TWO

MUDBANKS OF KERALA-KARNATAKA—NEED FOR AN INTEGRATED STUDY

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INTRODUCTION

We have documented reports of the mudbanks along the south-west coast between Mangalore and Quilon for well over three hundred years. However, sequential record of their occurrence in time and space is wanting. This phenomenon in Kerala, typically as occurs south of Alleppey (Fig. 1), is known as *Chakara*, or *Santhakara* ("quiet shores"). During the last two decades the presence or absence of the *Chakara* phenomenon has attracted considerable attention of the fisheries sector, resulting in a number of useful studies on mudbanks covering specific aspects. Yet we are far from having precise answers to the problem of the mode of its origin, establishment, stability and dissipation, except propounding some hypotheses and suggestions based on physico-chemical and biological data.

The recent past has also seen large-scale erosion along long stretches of this coast and consequent serious impairment of the life of those living in the coastal zone. Since 1973, the mudbank has not developed to the extent anticipated, to sustain any major fishing activity along the coast. This, combined with extensive erosion, has created serious socio-economic problems in the coastal sector. Of a good mudbank season, the primary beneficiary is the artisanal fisherman, who is able to operate his canoe from the calm waters of the mudbank and often land heavy catches of shoals which enter the area. Owing to heavy surf along other parts of the coast, fishing in the artisanal sector is generally at a standstill during the monsoon season. As such, the formation of mudbank is eagerly awaited as it portends good fishing, and hundreds of canoes are transported by road to the sites of the mudbanks from villages even 50 to 60 km north and south.

These multifarious factors focus attention on an imperative need for developing an integrated multidisciplinary programme to study the mechanisms of mudbank formation, its life and dissipation and its impact on the coastal zone.

HISTORICAL RESUME

In the two volumes entitled "History of Mud Bank" Bristow (1938) refers to the early works on mudbanks, which are mainly narrative in nature. He also opines on the various possibilities of the mode of formation of the mudbanks.

Probably, the first mention of the mudbanks along the southwest coast in recorded history is a mention as early as 1678 in Pinkerton's "Collections of voyages and travels," appearing in the Administration Report of 1860 of Travancore. In his book, "A New History of the East India," Capt. Cope (1755) spoke of the Alleppey mudbank ("mud bay" as he calls), which, he says, is a place that few can parallel in the world. Crawford (1860) may be credited with attempting the first possible explanation of the source of the Alleppey mudbank. Based on personal observations of mud cones on the beach and on roads of Alleppey, Crawford found cause for linking them with the backwaters and rivers. His observations of bursting of mud and water, during the widening of the Alleppey canal, and his attempt to sound the

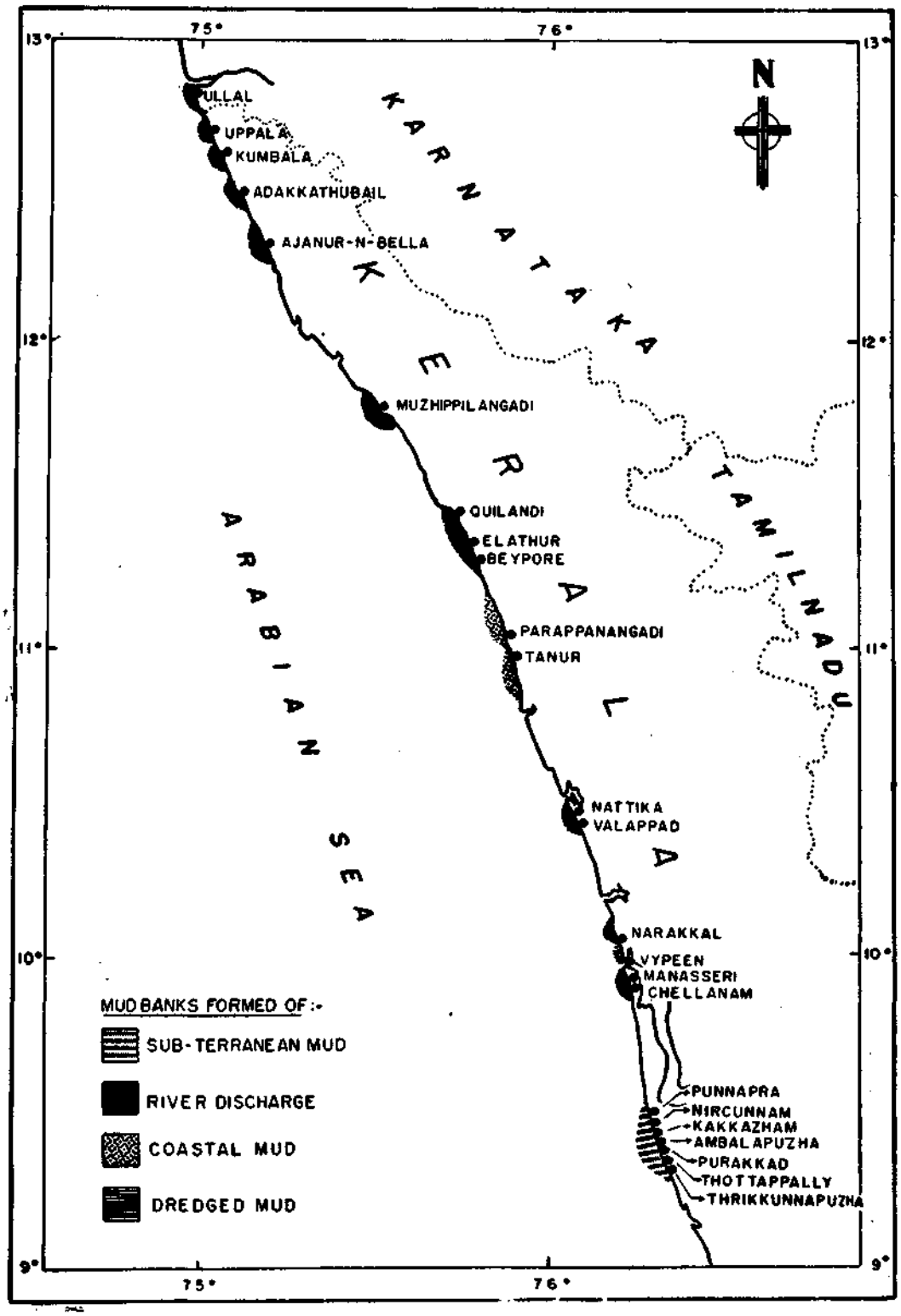


Fig. 1. Areas of mudbank formation and the various types of mudbanks along the Kerala-Karnataka coast

'Linus' of Chengannur River, strengthened his opinion that subterranean mud sustained the Alleppey mudbank. The observations of Logam (1882) further help us to note the importance of subterranean mud deposits. He found "deep pot-holes in the lake east of Alleppey and with a rise of 4' to 6', as occured in the floods of 1882, it can be easily believed that the enormous pressure thus caused would force relief ways for itself below the coastline through soft muds."

King (1881), in a report on "Considerations on the smooth water anchorage of mudbanks of Narakkal and Alleppey on the Travancore coast," discussed the migration and formation of the mudbanks between Alleppey and Purakkad and between Cochin and Narakkal. A siginificant observation was that of Rhode (1886; *in:* Bristow 1938), who spoke of fluid mud existing below Alleppey, and thereby postulating that the mudbank at Alleppey increases and diminishes as the level of the inland water rises and falls, as was observable during the 1882 floods. Opining on the same lines Drury (1906) was of the view that, in the absence of a natural outlet for the vast accumulation of waters which are poured down from the various mountain streams into the basin of the backwater, nearer than 36 miles on either side, it is not improbable that there exists a subterranean channel communication with the sea from the backwater, through which large quantity of mud is carried off and thrown up again by the sea in the from of a bank. According to Lake (1889), "it is to the observation of Mr. Rhode and of his predecessor, Mr Crawford, that we owe most of our knowledge of the Alleppey mudbank, and there is very little to add to what they have already recorded." He also reported on the occurrence of mud cones in his report on the Alleppey mudbank.

For more on these and for other references to the mudbanks, I would direct the reader to the comprehensive treatise of Bristow (1938) on the "History of the Mudbanks", wherein he has also added his exhaustive observations on the formation, maintenance and movements of the mudbanks at Alleppey and Narakkal. The mudbank at Narakkal plays an important role in the silting of the Cochin Harbour channel and was the cause for a Special report by Du Cane et al. (1938). This report also does not favour the view that an increase in the water level in the lake would result in mud being pushed up in the adjacent coastal area due to the insufficient pressure (2 lbs/sq. inch) that even a 5' rise in water would create. Nor is the consistency of the mud of the mudbank the same as that found in the lake, the latter having a high percentage of carbon and a lot of vegetable debris. However, I feel that a critical study of this is necessary, which will also necessitate borings and soil studies at different depths in the lake, intervening land area and the Purakkad inshore waters.

The post-war period saw a renewed interest in the studies on the coastal ecosystem. This has led to more specialised investigations on the mudbank ecosystem as summarised below: Seshappa (1953) and Seshappa and Jayaraman (1956) have studied the phosphate content of the mudbank at Calicut and noticed higher phosphate concentrations. Ramasastry and Myrland (1959) stated that the formation of the mudbank is associated with upwelling and divergence near the bottom between 20 and 30 m along the coastal line, which produce vertical acceleration, with resultant lifting of the bottom waters; the lifted bottom water carries along with it the fine mud of the bottom. Nair et al (1966) have studied the mud deposited on the sandy beaches of the Vypeen island near Cochin after a storm, for its physical and chemical properties, in order to understand the source and mechanism of mud deposition. A comparative study of these sediments with that obtained from offshore samples has also been made. They came to the conclusion that the mud deposited on the beach was from the nearshore areas, as it was composed of dredged material transported northward from Ernakulam channel. Varadachari (1966) has discussed the part played by the estuaries and mudbanks of Kerala coast on shore-line configuration. Varadachari and Murty (1966) have made some observations on a temporary mud flat that appeared between Cochin harbour entrance channel and Elamkunnapuzha, during a storm in December 1965. Damodaran and Hridayanathan (1966) suggest that lowering of surface salinity and a flocculation effect caused by the same keeps the mud in suspension. Rao (1967) has given an account

FURY OF THE SEA

PLATE II. Heavy monsoon seas and coastal erosion at Chellanam and adjacent areas on the Alleppey-Cochin coast.

MUDBANK AT PURAKKAD

PLATE III. A: Calm waters of the mudbank; B: Boat-seine, Thanguvala, operation; C: Awaiting the catch; D: Ice packing of fish before loading on cycles; E: Catch of Lesser sardines; and F: Heavy catch of *Parapenaeopsis stylifera* at the Purakad mudbank.

HARVEST FROM MUDBANK

PLATE IV. A. Oilsardine; B: a mixed catch; C: prawns spread out for drying; D: Shelling of prawns, after drying; E: a mixed catch of prawns, crabs and fishes; and F: Fishvans at Purakad waiting for transporting prawn and fish catch from mudbank.

of the fishery aspects of the mudbank at Alleppey with some considerations on the physico chemical features. Dora et al (1968) carried out investigations on the texture of Narakkal mudbank sediments.

Varma and Kurup (1969) opined that the formation of the mudbank is the result of the interaction between the inshore and offshore transport of sediments in suspension, the former by waves and the latter by rip-flows. According to Kurup (1972), the converging littoral currents in the inshore waters of the Kerala coast have influence on the shore-line changes along the coast and play an important role on the formation of the mud-bank south of Alleppey. Iyer and Moni (1972) evaluated the effects of mudbanks on the shore-line stability. Gopinathan and Qasim (1974) have investigated the formation and characteristics of the Alleppey mudbank. The organic carbon of the mudbank sediments of Alleppey have been studied by Jacob and Qasim (1974). Two recent fairly exhaustive works are; first, a detailed investigation on the meiobenthos and macrobenthos of the mudbanks on the south-west coast of India by Damodaran (1973) and, second, a study of the physical aspects of the mudbank including the texture of sediments, by Kurup (1977). Mathew et al (1977,) have studied the diurnal variations in the distribution of zooplankton in relation to currents and other ecological parameters of the mudbank of Alleppey. Recently, McPherson and Kurup (1981,) postulated a mathematical model to explain the wave damping at the mudbank.

Information was gathered from several sources, including statements by inhabitants in the fishing village. A fisherman (70 years old) of Punnapra stated that he had never seen mud cones at Punnapra area in his life-time; but he remembered that there was a well-formed mudbank at north Punnapra during 1950. Another person stated that, in the late fifties, the seat of the mudbank was at south Punnapra with its southern end at Nirkunnam, and this was so until 1968. Then it shifted to Valanjavazhi in 1969 and Nirkunnam and Ayyancoil became respectively the northern and southern ends of the mudbank. Local fishermen also stated that mud cones were observed on the land at Nirkunnam in 1969. In 1971 and 1972 the northern periphery of the mudbank was observed at Kakkazham, where the mud cones were observed in 1972 on the beach and in the inter-tidal zone. In 1973, there was no proper mudbank formation at Karoor-Ayyankoil, and the situation has re-mained so in subsequent years, when only 'incipient' mudbanks or 'evanescent' mudbanks have occurred. Thus Purakkad was the location of mudbank in 1974 and 1975. In 1976 it moved further south to appear between Pura-kkad and Thottappally. Since 1976, until the mudbank season in 1980, the mudbank appe-ared at Thottappally, north of the spillway. In 1981 two mudbanks were observed in the Alleppey region, one at Punnapra and the other at Thottappally-Pallana region. However, all the post-1973 mudbanks south of Alleppey have been very evanescent ones of not any great consequence.

TYPES OF MUDBANKS

Studies thus far carried out indicate that the mudbank could result from different fact-ors, such as :

a) erosion, accretion and transport of sediments,

b) transportation of sediments through upwelling or currents in the coastal waters,

c) transport of sediments to the river mouth,

d) formation of mud cones due to pressure in the lake site ; and

e) dredged sludge which is dumped into the inshore sea.

The need of the hour is a critical study of the various types of mudbanks and the mecha-nisms which are responsible for them under different situations.

Remote sensing and satellite imagery technique for studying mudbanks

It is necessary to obtain synoptic pictures of the river discharges in the inshore waters and the indication of formation or build up of sediments to form mudbank, and the related features between Quilon and Mangalore. The manpower and facilities required for monit-oring such a long stretch of coast will be

tremendous and, as such, the time has come for techniques such as remote sensing and satellite imagery to be taken advantage of to record the events synoptically. This will also facilitate monitoring the water shed of the rivers to assess the run off and the amount of inflow in the inshore waters. Because of the multifarious uses to which river waters are presently put it is only a short time before major imbalances may develop in the coastal regime, affecting its fertility as well as the other associated natural phenomena. Fortunately, intensive monitoring systems can be developed and today we are aware of the magnitude of the problems and how to approach the same.

Some priorities for consideration in future integrated investigations on mudbank

1. The stabilisation of the coastal track by use of appropriate vegetation is an area which needs investigations. This is necessary on account of the considerable erosion along long stretches of the coast. The importance of rehabilitation of mangrove vegetation as well as other plant community for stabilizing the beaches and the sublittoral should be given priority.

2. The flocculation of cohesive sediments in suspension and the agglomeration of particles added by biological organisms and the subsequent rate of sedimentation, is area which is yet to be understood. Similarly the inter-action between various biological and physical processes involved and accretion and fine-grain sediments in the areas adjacent to the mudbanks is practically unknown.

3. To-date we have no idea of the role of epiphytic microflora and diatoms which produce mucus and thereby accretion of intertidal mud deposition.

4. We know little about action of invertebrates on sediment deposition.

5. Normally, suspended sedimentary material should be a repository of trace metals as well as heavy metals. We have practically no information as to the extent that mudbanks contribute towards this.

6. The role of micro-biota in organic degradation and process of recycling is yet another area where information is lacking.

7. We have no information on sediment oxygen demand and the rate of oxygen transference in the mudbank.

8. The "critical limit" or "critical depth" for defining the boundary based on the suspended or silt disiribution in the mudbank has not been properly defined. This is important as the outer boundary may be oscillating, depending on the load of suspended matter. Our present projections in this are arbitrary.

9. The question may be asked as to whether we have any idea of the mudbank sediments as concentrating mechanisms of organic and inorganic materials. The answer is no! Similarly, we lack in information on entrainment, deposition and transport of fine grain sediments in the mudbank.

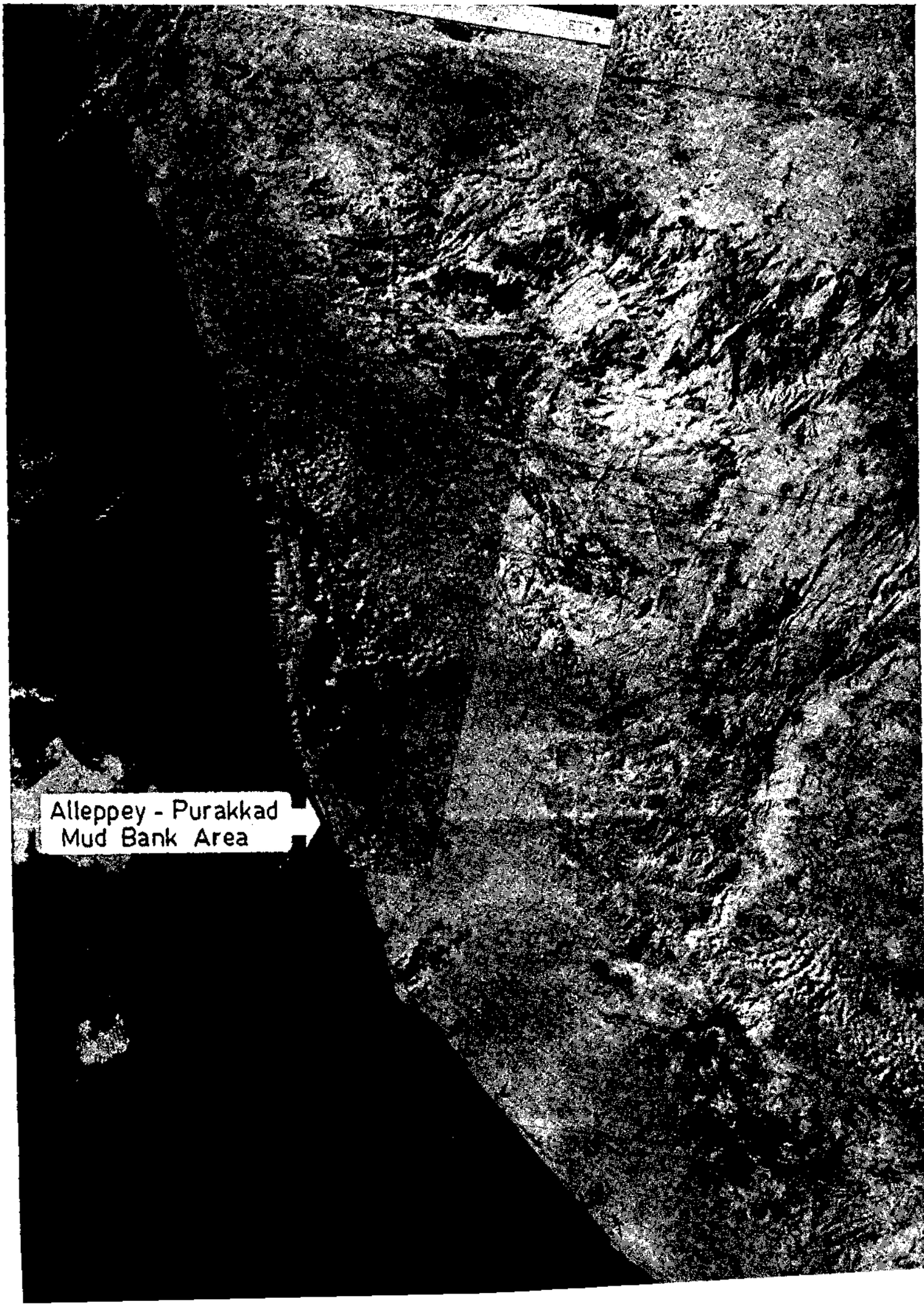
10. Is there a way of estimating annual/seasonal total budget of substances of the mudbank, which separate from mud to the water? Particularly suspended materials and trace metals? The answer at present is no.

11. Absolutely no information is available from the mudbank studies on the bio-geochemical cycles taking place there.

12. We have no information on the role of microbial metabolism in the mud sediments and the role it may play in mobilisation of phosphorus.

13. The optimum/maximum of trace metals in this natural ecosystem of mudbank is still unknown. There is hardly any information to assess trace metal uptake in sediments and suspended metals—to understand the modus operandi—whether it is through physico-chemical absorption or through physical accumulation of metal enrichment of particulate matter. Or through biological uptake.

14. There is a lack of information on biological uptake; the role of bacterial population in this process and the mineralisation of


Alleppey - Purakkad
Mud Bank Area

algal matter by bacteria are practically unknown.

15. The earlier works clearly indicate that nematodes constitute numerically the most important component of the meiofauna of the mudbanks. However, we have no information on the nematodes-bacteria interaction. The burying and feeding activity of nematodes may help in improving exchange of metabolites and other essential nutrients for bacteria to maintain the latter at the point of maximum growth. Nematodes also assist in the process of bio-turbination. According to Platt and Warwich (1980), nematodes are primary consumers of food for higher organisms and they play a vital subsidiary role in organic decomposition and in modifying the physical stability of sediments. More work on the nematodes in the mudbank area is necessary.

16. Often large quantities of benthic animals, such as tube-welling polychaetes and bivalves, are found accumulated in the intertidal area when the mudbank exists. The causative factors for their displacement from natural beds in the mudbank area needs study.

17. Examination of core samples from the mudbank and adjacent areas is necessary to understand as to how long this phenomenon in the Alleppey region has been in existence.

In the following reports stress has been made to study some aspects of the physico-chemical and biological aspects of the mudbank. It is hoped that this will stimulate more intensive studies of an integrated nature in future by collaboration and coordination of work with other interested agencies.

Coastal zone management—need for a national policy

The mudbank is a phenomenon of the coastal zone. The management problems connected with it during a year of successful mudbank formation, particularly between Quilon and Cochin, are up to now tackled on an *ad-hoc* or temporary basic. There is an imperative need for a national coastal management strategy to be developed to look constructively at these and other phenomena and shape public policy. A large share of this responsibility will rest with the Department of Environment, Government of India, which should develop a strategy, that would also improve the quality of life of the people involved in various activities along the coastal zone. This would involve also a judicious development of aquaculture practices in the sea and in the adjacent inundated brackish-water areas; the interest of the artisanal fishermen and fisheries; the development of harbour and other infrastructure; the proper management of the mangrove eco-systems; and the protection and safety of the estuarine areas from industrial pollution; besides monitoring of human interference on the rivers and watersheds, which eventually upsets run off into the sea and thereby affects deleteriously the coastal eco-systems, problems of erosion and accretion, and special phenomena such as mudbanks and their importance in influencing the coastal zone management.

It is hoped that priority will be given to evolving a coastal zone management policy for the country taking also into account an integrated approach of demographic and environmental problems of the coastal zone. No doubt, the Department of Environment, Government of India, has to play a nodal function in close liaison with the concerned maritime States and Union Territories. We hope that this Report will create an awareness in this direction and stimulate positive action.