

Introduction

Most of the natural processes are common to all coastlines and their physico-chemical characteristics are quite well known. But, there are some localised and seasonal process, have significant role in socio-economic benefit of coastal habitant and require continuous study to understand for sustainable exploration. Mud banks are such an inquisitive coastal phenomenon which occurs only at a few locations in the nearshore waters of the world ocean. Muddy shores and adjacent shore faces are found along several open coasts of the world including south west coast of India. They are generally associated with the dispersal pathways of rivers that discharge large quantities of fine-grained sediment. The high mud supply also has considerable coastal ecological and economic impacts on several coastal countries. In the world, the mud bank formation has been identified at the area between Cabo Cassipore and Cabo Orange (Capes region), between the mouths of the Amazon and the Orinoco: Brazil, French Guiana, Surinam, Guyana and Venezuela and Kerala coast under the influence of rivers and surface oceanic circulation. These mud bank may show the migration at nearby region. The longest of these muddy coasts, however, is the 1500 km long stretch between the mouths of the Amazon and the Orinoco Rivers in north-eastern South America, which is strongly impacted by the mud supply from the Amazon. Mud banks constitute the overarching control on the morph-dynamics and the ecosystems of the coastal area.

Mud Banks at Kerala

Mud banks of Kerala can be defined as those areas of the sea adjoining the coast, which have a special property of dampening the waves resulting in clearly demarcated areas of calm water even during the roughest monsoon conditions of the sea. These areas become distinct from the other areas which may have a muddy bottom, and the tranquillity is caused as a result of dissipation of wave energy in the large quantity of mud kept in suspension. Mud banks are seen within a water depth of 15 m, often in a semi-circular shape with a radius ranging from 4 to 8 km. Due to the prevalence of calm waters within the mud bank during south west monsoon, which is a period of very high wind and wave activity, fishermen use this region for launching and landing of small boats for fishing activities and large numbers of canoes are brought to the mud bank areas, even from far off places.



The fisheries sector is a vital component in Kerala's economy. It is an important source of food and cheaper animal protein, besides a major root of avenue generation through providing employment for coastal populations. The fish consumption of Kerala is four times than that of the national average. But, the south west monsoon period is generally an off-season for the fisher folk on the west coast of India due to seasonal closure of mechanized fishing and also fishermen do not have courage to take risk of fishing venture in very high rough of sea condition. In this period, the calm areas created by the mud banks to attract fishermen from far and wide.

'Mud bank fishery' is very popular among the fishermen as 'Chakara'. Though mud banks are reported at several places along the Kerala coast, the most prominent and persistent one occurs at Alappuzha. The formation of mud bank plays a major role in moulding the social and economic set up of the coastal people of that region by providing a stable fishing ground during the monsoon season. Mud banks have scientific and societal attention from time immemorial, predominantly due to the large fisheries associated with them. Mud banks, as they appear and disappear in the sea, have been considered as unique formations and seem to occur nowhere else except along the Kerala coast. Therefore, the existence of mud banks along Kerala coast is known as God's gift for Kerala fishermen.

Types of Mud Banks

There are some following types of the mud bank:

1. Active mud banks - This is area where the waves are dampened by the special property of the mud bank along its periphery during the south west monsoon and calm water demarcated within the mud bank.
2. Passive mud banks – These are the same areas at a time when the characteristics in the region are similar to those of other areas.
3. Persistent mud banks – Persistent mud banks are those mud banks which become active every year during the south west monsoon or whenever there is strong wave action. These mud banks are not permanent at a particular place. When active they can shift from one inshore region to another, but maintain their form. Hence the word persistent indicates their recurrence year after in a particular area.

Hypothesis

Various hypotheses have been postulated for explaining the formation of mud banks along the Kerala coast, which can be broadly, classified into two, (I) Local water-column dynamics in the near shore region and (II) Remotely mediated processes such as subterranean flow of mud and fresh water from hinterlands or adjacent lagoons.



There are four hypothesis under the former classification, which are;

- 1) Formation of fluid mud due to upwelling and Ekman divergence
- 2) Suspended sediment transport under littoral current and rip current system
- 3) Wave-induced oscillation and wave dampening and
- 4) Infra-gravity waves interacting with undertow and reflections from shore leading to mud suspension.

Similarly, there are five hypothesis under the remotely-mediated processes. The central premise of the remotely mediated process hypothesis is the fresh water from either the adjacent lagoon or from hinterland through underground facilitates mud suspension in the mud bank region. There are following hypothesis;

- 1) Passage for soft mud from rivers and backwater during monsoon through subterranean channels as evidenced by the mud cones observed in the beaches of Alappuzha
- 2) Water-bearing subsurface strata churning up mud within the region of mud bank
- 3) Seepage of methane gas, produced by marsh deposit, due to injection of fresh water from lagoon following heavy monsoonal rain or due to the pressure fluctuations of the short-period storm waves associated with the monsoon
- 4) Existence of submerged trending faults from Achankovil shear zone to Alappuzha
- 5) A combination of subterranean fresh water flow from the adjacent Vembanad Lake through the shallow trending faults over the lime shell bed during summer monsoon.

Fishery

Mud bank fishery can be observed at various localized coastal area of Kerala. For example, During the period of 25th to 30th June, 2012, mud bank fishery was observed in Thrissur District. During the six days of mud bank fishery, the landings of the district concentrated only at five centres, namely Puthan Kadapuram, Blangad, Chettuva, Kaipamangalam (Companykadavu) and Perijanam (Bhajanamadam). The phenomenon was first noticed along the west coast, off Chettuva and Kaipamangalam, mostly in 5 to 16 m depth range. Very low fish catch may be seen at nearby landing centre prior to the formation of mud bank, but a sudden increase may be observed in catch after onset of mud bank. Fishing at the mud bank area is done normally from the early hours of the day till noon. On heavy fishing days, fishing may be observed to continue till late in the afternoon.



Crafts and gears

Fishing by mechanised trawlers is prohibited at the mud bank and nearby areas. Ring seiners, motorised mini trawlers and non-motorised crafts are operated at mud bank region. Motorised wooden mini trawlers with either double or single outboard motor, each boat having 9.9 hp power are also employed for fishing. Dugout canoes and rigged canoes called locally as 'Vallam' or 'Vanchi' are the crafts used as non-motorised crafts in fishing operations. Mainly two lengths of canoes are operated in the mud bank areas, a larger one of 9.5 m manned by 15 persons and a smaller one of 6 m manned by 9 persons. The main gears of operation at the mud bank regions are ring seine (Choodavala and Thanguvala) and gill nets. Since mini trawl is operated with two attached crafts, it was locally known as double net.

Catch compositions

Mud banks fisheries are often rich in penaeid prawns, oil sardine, mackerel, *Stolephorus* and various other soles. Around fifty species of fish and six species of prawns have been identified from the mud bank areas. The different species may land from mud bank area include Oil Sardine - *Sardinella longiceps*, Croaker- *Otolithes cuivre*, Malabar Anchovy - *Thryssa malabarica*, Mustached anchovy - *Thryssa mystax*, Flower shrimp- *Metapenaeus dobsoni*, Hilsa Shad - *Tenualosa ilisha*, Indian White Prawn - *Fenneropenaeus indicus*, Silver bellies species, Indian Anchovy - *Stolephorus commersoni*, White sardine- *Escualosa thoracata*. Indian Mackerel - *Rastrelliger* and Bigjawed jumper- *Lactarius lactarius*. The pattern of fish distribution in the mud banks has been observed to change very frequently even ranging from day to seasonal. Catch was dominated by shrimps including in the landings *Penaeus indicus*, *Metapenaeus dobsoni*, *Parapenaeopsis stylifera*, *Metapenaeus monoceros* and *M. affinis*. Fishes belonging to the families Carcharinidae, Clupeidae, Dussumieridae, Dorosomidae, Engraulidae, Chirocentridae, Tachysuridae, Hemiramphidae, Sphyrnaeidae, Mugilidae, Polynemidae, Ambassidae, Theraponidae, Sillaginidae, Lactaridae, Siganiidae, Carangidae, Gerridae, Leiognathidae, Pomadasyidae, Sciaenidae, Trichiuridae, Scomberomoridae, Stromateidae, Cynoglossidae, Chirocentridae and Drepanidae may be encountered in mud bank fishery.

Socio-economics

Majority of the fishermen who used to engage in fishing at the mud bank area are not permanent dwellers of this region; but have come from far off places for the sake of fishing during monsoon season and stay with their relatives, friends or in rented apartments or on the beach itself. For an instant, if mud bank forms near chethua, many fishers from nearby fishing villages such as Kalamukku (Ernakulam district); Chettuva, Azhikode and Thalikulam



(Thrissur district) and Ponnani (Malappuram district) to temporarily migrate to these fishing grounds during the period. They come with own or hired crafts and gears. The fisher folk who assemble at the mud banks are not a homogenous group. They belong to various castes and religions and speak different languages, but they all live in perfect harmony. Mud bank formation commensurate with the fishing holidays or closed season in fisheries in Kerala. The fishermen who are devoid of fishing activities finds this as an opportunity to gain the sole income during this particular period. Revenues depend on species and quantities caught and prices obtained, which again depend on marketing channels and markets, seasonal fluctuations and other factors. For example, a huge landing of *Stolephorus* sp. may lead to steep fall in prices.

General considerations

The monsoon fishery along the coast of Kerala in calm area by traditional and motorized craft is often called as mud bank fishery. There is a common belief that mud bank and fishery are interrelated *i.e.*, a good mud bank means a good fishery to the public. The fishermen believe that a good mud bank formation will provide them a good catch. In fact, it has been found that the mud bank and the fishery are independent. Similarly, there have been cases of heavy catch from the coastal waters even when there was no mud bank formation.

Estimation of catch

Even though, mud banks appear at localized area for a certain period, but the information about its appearance spreads very fast among fishermen. The appearance of mud bank able to harbourage a large number of fishing crafts, resulted a large quantity of marine fishes are landed even in lean fishing season. Therefore, estimation of fish catch from mud bank area is essential. The harvested fish catch from mud banks region may land either at regular landing centre or at other place according convenience landing and marketing facilities. Thus, the monitoring and data collection of marine fish catch during mud bank is done by the field staff of the Fishery Resources Assessment Division, CMFRI. The survey duty for field staffs is assigned to these centres to collect the details of the catch and effort for mud bank fisheries. They record the information about craft and gear combinations, species caught, quantity, price, duration of fishing, *etc.* as well as the period of the mud bank in that particular centre. The survey can be repeated in the same landing centre depending on the intensity and the duration of mud bank fishery. As the appeared mud bank may shift to another nearby region, the survey field staffs may also shifted accordingly to collect the catch details. After the mud bank ceases, the collected data is entered in computer and estimated separately for each centre of mud bank fishery.



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