SUBMERGENCE OF POOMPUHAR – STUDY BASED ON UNDERWATER EXPLORATIONS AND COASTAL PROCESSES

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Abstract

Poompuhar, a flourishing port in the beginning of Christian era played a major role in maritime activities and cultural expansion in the history of India. Sangam literature vividly describe about its location, habitation and the town planning of Poompuhar. The marine archaeological explorations around Poompuhar brought to light the remains of terracotta ring wells, brick structures, storage jars in the inter tidal zone and brick structures, stone structures, pottery from offshore explorations strongly supports thehabitation sites. There are several references suggesting the shift of shoreline at Poompuhar, which may be one of the reasons of its submergence. The studies on waves were conducted in the region for a period of one year to understand the local phenomena responsible for the coastline changes. The paper deals with the archaeological findings around Poompuhar and the impact coastal process in the shifting of shoreline in the area, which was responsible for the submergence ancient port town and other monuments in the region. The data collected during underwater investigations at Poompuhar and the study of coastal processes are discussed to prove the causes of its submergence.

1.0 INTRODUCTION

The ancient ports of the east and west coast of India have played a dominant role in the transoceanic trade and commerce with Arab countries, Africa, Rome and Southeast Asian countries. The ports located on the Bay of Bengal, namely Tamralipti in West Bengal, Palur in Orissa, Kalingapatnam in Andhra Pradesh and Kaveripattinam in Tamil Nadu are noted not only for brisk maritime trade but also for the spread of Indian culture in foreign land from beginning of the Christian era up to 11th century A.D. Many such port towns that existed on the coastal region got vanished or submerged in the sea may be due to coastal erosion, sea level changes, neotectonic activity etc. Many mythological literatures across the country refer to submergence of prosperous cities. The traditions, like submergence of 'Golden City' Dwarka mentioned in Mahabharata, Sangam literature referring submergence of Poompuhar and popular belief of submergence of Temples off Mahabalipuram, 'Kumari Kandam' traditions of Tamil Nnadu etc. are well known as they are passed on from father to son as a local tradition. It may well be impossible to search their root or find proof as such of these beliefs.

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Nevertheless, many archaeological explorations have been taken up. Though direct specific traditions and mythology have not been found, the artefacts found due to such land excavations in different parts of the country support the presence of habitation.

Poompuhar, also known as Kaveripattinam in Nagai Quaid-e-Milleth district of Tamil Nadu state is situated (Lat. 11^{0} 08' 33" N and Long. 79^{o} 51' 31" E) on the east cost of India (Figure 1). Several texts of Sangam literature (3rd century B.C. to 3rd century AD) such as Cilappadikaram, Pattinappalai and Manimekhalai mention about the important port towns of Tamil Nadu. Texts such as Cilappatikaram, Pattinappalai and later ones including Manimekhalai, Ahananaru and Purannaru vividly describe Poompuhar, the capital port city of the Early Cholas. Cilappadikaram mentions that the city of Poompuhar was spread over an area of 4 Kavatham, approximate to 30 square miles (Damodaran, 1992). The boundaries of the city extended up to Karuvendanathapuram and Kadarankandan on the west, Thirukadav[y]ur on the south, Kalikamur on the north and the Bay of Bengal on the east. About 60,000 families said to have lived in 30 villages in the vicinity of Poompuhar. Cilappadikaram (Pillai: 1989) further mentions the eastern part of Poompuhar was known as Maruvurpakkam, the western part as Pattinapakkam and the central part as Nalangadi.

The Manimekhalai mentions that the Chola king had lost his son and in his great grief he forgot to celebrate the annual Indra festival (Nandakumar, 1989). This enraged the goddess Manimekhalai who caused the city to be swallowed by the sea. Though the reference is only to a supernatural incident, it may be taken as an echo of some actual sea erosion due to high tidal wave/storm surge that engulfed/lashed the city.

The archaeological exploration at Kilaiyur, a part of Kaveripatinam, had yielded square copper coins with the tiger emblem, which was the royal crest of the early Cholas (Soundararajan 1994). Other finds include beads of semi-precious stones and amphora pieces (Rao 1965). The most significant discovery was an I-shaped brick structure, exposed in the ancient channel of Kaveri at Kilaiyur, which is now completely silted up (IAR 1962-63; Rao, 1965; Raman, 1968). This brick structure with a drain for the flow of water and a platform supported by wooden posts for handling cargo, served as a wharf built in the channel of the river Kaveri (IAR 1962-63 p-13) The Radio Carbon 14 date is 316±103 BC of the wharf. A semicircular brick structure exposed in the excavation at Vanagiri, which served as reservoir IAR, 1963 pl.XIV). Excavations at Sampapathi Amman temple revealed terracotta ringwells, which indicates that ancient Poompuhar was extended till Puduppuram on the north and up to Tarangambadi / Tranquebar (Wheeler 1976) on the south.

1.1 Geological Setting

The coastal regions of South Arcot, Tanjore and Ramanathapuram is a marine basin in which the estuarine upper Gondawana beds are overlain, on the sea-ward side, by marine strata extending from the Albian to the Recent. The strata attain a thickness of 2500 to 3000 m near

the coast and must be thicker offshore and in Palk bay (Krishnan, 1968). On the east coast of India, patchy submerged shorelines were found between ± 30 to ±100 m depths, probably formed during the Late Pleistocene – Holocene transgression (Banerjee and Sengupta, 1992).

Sedimentation during the Tertiary period was marked by repeated transgressions and regressions and the Quaternary sediments in the Basin consist of sandstones, pebbly sandstones and clays (Sastry, et. al., 1977). Two rivers join the Bay of Bengal in this area namely Kaveri, on the south of Poompuhar and Palayar on the north of Poompuhar. Apart from these rivers, minor streams join Bay of Bengal in the north of Poompuhar.

The sediments in the near shore area are mostly comprised of a mixture of clay and sand up to a water depth of 10m. Further seaward it changes to sandy. In addition to sands some brickbats and stone blocks were found between 6 and 9 m water depth. The sea bed is observed to have a gradual slope towards offshore. Beach rocks were observed at various water depths between 8 and 15 m for a stretch of more than 20 km between Tranquebar on the south and Kadaikkadu on the north.

2.0 METHODOLOGY

Initially preliminary onshore and initertidal zone explorations were carried out to collect the information on coastal archaeology which provide clues for offshore explorations. The offshore explorations involved both geophysical surveys and underwater diving. The geophysical surveys were carried out with the help of side scan sonar, ecosounder, sub bottom profiler to identify the structures in underwater and marked the area with the help of GPS followed by diving. Airlifting operations have been carried out for underwater excavation to expose the structures and to mark the stratigraphy of the site.

Sediment Transport**:** Shoreline dynamics are due to the underlying coastal processes in the region. The main process directly responsible for shoreline changes being the sediment transport (ST). Majority of the ST is due to wave activity in the nearshore region. The realistic assessment of the sediment transport along the Poompuhar coastline is important since it adjoins the sheltered region of Palk Bay. Any depletion of sediment supply to this region would invariably affect the stability of the northern Tamil Nadu coastline. Directional wave measurements were undertaken at 15 m water depth off Nagapattinam, 30 km south of Poompuhar from March 1995 to February 1996 in order to evaluate the wave climate. The buoy measures and transmits wave height, wave period, mean wave direction apart from other wave parameters. Longshore sediment transport was estimated using the measured coastal parameters.

3.0 RESULTS AND DISCUSSIONS

At Poompuhar a terracotta ring well was exposed about 300 north of Kannagi stature in the intertidal zone at Poompuhar. It has exposed up to 65 cm in a trench measuring 2.5mX2.5m.

It has three courses of 25 cm high, with 4 cm thickness of rim and a diameter of 75 cm.

A brick structure of eleven courses having 1.2 m width, 1.2 m high and 4 m length was exposed at about 200 m south of Kannagi statue at Poompuhar (Fig. 2). The sizes of the bricks are 36x18x6 cm. Compact sticky clay was used as a binding material. This structure is almost parallel to the coast.

Four brick structure were noticed about 60 m from the high water line at 1 m water depth opposite to present Kaveri temple. These structures indicated that they were disturbed walls having 25 m in length, 3.4 m width aligned in a line. The sizes of the bricks are 22x13x6 cm, lime mortar served as binding material.

Three terracotta ring wells were exposed at Vanagiri about 300m south of Yelleyamman temple. The ring well was exposed up to a depth of 65 cm and found to have three courses of 15 cm height each and 6cm thickness at the rim. The diameter of the ring is 75 cm. All the three ring wells are found to have same measurement. Two more ring wells were exposed on the northern side of temple where many rings have washed away. A neatly paved floor of a insitu brick structure probably floor of a house was exposed in a trench during the intertidal excavation (Fig. 3) and a rectangular platform was also recorded on the northern side. The sizes of the bricks are 35x20x5 cm.

The Yellamman temple of Vanagiri dated to approximately to 11 CAD constructed with bricks, stone lintels and pillar, recently collapsed and submerged in the sea (Fig. 4). A terracotta ring well associated megalithic black and red ware and other associated materials were exposed in a trench at beach site near Chinnavanagiri about a km south of Vanagiri. The ring well was surrounded by burnt bricks at 70 cm depth. The rings are 25 cm height with 5 cm rim and the dia of ring is 115 cm (Fig. 5). These indicate retreating shoreline. The other important finds from here are inscribed Brahmi 'Ma' on a potsherd, an early Chola square coin (completely eroded) and the later chola coins, beads of semiprecious stones such as agate, crystal carnelian and varieties of glass and a terracotta beads.

Tranquebar is situated about 15 km south of Poompuhar has the habitation of late Chola period to till day. A temple known as Masalamani of later chola period of 10 CAD is under threat. The sea has almost destroyed more than 50% of the temple (Fig. 6) and is likely to engulf the entire temple in near future. The remains of Dutch fort have been submerged in the sea. The brick wells of Danish period were completely exposed in the inter-tidal zone (Fig. 7). There are also evidences in Tranquebar about the destruction of modern houses due to the encroachment of sea (Sundaresh et al 1997) the coins of Chola, Dutch, Danish period were collected in the inter tidal zone of Tranquebar. The entire Tranquebar was well protected by a fort wall including Masalamani temple and Danseberg museum with a sufficient distance from the shore line as shown in the map prepared by the Danish rulers in mid 17th century (Fig. 8).

Under water explorations were conducted between Tranquebar and Nayakankuppam of a

distance of about 25 km with a small grids at Tranquebar and Poompuhar. Several isolated objects were recorded at a depth of 7-8 m and 11-13 opposite to Masalamani temple (Vora 1987, Rao 1992, Rao 1991) were confirmed by diving as rock boulders. Further south of Tranquebar, sonograms and echograms recorded the extension of submerged river valleys of Nandalar and Uppanar (Rao, 1991). Between Tranquebar and Poompuhar, in the same water depth, several isolated objects were found and confirmed them as beach rocks. Off Poompuhar between the water depths of 5.5 to 10.5m presence of three major sites of interest namely, southern bank of river Cauvery, off Pudukuppam and off Nayakankuppam were observed.

A few dressed stone blocks measuring 90 X 40 X 15 cm, a semi circular stone with a L-shape cut on it's surface and many other irregular blocks of sandstone were noticed in 5 to 8 m water depth off Cauvery mouth (Figure 1). The area is covered with fine black sand. The other findings during airlifting operations are brickbats and early historic pottery of Black and Red ware, Red ware, Buff ware and Grey ware. The stratigraphy of this area is fine black sand, sticky black clay, compact yellow clay and white coarse sand with stone blocks and few potsherds (NIO Technical Report 1995).

The airlifting operations at north of Poompuhar revealed a few dressed stone blocks in three general dimensions (30x20x5 cm, 65x40x10 cm and 60x35x10 cm) including the potsherds of Grey ware, huge storage jars at 1m below the sea bed. The echograms of the Sub-bottom profiler revealed a submerged paleochannel of river Kaveri on the north of Poompuhar at 10 to 15 m water depth, with a width of 300 m to 500 m buried in 20 m below the sea bottom. (Fig. 9)(NIO technical report 1997).

Three objects were identified by geophysical surveys at 22-24 m water depth off Poompuhar (Vora 1987, Rao 1992, Rao 1991) were confirmed by diving. They are lying in north south direction. The first structure was located at a water depth of 23 m about 5 km off shore. It is oval in shape. The total periphery of the object is 140 m. North-south length of object is 40 m and east-west length is 20 m. The object is hollow in the centre. The height of object on the outer edge is 3 m while on the inner side maximum height is 1 m. The height of eastern arm is greater than that of the western arm. The width of arm varies from 3 to 6 m. The centre of the object is covered with sediments and rock patches. On the northern side of the object an open space with rubble was found. Growth of thick marine organisms like oyster shells and gorgonian were observed on the structureAbout 40 m. north of the above object, two smaller objects of the same material were noticed. These two objects are lying in east-west direction with a distance of 10 m. The circumference of each object is not more than 15 m and their height is about 2 m. They have a maximum height in the centre and edges are sloping. There are a number of wide cracks on the objects. A few blocks are 2 m in length 1.5 m in breadth and 1 m in height. A few smaller blocks measure 100 X 60 X 20 cm (NIO Technical report 1995,1997.

During marine archaeological explorations, a large number of ringwells, brick structures, storage jars and brick paved platforms were noticed in the intertidal zone and on the shore some

of them were also exposed. One ringwell was excavated near Chinnavanagiri where habitation site is also preserved. The pottery from the site suggests that the ringwell can be dated to 2nd century BC as one of the potsherds is inscribed in Brahmi 'Ma'. The other ringwells found at Vanagiri and Poompuhar are of the same period. Similar kind of ringwells found at Arikamedu and Vasavasamudram belongs to 2nd Century BC to 3rd Century AD (Rao, et al., 1995). The brick structure exposed near Kannagi Statue can be dated to Sangam period. The size of the bricks used are 36x18x6 cm are closely corresponds to the bricks used in Buddha Vihar at Kaveripattinam.

Underwater exploration in shallow water revealed a few well-dressed stone blocks. One of them is a semicircular in shape along with a number of eroded blocks. This evidence suggests that stones were also used for construction of buildings, but whether they were used for habitation or some other kind of building is still not confirmed. Sangam literature mentions that buildings were constructed of bricks. Airlift operation suggests that habitation site was buried at least 1 m under sediment. Above the habitation site a layer of compact and sticky clay suggests that sedimentation process must have taken a long time. The explorations also suggest that habitation extended north of the present Kaveri River. The ceramic evidences suggest that the habitation belongs to the early Christian era. In the Bay of Bengal the high-energy zone can be considered up to a depth of 8-9 m. As this area is much more disturbed by high waves, currents and tides. It is very difficult to presume that some structures particularly of bricks that were mostly used in Sangam Period would have survived intact in the high-energy zone. It is only the stone structures, which are likely to give a clue to understand the plan.

The U-shaped structure at 23m water depths is a speculation. According to the views of SR Rao, T.C.S. Rao and Tamil literature Scholars at Tamil University, Thanjavur (personal Communications) it may be a man made and probably a Buddhist structure as referred in Sangam literature suppose to be located at the mouth of river Cauvery. This view gets support from the palaeochannel of the river Kaveri that is in the same direction, which can be connected to the wharf found in Kilayur and the structure found at 23 m water depth. Remote sensing studies also suggest that the palaeochannel of river Kaveri is to the north of present Poompuhar (NIO Technical report, 1995).

Coastal processes:

The coastline between Nagapattinam and Poompuhar is almost straight with an inclination of 359° to north as per the published naval hydrographic charts. The coastline is low and the beach material consists of sand sized particles. The sandy beach meets the sea without any prominent rock outcrops or thick vegetation in the foreshore. The beach gradient is gentle to moderate. The variation of monthly beach levels measured near Poompuhar museum indicates that the lowest level occurs in December and the highest level occurs in April. During the study period, the beach was subjected to seasonal changes with erosion during monsoon

and accretion during fair weather. The beach was stable without any significant loss of material over the one-year cycle. It has to be stressed over here that no cyclone has occurred during the period of one-year study. Since there were no cyclones during the measurement period, the data collected provided normal estimates in the region by which the general processes can be understood. From the beach profile studies, it is observed that the coastline of Poompuhar was stable during the one-year study period. This in turn indicates that the sediment transport in the region is balanced. The erosion during the November to February is compensated by the accretion during the rest of the period.

The studies on waves were conducted in the region for a period of one year to understand the local phenomena responsible for the coastline changes. Based on the analysis of the wave records, the significant wave heights persisted between 0.5 and 1 m during March to October, and 1 to 2.1 m from November to February with the higher waves occurring during November. The zero crossing wave period predominantly varied between 3 and 8 s in November and December and between 3 and 5 s during the rest of the year. The wave direction (with respect north) mostly prevailed between 60^o - 120^o during November to February, 90^o - 120^o during the rest of the year. As the region is prone to cyclones, it can be inferred that due to high wave activity during the cyclones, the beach sand either gets deposited offshore or transported away from the vicinity of the region which can not be replenished after the seizure of the cyclone, thereby causing erosion of the coastline.

The measured wave characteristics reduced to breaker zone were used to estimate the longshore sediment transport. From the estimated transport rate, it is seen that the sediment transport is relatively low along the Poompuhar coastline as compared to the rest of Tamilnadu coastline, north of Pondicherry during the study period. The transport rate was large (0.1×10^6 m^3/month) during November - December and low (0.03×10^6 m^3 /month) during March, April and July. The monthly distribution of littoral transport rate indicates that the southwest monsoon waves have less significance effect compared to the northeast monsoon waves. The predominant direction of transport is northerly from March to October and southerly from November to February. Though the annual gross transport is found to be 0.6×10^6 m^3/year, the annual net transport is very low showing less than 0.006×10^6 m^3/year (towards north), indicating the coastline is close to a nodal drift regime. This means that the sediment transport during the non-monsoon period is almost equal to the sediment transport during the monsoon period. The low net sediment transport substantiates the stability of the beach from the beach profile studies.

Nageswararao and Sadakata (1993) have reported the existence of Cauvery river mouth in the present offshore region based on the studies related to strandlines of the Cauvery coast. Mohapatra and Hariprasad (2002) have inferred that the coastline south of Pondichery is receding.

The explorations at Poompuhar and Tranquebar demonstrate that the sea has gradually encroached the land in greater extent since last 2000 years. It is worth mentioning here that

shifting of Kannagi statue about 150 m land ward from its original place after it destroyed by the sea during 1994, was said to have been installed during 1973 about 200 m from the high water line which is a clear indication of advancement of sea (Fig. 10). Similarly other monuments also destroyed in the vicinity by the wave activity.

The erosion on sandy coastlines are due to less sediment supply from the rivers, especially where dams have been built for reservoirs and also due to shifting of river mouths (Bird, 1984). For instance several dams were constructed along the course of river Kaveri for irrigation and hydroelectricity. Hence the influx of sediment to the sea by Kaveri has been reduced to negligible amount resulting in a disturbed natural balance. Subsequently, the sea began to erode the coastline, leading to submergence of several ancient coastal structures of the Poompuhar (Sundaresh et al 1997). The responsible to a possible rise in sea level relative to the land and the possibility of increased storminess in coastal waters, also a long duration storms can erode the beach to a considerable destruction (Caldwell, 1966). The Bay of Bengal is subjected to a large number of high intensity of cyclones compared to west coast of India. Cyclones are short-lived phenomena, capable of causing immense amounts of destruction where they cross the sea and hit the coastline. The cyclones of the east coast are well documented between 1891 – 1970, 42 major cyclones / depressions have been reported from the area. Average bottom currents at 500m depth is around 0.25 m/s with direction parallel to shore towards north. These factors vary in relative importance from sector to sector along sand coastlines. Beach systems are thus dynamic interactions between shore process and coastal sedimentation. (Bird 1985)

Permanent beach loses occur along shores due to an excess of littoral drift leaving a given sector, material lost inland by the tidal actions of inlet and material pulled offshore in to deep water by local storms. The continuing erosion of a beach narrows the beach to where it is extremely vulnerable to severe erosion and wave topping during severe storms (Caldwell, 1966). The narrowness of the eastern continental shelf is also another responsible factor for the coastal erosion. This shelf is less than 50 km wide. Wave propagation over a narrow shelf results in low frictional loss of energy and thus expends much energy on the coastline, causing great coastal erosion. The removal of sand from the beaches results in destabilization and destruction of coastal structures. In some cases the erosion has a local explanation due to the reduction of sand supply from eroding cliffs. Beach systems are thus dynamic interactions between shore process and coastal sedimentation (Bird and Schwartz1985).

The present inclination of coastline at Poompuhar (359° w.r.t north) is found to be sensitively balanced since, any slight increase in approaching wave angles significantly increase the volume and also may alter the direction of sediment transport in this region. The volume of southerly drift during monsoon months, i.e. in November and December is large to nearly balance the northerly-drift taking place in another 8 months, i.e. from March to October. It is found that for the coastal orientation of 360° to north, i.e. 1° shift in the present orientation, the annual net transport would be opposite, in the southerly direction. It is important to notice that

no cyclone had occurred during the study period, which otherwise is common during north-east monsoon. Occurrence of such cyclones would considerably increase the volume of sediment transport towards south within a short spell. It is noticed that for the occurrence of every cyclone, there was a permanent loss of beach due to erosion. Comparison with the Indian Naval hydrographic Charts (Nos. 3006 and 3007) surveyed during 1963 and 1993 indicates that 150 - 200 m wide coastal belt has been eroded during the last 30 years and the erosion is still active along the Nagapattinam - Poompuhar shoreline.

There are specific evidences to indicate that Poompuhar coastline has changed significantly during last 300 years. A study near Tranquebar-Poompuhar indicates remains of a Dutch Fort in Tranquebar now lying in 2-3 m water depth. Based on the original 250 years old map Sundaresh, et. al. (1997) have inferred that shoreline has advanced by about 300 m during last 250 years which in turn, indicates a rapidly advancing shoreline at the rate of 1 m/year. Similarly, the presence of ringwells in the inter-tidal zone confirms retreat of shoreline. The hydrodynamic regime prevailing in the region may be the cause of this severe coastal erosion (Chandramohan, et al, 1997). In view of above it can be said that shoreline has advanced significantly in last 2000 years or so off Poompuhar

It is interesting to note here that a 12th century AD city known as Dunwick in Baltic Sea, Europe, is lying between 5 -16 m water depths as a result of coastal erosion.

Besides these, the recent evidences from west coast of India (Nair et al 1997) and Florida (Locker et al 1996), in the Atlantic indicate episodic and on rapid sea level rise and fall of the sea level. The rates reported of 500 to 1000 years. These findings have now dispelled the notion that sea level is a stable and unchanging datum. The inference drawn from the above is that during a period of rising sea level the zone of erosion shifts landward and during a fall in sea level the zone of erosion shifts seaward, resulting in seaward progradation of land. An example of this is the location of ancient ports at Korkai and Algankulam in south Tamil Nadu coast far inland but which were patently designed and located to be on the shoreline

From the above discussions, it can be attributed that coastal erosion followed by invasion of sea has played a major role in submergence of these structures and sea level changes might have played a contributory role.

4.0 CONCLUSIONS

The archaeological evidences in the intertidal zone and offshore are confirmed that they are belong to Sangam period (3rd Century BC to 3rd Century AD) based on the antiquity. Evidences in the inter-tidal zone, hydrographic charts, and the map of 17th Century at Tranquebar confirm the shoreline advancement. This suggests that about 300m advancement of shoreline occurred in last 300 years at an average rate of one meter per year. If the same rate was continued for the last 2000 years then definitely ancient Poompuhar must have extended

much inside from the present coast. The relative sea level rise has undoubtedly been taking place on coasts where the land margin is subsiding.

The study on waves and sediment movement shows that the Poompuhar coastline is subjected to relatively low volume of transport and the annual net drift is negligibly small. It is seen that the occurrence of prolonged high wave activity due to cyclone, during northeast monsoon may tend to change the annual net transport towards south. Under such circumstances, the large volume of southerly transport is likely to enter into the adjacent Palk Bay and partly deposit as spits/shoals. Large accumulation of sand and emergence of such sand spits/ islands in Palk Bay have been widely reported. As the Palk Bay is well protected for southerly waves, no mechanism is set to transport these deposited material towards north. This phenomenon appears to be the primary reason for the timely depletion of sediment supply to the littoral system and for the intermittent erosion along the Nagapattinam - Poompuhar coastal segment. Such processes would have prevailed right from the historical period, accelerating erosion in Poompuhar coast, which may continue till the coastline take the shape/orientation to balance the littoral drift over an annual cycle. However, certain rate erosion bounds to prevail due to the occurrence of cyclones in this region and the resultant loss of littoral sediments into the Palk Bay.

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Fig. 1. Location Map

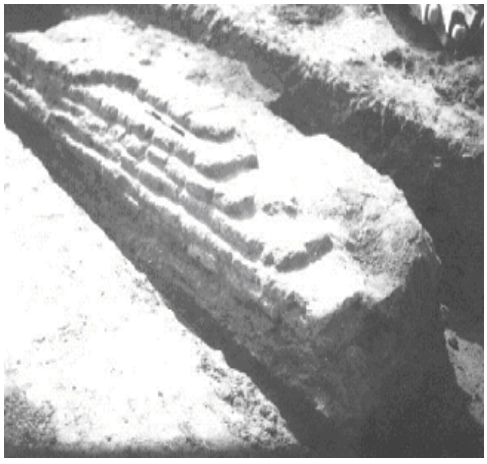

Fig.2. Figure showing the brick structure exposed in the IZ near Kannagi statue at Poompuhar

Fig. 3. Brick paved structure found in the IZ at Vanagiri

Fig. 4. Yelleyamman temple destroyed by the sea at Vanagiri

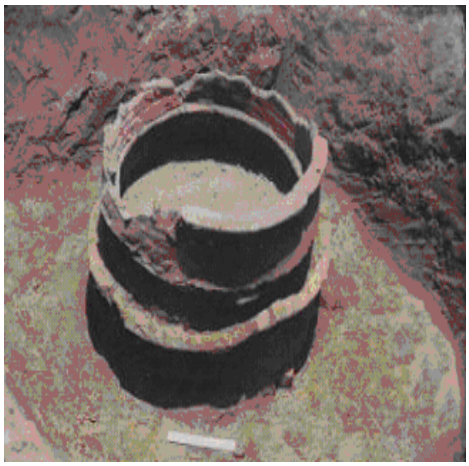

Fig. 5. Terracotta ringwell in the IZ at Chinnavanagiri.

Fig. 6. Masalamani temple at Tranquebar

Fig. 7. Exposed Brick well and Dansburg museum at Tranquebar

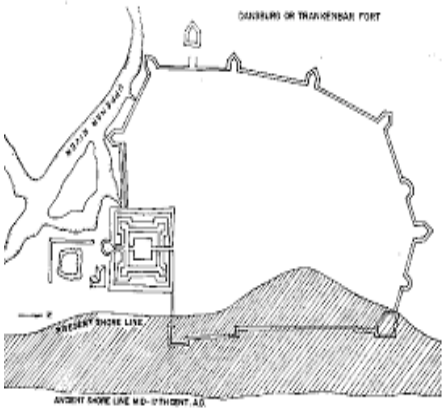

Fig. 8. A 17th Century. Map of Danish fort at Tranquebar

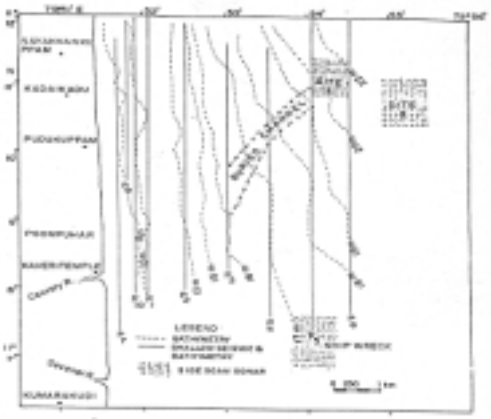

Fig. 9. Figure shows the palaeochannel of river Kaveri. (source NIO Technical report)

Fig.10. Shifting of Kannagi statue due to coastal erosion