ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)

Vol 10, Issue 2, February 2023

Analysis of Geophysical representation of submerged sub surface of historical port Poompuhar - A Case study

[1] Dr.T. Sasilatha, [2]Mr. G Mohendran, [3]Dr.T. Baldwin Immanuel
[4] Mr. Mohammed Fadil H, [5]Mr M Ashok Kumar
[1] Professor and Dean, AMET Deemed to be University, Chennai
[2] Project Associate, AMET Deemed to be University, Chennai
[3] Associate Professor, AMET Deemed to be University, Chennai
[4] Junior Research Fellow, AMET Deemed to be University, Chennai
[5] Project Associate, AMET Deemed to be University, Chennai

Abstract— Ancient ports provide insight on port strategic sites, sea trade, routes, material exchange, and current socioeconomic conditions. Many similar port towns that were along the coast disappeared or were submerged in the sea, most probably as a result of coastal erosion, sea level fluctuations, neo-tectonic activity, and other factors. The present paper deals with offshore exploration of Poompuhar, which was the famous port city of early chola periods of Tamilnadu. The report of bathymetric and sub bottom profile data is got from NIOT, Chennai and is interpreted using ArcGIS software. The main objective of marine archaeological expedition was to understand the geological features and locate submerged structures of Poompuhar. The available evidence confirms the submergence of a vast region or structures. The information gathered at poompuhar sites supports the literary evidence proving their existence as ports. The principal cause of these port cities' submergence was shoreline alterations caused by coastal erosion.

Keywords: bathymetry, sub-bottom profile data, geological features.

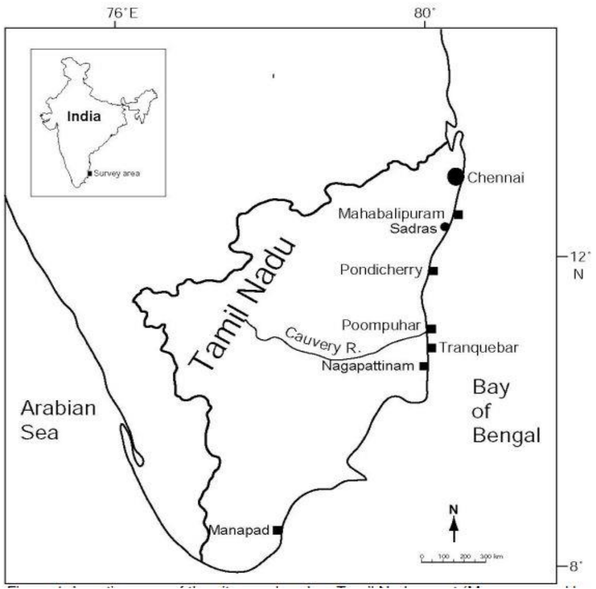
I. INTRODUCTION

Ancient ports are a source of information for understanding port locations, trade, exchange, routes, and present socioeconomic conditions. From the beginning of the Christian period, prominent ports on the Tamil Nadu coast such as Kaveripattinam, Nagapattinam, have played an important role in trade and exchange.

Sangam literature contains several historical reports of marine trade and exchange in the wealthy port town of Poompuhar.It is also referred as the early Cholas culture's capital. Poompuhar was swallowed up by the sea due to the goddess Manimekhalai's wrath for not celebrating the Indra festival. Though the association is purely supernatural, it could be seen as an echo of genuine sea erosion caused by high tidal wave surge(s) that overwhelmed the capital.

II. POOMPUHAR

Poompuhar, also known as Kaveripattinam, is located on the Tamil Nadu coast on the northern bank of the Kaveri River. Poompuhar is vividly described as the port capital of the early Cholas in Sangam scriptures, specifically the Silappatikaram, Pattinapalai, Manimekhalai, and Ahananaru.



The ancient port of poompuhar is not confined to present mouth of cauvery near vanagiri.it extended both northward and south ward along the coast and landward also.

Underwater imaging is an unexplored area and is gaining importance in recent years, due to its increase in the use of naval and civilian applications. It is necessary to continuously monitor the sea floor in many situations, including surveys of coral reefs, the counting and monitoring of marine animals, pipeline maintenance, the detection of underwater mines, shipwrecks, etc. Automated object detection systems based on image processing methods are needed by marine biologists. This is because manual

ISSN (Online) 2456 -1304
International Journal of Science, Engineering and Management (IJSEM)
Vol 10, Issue 2, February 2023

classification is expensive and time-consuming. There are numerous image processing methods available for classifying real-world objects. However, for the following reasons, those techniques might not be appropriate for underwater image processing needs. Images that are captured are blurry, contain very little feature information, frequently have the same intensities for the foreground and background, and fluctuate from image to image in terms of shape, orientation, and size. Artificial intelligence must therefore be used to address all of the aforementioned issues and attain higher categorization accuracy.

Poompuhar, located on the east coast, presents archaeological evidence of a coastal shift. Since 1989, onshore and offshore explorations have uncovered numerous terracotta ring wells, brick structures in the intertidal zone and submerged structures, and early historic pottery in shallow seas. The sea has badly damaged two temples from the 12th-13th centuries AD at Varanagiri and Tranquebar. Coastal erosion has been blamed for the submergence of an old township and the disruption of coastal structures. It is worth noting that the Kannagi monument was put on the shore of Poompuhar approximately 200 metres away from the high watermark in 1973 and was moved about 150 metres inward in 1994 since the structure was destroyed by the sea. Similarly sea has destroyed other monuments too.

Tranquebar also known as Tharangabadi is a one-of-a-kind location that highlights the seaside getaway. A map of Tharangabadi from the mid-17th century, on display in the Dansborg Museum in Tranquebar, displays a detailed plan of the town as well as the then-shoreline. A detailed examination of the map indicates that it was strongly secured by a seaward fort wall, with a Shiva temple sufficiently landward within the fort wall. It is estimated that during the 17th century AD, the seashore was at least 50 metres away from the fort wall, with the temple placed roughly 250-300 metres away. This observation clearly indicates that the shoreline has overstepped roughly 300m in the last 300 years, intruding at a rate of 1 m per year on average.

The archaeological evidence identified in the intertidal zone and offshore was discovered during the Sangam period (3rd century BC to 3rd century AD). The intertidal zone, hydrographic charts, and Tranquebar's 17th century map all show that the shoreline is receding at a rate of one metre per year. If the same rate has been maintained over the last 2000 years, old Poompuhar must have reached the sea far further than the current coastline.

The National Institute of Oceanography in Chennai has conducted marine archaeological explorations at Poompuhar to determine the extent of the submerged evidence on the historic port towns. The underwater explorations produced information about submerged structures as well as data on coastal variations.

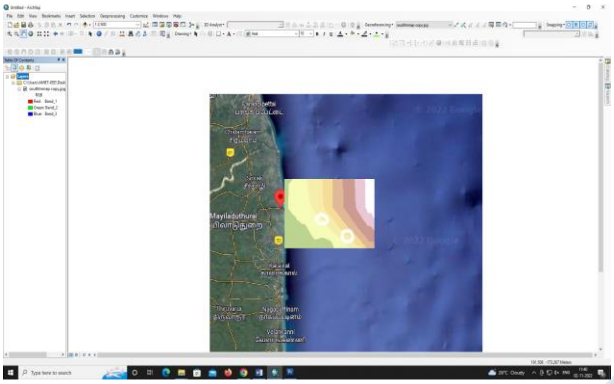
III. METHODOLOGY AND OBSERVATION:

The National Institute of Ocean Technology, Chennai, collected the MBES data that show seabed elevations. The Raw Data received from NIOT is then converted into SGEY Format which is accessible by ARCGIS Software, it is then run into the software with the Mapping of the Coordinates that shows the clear view of geological location of the data that is taken by NIOT. MBES emits sound waves from transducer and receiver gets the signal after it is reflected. Each received sound waves is defined by a triplet (x, y, z), where x and y represent the geographical or projected coordinates on the horizontal plane, and z is the measured depth, respectively. The x, y, and z Data are converted into CSV format which can be plotted in ArcGIS. In mapping the lost/submerged port cities, these submarine geological/geomorphological features are to be mapped.

The location, motion, and depth components of the bathymetric data were then combined and geometrically rectified to create processed x, y, and z data. The data were then modified for outliers, further examined for crossing status in the Subset Editor tool, and ambiguous data points or locations were also assessed. The exported geometrically corrected point data were then referenced to WGS84 & UTN North Zone 45 using an x, y, and z ASCII text file. Using ArcGIS, they were rasterized, the heights of each pixel were recorded, and seabed topographic contours spaced 1 m apart were produced.

By analysing the contour patterns shaded relief images, and the color-coded DEM, the data detected from the MBES-DEM data/contours and the digitally processed outputs, were further interpreted in detail. Using the choices provided by ArcGIS, different colour shades were allocated to different DEM altitudes for colour coding. The colour mapping should vary smoothly from surface to bottom depth of seal level. By this geomorphic mapping can be done easily. Once the mapping has been completed in ArcGIS, it offers a number of features that have colour coding and varied shades attributed to different DEM altitudes.

The ArcGIS 3D analyst module was used to flash a light source over the DEM at two distinct heights and azimuths in order to prepare the shaded relief images using MBES-DEM data. Depending on the elevation of the seabed topography, shadows were produced in the DEM, exaggerating the relief of the seabed and allowing for improved feature interpretation. The data imported in ARCGIS show the level of bed surfaces. From the mapping, we can assume that the landscape is submerged under the sea in and around poompuhar. It is confirmed that the structure is neither a natural or artificial wall constructed to provide protection from waves and storms by its geoposition on the western wave and tide shadow slope region.



Further, we can improve our study by using ROV survey data, and sonar photography which will give a clear image of the scattered structure inside the bottom of our study area Poompuhar, which is believed to be submerged there.

IV. CONCLUSIONS

Marine archaeological explorations off the coast of Tamil Nadu have revealed submerged structural evidence at Poompuhar. The data from underwater has partially supported the traditions concerning the submergence of these port town. These structures may have been drowned as a result of coastal erosion and subsequent shoreline modifications. The excavations at poompuhar suggest that these constructions were drowned as a result of extensive coastal flooding.

REFERENCES

[1] Diningeng Zhao ,Ziyin Wu, Jiequiong Zhou, Kai Zhang, Xiaowen Luo, Mingwei Wang , Yang Liu, Chao Zhu “From 10 m to 11000 m, Automatic Processing Multi-Beam Bathymetric Data Based on PGO Method” published 2021.

[2] EM 124-12 KHz Multibeam Echo Sounder. Accessed: Jul. 5, 2020. [Online]. Available: https://www.kongsberg.com/globalassets/maritime/ km-products/product-documents/em-124-multibeam-echo-sounder.

[3] Pedro V. Teixeira, Michael Kaess, Franz S. Hover, and John J. Leonard “Multibeam Data Processing for Underwater Mapping” Published 2018.

[4] S.Tripati, Gopal Parthiban,Kamlesh H Vora, Sundress,”Lead Ingots from a shipwreck off Poompuhar, Tamilnadu,East coast of India: Evidence for Overseas Trade and their Significance”,Published 2003.

[5] S.Triapti, Sunderesh,AS Gaur “ Marine archealogical explorations in the Kaveripoopatinam regions:Fresh light on the Structural remains”Published 1996.

[6] J. E. H. Clarke, ‘‘Multibeam echosounders,’’ in Submarine Geomorphology, 1st ed., A. Micallef, S. Krastel, and A. Savini, Eds. New York, NY, USA, Springer, 2018, pp. 25–42.

[7] V. Lucieer, Z. Huang, and J. Siwabessy, ‘‘analyzing uncertainty in multibeam bathymetric data and the impact on derived seafloor attributes,’’ Mar. Geodesy, vol. 39, no. 1, pp. 32–52, Jan. 2016.

[8] Arafat Mohmmed M , Palanivel K, Kumanan C.J 3 Saravanavel J. 4 and Ramasamy SM “Geo spatial mapping and 3D Gis based visualization of subsurface structures “ published Jun 2011.

[9] Yet-Chung Chang, Ching-Hui Tsai, and Shu-Kun Hsu, “Generalized XYZ Data editor software for marine geophysical survey” published 2011.

[10] Ramasamy SM, J. Saravanavel. C. J. Kumanan and S. Guansekaran “Coordinates and chronology of the ancient port city of Poompuhar, South India” published 2018.

[11] AS Gaur, Sunderesh “Underwater exploration off Poompuhar and possible causes of its submergence” published 1998.

[12] Laurent Hellequin, Jean-Marc Boucher, Member, IEEE, and Xavier Lurton “Processing of High-Frequency Multibeam Echo Sounder Data for Seafloor Characterization” published vol 28 Jun 2008.

[13] J. E. H. Clarke, ‘‘Optimal use of multibeam technology in the study of shelf morphodynamics,’’ in Sediments, Morphology, and Sedimentary Processes on Continental Shelves: Advances in Technologies, Research, and Applications, 1st ed. Z. L. Michael, R. S. Christopher, and R. H. Philip, Eds. West Sussex, U.K.: Blackwell, 2012, pp. 1–28.

[14] H. K. Farr, ‘‘Multibeam bathymetric sonar: Sea beam and hydro chart,’’ Mar. Geodesy, vol. 4, no. 2, pp. 77–93, Jan. 1980.