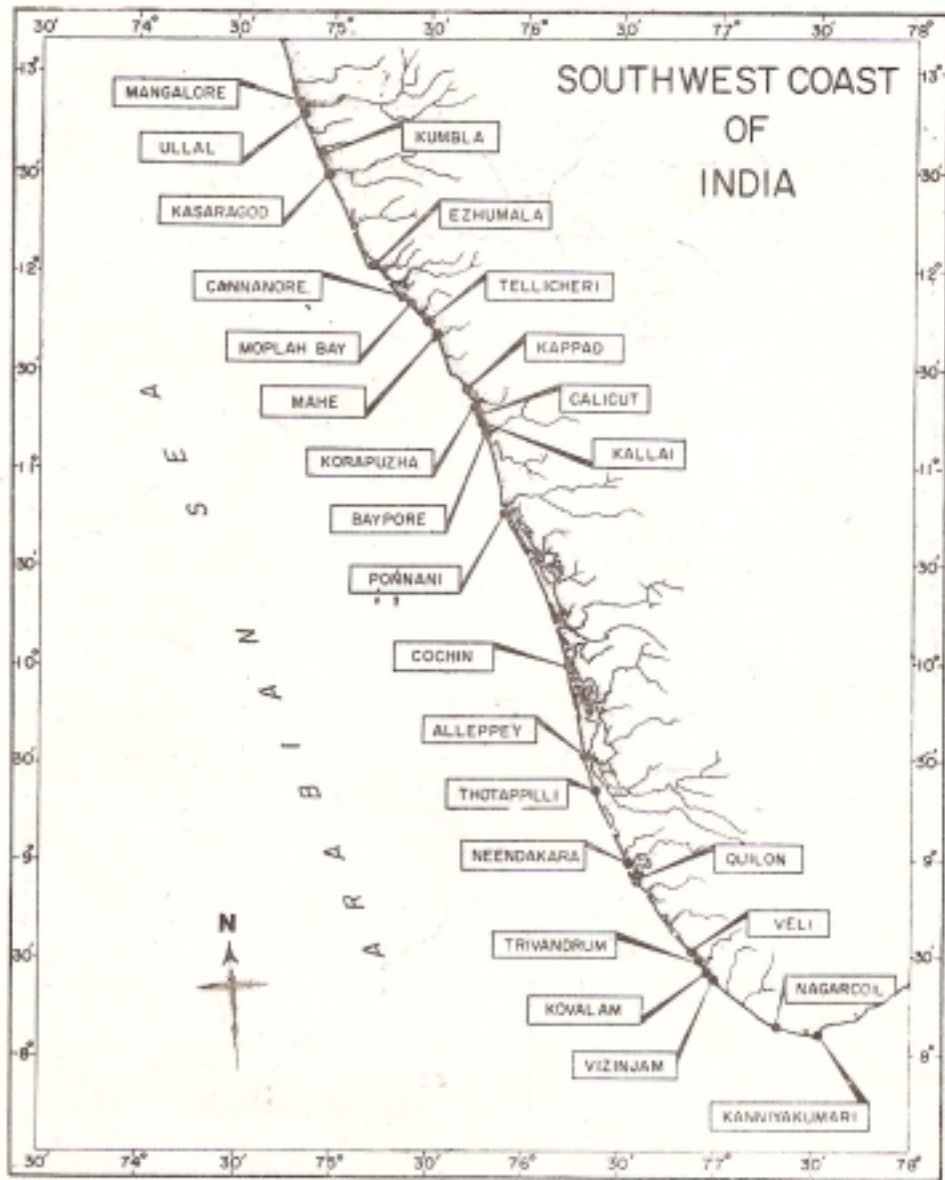


Fig. 1. South west coast

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practically meagre except a few reported works of GORE (1971), GORE and SINGHAL (1973), DWIVEDI *et al.*, (1974), RAVEENDRAN *et al.*, (1978), GORE *et al.*, (1979, 1980) and UNNITHAN *et al.* (1981). None has attempted the present enquiry.

This paper refers to the type and magnitude of sewage pollution and water quality in two paired sets of beaches widely separated *viz.*, Cannanore and Moplah beach in north and Vizhinjam and Kovalam in the south Kerala. The paper compares the pollution status of these adjacent beaches in the north and the south. Ezhumala beach is taken as a datum point of comparison of the 'health' of these beaches (Fig. 2).

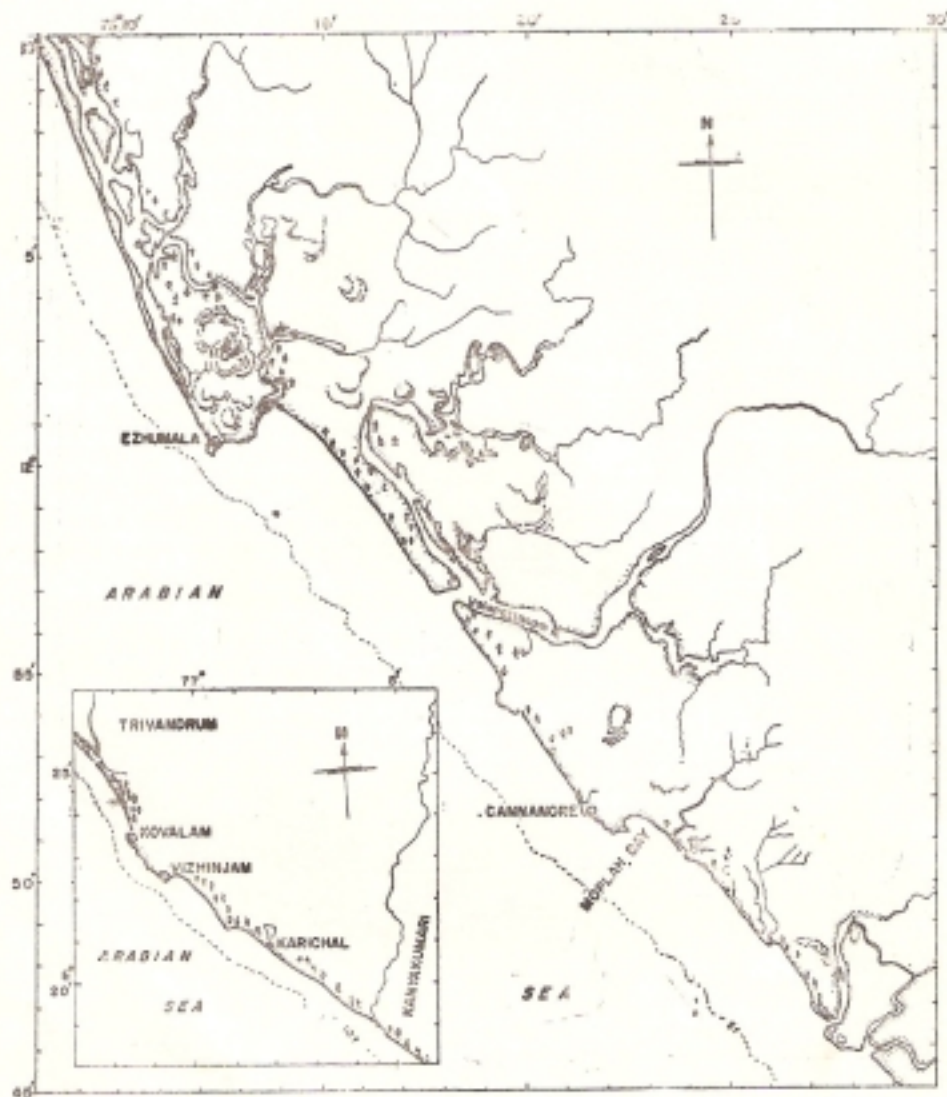


Fig. 2. The adjacent pair of beaches and Ezhumala.

THE ENVIRONMENT

Vizhinjam : Located 14 km south of Trivandrum city, Vizhinjam is a small fishing harbour. Small to medium mechanised vessels and country crafts operate out of this port and land their catches here. An inundation along the coast is given further production by making an artificial breakwater on its seaward side. Wave action is thus greatly reduced and circulation altered. The back-lands beyond the beach climb to a laterite plateau rather abruptly. The fairly made beach is dotted with country crafts and shacks for storing gear. The immediate vicinity of the beach is thickly populated and wastes from this community are discharged directly on to the beach. In addition to this there are sewerage openings also on this beach (Fig. 3).

Kovalam : This beach is 13 km south-west of Trivandrum. Projecting between two landheads north of Vizhinjam and spatially close to it is an international tourist resort. Fishing activity is sporadic and limited to the northern parts of the beach. Several thousands of people visit this beach annually seeking recreation and availing bathing facilities. The supralittoral region is planted with coconut palms. Various facilities of the tourist complex are being developed. The backlands here too is a laterite plateau climbing quickly up from the beach (Fig. 4).

Moplah Bay : About 1½ km from the city of Cannanore, Moplah Bay is also a fishing port as Vizhinjam. Here, anchorage facility for small craft is developed by constructing an artificial breakwater. Consequently wave action is low inside the bay. Intensive fish landing and drying are common features along this beach (Fig. 5). Cold storages and accessory facilities are available close to the beach. The backlands are low lying and the access to the beach remains water logged for most of the year. Sewage openings and drains for storm water open into this bay.

Cannanore : This is an open sandy beach which bears the name of the city where it is situated. Here fishing activity is limited and predominant use is recreation. A small water stream empties itself at the southern end. Considerable quantity of fresh water flows down the stream during monsoon. The backland is a sloping laterite plateau (Fig. 6).

Ezhumala : Ezhumala is an open sea, sandy beach about 13 km from Payyannur in Cannanore district with a vast supralittoral expanse. The beach is ringed by seven hillocks and hence the name. The supralittoral zones go up fairly sharply on to the laterite hillocks of the backland. The surroundings are not very thickly populated and human interference is not very high.

MATERIALS AND METHODS

Monthly samples of surf water and sand were collected during the period 1977 to 1979. Thereafter the sampling was repeated seasonally to cover the pre-, in- and post-monsoon seasons. Sand samples were collected using a sterile spatula or glass slide and emptied into a sterile petri dish (about 50 g). Three transects about 100 m apart were sampled at the high, mid and low tide levels. Surf water was collected in sterile glass bottles (250 ml) by wading some distance into the sea. Visual pollution counts were recorded from a stretch of about 100 m of the beach, and classified as per SHUVAL *et al.*, (1968). Isolation and procedures followed for indicator bacteria are given in RAVEENDRAN *et al.*, (1978). Characterisation and isolation of *Salmonella* spp. was done as per GORE *et al.*, (1980). FC/FS ratio was worked out as per FINSTEIN (1972). Enquiries in the field on occurrence of epidemics, if any, were made and hospital records were examined whenever possible.

Water samples for other analyses were collected using a clean plastic bucket from which portions were drawn to different bottles and preserved when necessary. Environmental characteristics were measured and analyses for water quality carried out using standard procedures (ApHA, 1960). Further details are available in SARALA DEVI *et al.* (1979).

RESULTS AND DISCUSSION

Environmental features and water quality : Seasonal averages of some environmental features and water quality criteria of the four beaches are given in Table I. Temperature was lower during the in-monsoon and post-monsoon seasons at all beaches. Salinity did not show much variation except at the Pophlah Bay. Here lower values were obtained during

Table I. Seasonal Averages of some environmental features and water quality characters of the beaches.

Season	Temp. (OC)	Salinity (%0)	Oxygen (ml/l)	Alkalinity (mg CaCO ₃ /l)	Dichromate COD (mg/l)	Permanganate COD (mg/l)	BOD (mg/l)	pH
<i>Ez/wllala</i>								
Premonsoon	31.40	35.30	3.00	20.70	<10	1.20	5.00	7.88
Monsoon	23.00	34.90	4.300	43.50	<10	1.30	8.00	7.50
Postmonsoon	29.00	33.90	4.30	66.20	<10	2.20	4.00	7.80
Pre monsoon	29.10	34.40	4.20	81.20	267.0	2.10	14.5 ₃	7.60
Monsoon	27.20	31.90	4.40	59.80	<10	4.30	5.96	7.20
Postmonsoon	27.00	29.50	4.70	33.40	445.0	2.90	7.13	7.80
<i>Call/al/ore</i>								
Pre monsoon	28.40	34.20	3.80	73.20	144.0	1.63	5.00	7.80
Monsoon	26.50	34.40	4.70	52.00	<10	5.00	6.75	7.50
Postmonsoon	27.25	32.59	4.63	55.25	123.0	2.42	5.21	7.80
<i>Vizhinjall</i>								
Premonsooll	29.11	33.59	4.02	80.02	38	1.67	13.5 ₄	7.35
Monsoon	27.10	33.71	4.10	69.82	<10	1.75	9.25	7.15 ₅
Postmonsoon	28.72	34.17	4.65	83.03	110.5	1.91	5.65	7.50
<i>Kovalam</i>								
Premonsoon	29.90	33.40	4.20	69.60	41.0	2.20	4.39	7.80
Monsoon	25.80	34.10	4.60	65.60	<10	1.70	6.05	7.50
Post monsoon	20.00	34.20	3.90	72.70	<10	1.40	4.85	7.80

the in-monsoon and post-monsoon season, probably due to ground water discharge. Oxygen content was higher during the cooler in-monsoon and post-monsoon periods. The lower values in the pre-monsoon season are probably associated with higher ambient temperature.

Water quality was measured by COD and BOD₅. COD measured by dichromate reflux method was higher at Moplah Bay and Cannanore during the pre-and post-monsoon seasons and low during the in-monsoon season. Though the trend in variation was similar, the existing average levels differed by two to four folds. Permanganate COD also followed a similar trend. BODs values were higher at Vizhinjam and Moplah Bay during the pre-monsoon season, indicating the influence of waste discharge. The adjoining beaches however showed higher levels during the in-monsoon season, values being highest in the early monsoon season.

EzhumaJa which is free from excessive human use showed uniformly high quality of water throughout the period of observation.

Bacteriological studies: Results on bacteriological studies are given in Table II which shows the occurrence of indicator bacteria and *Salmonella* in the beach sand and water. In general, higher bacterial counts were obtained in the beach sand compared to water. Vizhinjam had consistently higher coliforms and *E. coli* counts through out the period of observation followed by Moplah Bay. Presence of *Salmonella* spp. was also noted in this beach during all seasons. The highest bacterial counts were obtained from Vizhinjam beach. Post-monsoon showed the highest average values of coliform (11000/100 g), *E. coli* (6000/100 g) and *S. faecalis* (2200/100 g). Visual pollution counts and litter were consistently high at this beach and so also the FC/FS ratios, both in the sand and in water indicating anthropogenic sources.

The adjoining beach at Kovalam showed a remarkably different picture. Coliform counts were very low (Table II), *E. coli* and *S. faecalis* being absent during pre-and postmonsoon seasons. *Salmonella* spp., were not encountered at this beach, throughout the period of observation (Table II). Visual pollution counts were 'nil' for the in-monsoon and post-monsoon seasons. The low Counts obtained in the pre-monsoon season (Table II) is not surprising in view of the very high number of visitors to this beach during that season. The aesthetic insult caused by litter was also the highest during the pre-monsoon season (Jan-May) when the beach is highly frequented.

Moplah Bay beach like Vizhinjam is a fishing and fish-landing centre. Here also the beach was found to be contaminated by sewage discharge and badly littered. High counts of indicator bacteria were obtained for both the sand and surf water samples (Table II). These values, though by themselves high and objectionable, were low compared to those at Vizhinjam. Seasonal average of coliforms, *E. coli* and *S. faecalis* were highest during the monsoon season here (Table I) as against post-monsoon season at Vizhinjam. Presence of *Salmonella* spp., was noted in the beach sand during pre-monsoon and post-monsoon seasons. Visual pollution counts were also quite high here throughout the period of observation. FC/FS ratios too were consistently high showing human sources of contamination.

Cannanore, an open sea beach about 2 km away from Moplah Bay presented a much cleaner environment. Indicator bacteria were rare and often absent in the surf water. Counts of the beach sand though low was higher compared to Kovalam beach (Table II). Visual pollution counts were low and could be termed as "slight" (SHUVAL *et al.*, 1968) but the beach showed a higher accumulation of debris and litter during the dry season compared to Kovalam.

Ezhumala showed consistently low bacterial counts throughout the period of observation (Table II). *E. coli* and *S. faecalis* were totally absent both in the sand and water and so was the pathogen *Salmonella* spp. Thus, this beach is perhaps the nearest approach to a least tampered natural environment.

Spot values of water quality or bacteriological characteristics are of limited value in assessing the level of pollution of the beach. Organic loads as well as bacterial flora introduced on the beaches undergo a natural process of 'decay', showing diminishing values away from the point of discharge. 'Accidental' introductions at or near the sampling sites in the 'immediate past' can also distort the picture by creating high values for the criteria being measured. Hence, averages obtained from fairly long term observations presented here may seem to be a more reliable tool as they show up trends much more clearly. In dynamic environments like the beaches, averages arrived at without due regard to the seasonal cycles are also liable to err by over simplifying.

Viewed from this angle, the five beaches examined here may be arranged in the order of pollution status (Table I & II) as Vizhinjam-Moplah Bay - Cannanore-Kovalam. Ezhumala. Examining the first two of the above, one could see that these two sites have some common features. Both are fishing harbours, receiving sewage- discharge and are protected from excessive wave action by artificial barriers. These barriers seem to have changed circulation within the bay and slackened. Littoral currents allowing wastes to wash back and accumulate on the shore. The presence of black sand at 90th these beaches also indicate deposition of degradable material. Assuming the quantities of organic wastes from sewage and fish slime, carcasses and other wastes from landing, handling to be similar, the density of population in the immediate vicinity seems to be the factor; pushing Vizhinjam to the bottom of the scale ..

Comparing the next two beaches viz. Kovalam and Cannanore which are adjacent to the polluted sites, the common features are their similar open sea location and their use predominantly as holidaying sites, as well as lack of point sources of discharge. However, Cannanore showed higher bacterial counts and organic loads (Table I & II) and more of accumulated litter. The sweet water stream at the southern end of the beach 'transporting organic wastes on to the beach and currents transporting it along the beach could at least partly explain the first two. Accumulation of litter seems to be more of a civic problem due to the lack of proper arrangements for periodic removal and disposal. Kovalam being an acclaimed tourist resort the more deliberate care being taken to avoid aesthetic insult seems to keep the place cleaner.

Ezhumala which as per the present data is at top of the ladder is as 'yet an undisturbed area. Literature on water quality and standards often refer to 'natural water', 'natural environment', 'surface water' etc. which is the realm of conceptual (UNNITHAN, 1979). Preservation of at least a few such localities from excessive human interference could provide more tangible datum points. Certain points which require immediate remedial measures to avoid contamination of these beaches are-

- 1) The sewage material should be treated before it is allowed to flow through.
- 2) The sewage canals should be extended farther into the sea.

In addition to these, the fishing activities should be controlled on the following

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lines

a) The landings should be restricted to only certain areas of the beach,

- b) The fish drying should be avoided on the beach sand. However, Indigenous methods like wooden platforms may be effectively undertaken in selected localities of the beach.

- c) The washing of the fish landed on the beach should not be in the polluted sea water of the beach. This gives rise to secondary contamination.

CONCLUSION

With tourism suggested in the priority sector, the country needs more beach resorts of quality along its peninsular coast. The existing ones like Kovalam and Cannanore have to be improved as well as to reach changing international standards. However, Kovalam recommended for bathing has its neighbour Vizhinjam heavily polluted. Rural and urban development should go together at Vizhinjam and Kovalam and similar pairs of adjacent beaches.

Under-developed fishing ports like Moplah Bay and Vizhinjam should be developed on modern lines. Inhabitants of the coast especially under unhygienic environment should be rehabilitated elsewhere with free approach to the sea, their work place.

If possible, an edible fauna suitable to our waters along the coastlines may be cultivated which will consume the pollutants and biologically control pollution of the inshore waters? This approach may accelerate considerably, the mariculture practices especially productive sea farming in Vizhinjam, Moplah Bay and similar areas of fisheries importance.

Half a kilometre from the sea to the coast may be declared as protected area with public access to safe work areas and beach recreation spots so as to prevent environmental insult.

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