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Case Study

Case Study of Underwater Archaeology - Ancient Dwarka, India

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I N F O

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A B S T R A C T

The research study deals with the aspects & methods of underwater archaeology with the help of the study of Dwarka. The method of underwater archaeology is used to locate the lost city of Lord Krishna under the water. The first underwater archaeology excavation was conducted by the Deccan College of Pune in 1979. The speed growth of the discovery of the lost city of Dwarka was done by the great archaeologist Shikaripura Ranganatha Rao (S. R. Rao) with the help of the department of the National Institute of Oceanography (NIO), Goa India. the discovery of structures of lost Dwarka was found during the excavation of Dwarka & Bet Dwarka by the unit of the National Institute of Oceanography. The archaeologist together with divers found various things like stone structures, anchors, poetry etc, the study of the lost city of Dwarka become the best place for the study of underwater archaeology in India. According to the reference to Mahabharat the city of Dwarka sunk after the death of Lord Krishna, the archaeologists try to prove the existence of this legendary city by the methods of underwater archaeology.

Keywords: Underwater, Archaeology, Discipline, Submersibles, Ancient, Dwarka

Introduction

Archaeology as the definition is the study of the past through materials that are left behind by people in the past these can come in a range from small artefacts like stone tools to large buildings like pyramids Archaeologists use these remains to study & understanding all aspects of the past cultures. It means that archaeologists study the remains of the past to understand the beliefs & behaviour of people. The archaeological remains are irreplaceable, particularly for the information on the prehistoric period. The past remains are influenced by the elements of environment & community, archaeology analysis both helps in creating the value of the past. There is a planning system or process of archaeology it includes identifying & defining archaeological remains, sites & areas through this planning system ensures the preservation of archaeology. The registration of sites as archaeological sites are based upon the specific information about the nature & location where past artefacts or remains are found. Archaeology emerged as an inquiry into the past, where questions must be answered by archaeologists. Archaeology's goal seeks to understand human behaviour by understanding the past & present.

In the field of archaeology, there are many types of archaeology or archaeology as a discipline that can be divided into many specialities & some of which overlap like industrial archaeology, water archaeology, ariel archaeology,

etc. In a broader sense, the material remains found before the writing period are considered prehistoric & the material remains found after the advent of written records are generally considered historic, although historical times are given names depending upon the region. Archaeologists tend to specialize in different branches of archaeology some specialized in periods based on the technology of the stone age, bronze age, iron age while some focus on the study in all time periods but of specific regions. The time of prehistoric deals with things before there was the invention of writing. Historical evidence has the ability to an examination of both materials' remains & texts. Archaeology as a discipline has relation with other sciences like environment, natural science & history to have better conduct of gaining information of past cultures. The archaeologists choose to focus on the particular culture that is often associated with geographic factors & chronological factors industrial archaeology deals with the study of buildings & remains that date to the period after the industrial revolution, classical archaeology deals with the civilization affected by the greeks & Romans, Egyptian archaeology deals with the study focuses on Egypt specifically. Others who specialized in aspects like environmental archaeology tend to study the past effects of human behavior & environment on each other in other words it deals with the relationship between the environmental factors that cause human actions & results of the past or studies the geoarchaeology in which it studies the relationship between geology & geological processes & the impacts which show on archaeological interpretations.

Underwater Archaeology

Underwater Archaeology - The study field of underwater archaeology helps in contributing to understanding human interaction with the sea & maritime environment & it also provides a basic understanding of human prehistory & history. However, the potential of underwater archaeology is substantial to our understanding of humanity's relationship with the marine environment & its archaeological remains are unfulfilled. Some of the several challenges or difficulties that come with the aspects of underwater archaeology like when it comes with the study of unresolved conflicts of treasure hunts, a lack of consistent outreach, high coast research, lack of public support, technical difficulty, etc. George F Bass started this sub-discipline of underwater archaeological research.[1] Today, the institute of nautical archaeology (INA) is as the discipline of underwater archaeological research since the beginning of the 1960s & it is associated with George F Bass. He developed the mapping photography excavating & conservation of underwater archaeological sites which helps in revolving our understanding history of ancient maritime. The INA under the direction of Bass continued the projection of excavations & efforts of interpretation of antiquities that are found under the water. The Penn Museum has started this new field of underwater archaeology. George leads a team of archaeologists in 1960 at Cape Gelidonya of Southern Tokyo to excavate an ancient ship. It was the very first time that archaeologists dived underwater, previously only those shipwrecks excavated which were only at land while directed by the divers, they reported what they saw but archaeologists could never dive themselves. It was George who find ways & techniques of land archaeology for archaeologists to excavate underwater sites. This discovery of a new discipline has led in advance knowledge of maritime history.[1] Now underwater archaeology is projected as water heritage.

Underwater Archaeology is the systematic study of past human life culture & activities by using the material remains & other pieces of evidence found under the water or the submerged environment. This evidence exists beneath the fresh (inland) water or beneath the salt water. Its sites may consist of ships(shipwrecks), boats, materials that are dropped like the remains of fish traps, crannogs, piers & wharves. Underwater archaeology also includes the human activity remains, that took place in dry or marshy lands. The term underwater archaeology simply donates that the environment in which human practices are undertaken There are some contemporary definitions of underwater archaeology that overlaps with definitions of Marine archaeology, Maritime archaeology & Nautical Archaeology

- **Marine Archaeology:** is the archaeological study of the material remains created in past by humans that are submerged in water
- **Maritime Archaeology:** it is the study of humans & their interactions with the sea & which can include sites that are not under the water but are related to maritime activities such as lighthouses, ports, etc
- **Nautical Archaeology:** it is the archaeological study of ships & their buildings the maritime archaeology it can include the sites that are not under the water but are related to ships & ship buildings which includes ship burials & shipwreck remains found in terrestrial environments

The aims of underwater archaeology include marine, maritime & nautical archaeology which integrates archaeological data & interpretation that leads to the broader study of human culture. It not only emphasizes the materials found in the submerged sites but also takes into account maritime activities, as two third of our earth is covered with water & human civilization has used its lake, sea, ocean, etc. for trade, transportation & war. To have a complete understanding of the past, archaeologists must include the study of submerged sites or underwater activities for the reconstruction of the past. The study of

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underwater archaeology is relatively a new sub-discipline & it is just passing from a pioneering period that spanned the last of the 20th century. The goal of archaeologists working in this field over the next years will focus on the integration of underwater archaeological data with the wider professional community.

Techniques & Equipment

For people to remain submerged in the water for a long period, they need special equipment. In times of shallow water which is usually less than 40 meters depth then here comes the option of "diving" where divers are supplied with compressed gas such as SCUBA or surface-supplied air, during recent times there are advances in diving technology as here comes the usage of Nitrox or Trimix that helped the divers to dive in water beyond 80 meters depth. Nevertheless, at time of present, the vast oceans of the world are too deep which makes it difficult for divers to carry out diving activities & humans can only able to work in shallow waters. To work in an underwater environment at depth of beyond 100 meters there involves the usage of submarines(Submersibles) or there is an adaptation of the technical diving regime. The usage of submarines increases the opportunity of exploring underwater archaeology. Submersibles allow humans to present on such sites at a depth where diving is impossible like of deep ocean wreck sites of the Titanic. The first conduct of usage of submersibles for underwater archaeological research was during the 1960s- built Asherah, was built for the university of Pennsylvania for the Institute of Nautical Archaeology (INA) to work on the Mediterranean shipwrecks sites under the direction of Dr George F Bass.[1] The military & government-funded bodies like Woods Hole Oceanographic have resulted in the extension of deep-sea exploration into the commercial world as the archaeology of Nautile & Titanic projects demonstrate shallower work tethered diving suits which are less expensive & also allow people to dive in depths without the fear of decompression sickness. They recently updated the new armoured diving suits" Newtsuits" developed between 1979 & 1987 by International Hardsuits. These suits allow the diver to not only dive 1000 feet but also have safety instruments of divers installed inside these suits.[1]

During the period of Indus Valley Civilization there were maritime activities near Somnath & Dwarka of Gujarat because archaeologists during excavation found various types of seal, poetry & artifacts near & under the water. The ships were discovered from underwater sea of Arabian by underwater archaeologists. The first maritime activities were undertaken in Gujarat's Dwarka & Somnath took place between 1997 2007 has discovered many stone anchors & submerged ships. The maritime archaeology tools like aqualung helps in exploration of underwater material remains, which may be defined as study of past seafearing activities. Seafearing are the practice of regular sea traveling & this involves economic & operational activities of sea. The maritime archaeology gives better understanding of sea trade, boat building & navigation especially in India because India is maritime activity country who has evolved her own techniques of ship-boat building, sheltered Harbors, navigation & other infrastructure fascilities. UNESCO also realises the importance of heritage of underwater culture. It becomes an important element of history of people & nations relation. Now more interest are given to the preservation of underwater heritage.[1]

Case Study on Underwater Archaeology- Ancient Dwarka, India

Ancient Dwarka, An Ancient Sea-Sunk City

The word Dwarka is derived from Sanskrit means door & it has become very significant to India because it is related to events of Mahabharata, it gives importance to history, religion & archaeological discovery. The Dwarka was founded by the prince of the Vasudeva Krishna of the yadu clan, according to Sri Bhagwat Geeta the great fortified city of Dwarka was sunk after the death of Lord Krishna. Archaeologists over the centuries have made attempts to find material remains to prove this historic city. The first excavation was done by the Deccan College of Puna & then the Archaeological Survey of India conducted another excavation in 1979, where they found some poetry that was from the second millennium BC. The work of marine archaeology of Dwarka started with the excavation of the present-day temple known as Dwarkadish Temple.

The discovery of Lord Krishna's legendary city of Dwarka was led by an intelligent archaeologist Shikaripura Ranganatha Rao (S. R. Rao) who was the government officer of Marine Archaeology & Oceanography of India with a group of scientists. But even after 30 years of archaeological research, the work of further excavation could not happen because It was very clear that the central government of India was not interested in the excavation of Dwarka & government neglected the objectives of explore report paper thus leading to the blocking of archaeology discovery. until a proposal was submitted in the first decade of the 2000s to the government by the late Dr S. R. Rao. to do an interdisciplinary review analysis on the sea unearthing, this gave rise to new series of questions that stimulate scholars to investigate further. There was breaking news around the world that informed people about the discovery of the submerged city of ancient Dwarka, which was made by archaeologist S. R. Rao. He gave the thinking to conducting an offshore city to find proof of the sunken city of Dwarka. He excavated the inter-tidal zone of Balapur Bay Bay in Bet Dwarka (it is an inhabited island at the mouth of the gulf of Kutch, situated at the offshore town of Okhala & North

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of Dwarka city) where he could find the antiquities but due to lack of funds &mainly due to lack of interest. Even now though the study of Dwarka is still regarded as the best study of underwater archaeology sites.[5]

The Mul Dwarka, a small coastal village near Kodinar of Junagad district is claimed to be the origin of the Ancient Dwarka of epic Mahabharata. The Junagadh hills are in the north & the sea is in the south, where there is a town which is associated to be Dwarka, there is also an ancient temple situated on land that is close to the sea. The temple made up of limestone is not in very good condition & it is also not used for worship. There is also a structure with a height of 4m situated very close to the temple & it is regarded as a lighthouse(Diva Dandi). The exploration over Mul Dwarka reveals that the region has uneven rocky & sandy patches, regarded as major seabed topography observations.[3] The findings of lard Krishna worshipped in Dwarka has been found in 574 A.D in Palitana Plates of Samata Simhaditya, which stated that Dwarka was the seat of Lord Krishna. There is also very clear evidence that mentions Dwarka found in Vishnu Purana & epic chapters of Sri Bhagvat Gita

Methodology- in exploration & excavation of underwater archaeology has various system for targeting, survey, search & fixing the position of objects. We can see how methods are adopted in Indian water by studying the case of Dwarka exploration. Marine archaeology demands good cooperation from other branches of science, humanities, techniques etc, so Marine archaeology is a concept of multi disciplinary.

Survey- first data is collected from available sources, to study Dwarka archaeologists collected data from archival, literary source of Shrimad Bhagwat Geeta & from the oral traditions. This collection of data helps in the formation of an outline map of ancient Dwarka. Then archaeologists prepare a long scale map with the help of topography & hydrographic charts of area. Sextant (an instrument use for sight measuring, it determines the angle & celestial body like sun, moon etc) & compas was used for merely measuring angles between the two objects. With this an observer can sight two objects at same time. The Ariel survey was also used for photographs. The Marine Archaeological Centre of National Institute of Oceanographrt of Goa India requests Ariel Surveys Division of Survey of India for Ariel photography. The black - white, colour & infra red photographs were taken great height. With the help of techniques & method the full fledge survey of Dwarka was conducted.

Excavations & Exploration at Dwarka

To understand the excavation & exploration of Dwarka we need first to understand the geographical location of Dwarka city. Dwarka city is in the western part of the Jamnagar district of Gujrat. Dwarka is one of the harbours of early settlers because it is located near one of the tributaries of the Ganga known as the Gomati River. This Gomati River meets the Arabian Sea in the end, here was built ancient rock surface temples of Indra, Varuna, Syria- Narayana & on the interior there is the famous temple of Lord Krishna. These places of the temple are now called Bet Dwarka, the island of Bet Dwarka is also known as Shankhodhara the place is regarded as the summer resort of lord Krishna. The archaeologists found poetry during the excavation of these temples. The references of Bhagvata & Harivansa claim other places like Mula Dwarka to be the ancient kingdom of Dwarka which is now under the sea. The wonderful archaeologist Dr S. R. Rao excavate the western shore to prove this mythical city was real, at that time marine archaeology was not introduced in India. The archaeologists needed oceanographers of goa & trained them. Professor Alok Tripathi also accompanied Dr S. R. Rao in the excavation of Dwarka. Archaeologists would never believe things unless they can see & touch them. The data provided by the oceanographic department of Goa, divers dive under 30m depth of sea & found a city. The archaeologists also found Mesopotamian seals over Dwarka. The actual excavation of old Dwarka was conducted in a plot manner after the demolishing of the old dilapidated structure over there.[3] Dwarka was the first site in India where marine & underwater archaeology exploration has been conducted. Their excavation & investigation are both continued till today under the sea for more findings about the lost city of Dwarka. The primary data of underwater visual surveys are mainly done by the Scuba diving system. The archaeologists find many artefacts, stone structures & anchors which were detailed in measurements & recordings. Airlifts were used to detect & expose the burial artefacts in a few places. The compass was used in locating the objects of the underwater sea. The exploration of Dwarka has been conducted from onshore to a 20M depth of about 1KM offshore from Samudra Narayana Temple, it is located at the workplace of river Gomati & Arabian Sea.

Navigation Techniques

This helps in formating the routine of ships positions by laying down straight survey tracks. To locate submerged ships the archaeologist use three different navigation systems - Electronic navigation aids which helps in fixing the position of ships, The tri sponder which was manufactured by Del Narete, this technology is easily portable & it uses three station in which one is in survey vessel & other two are in remote area. In this we see that mobile unit send coded pulse remote areas at standard frequency rate then remote areas send back coded pulses back to mobile unit, with this system helps in studying the coastal surveys of wreck & submerged ships & Magnometer, it is an navigation tool & it is widely used in marine archaeology. This tool is more useful in wreck/ site location.

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The Inter Tidal Zone exploration

Inter Tidal Zone is an area where the ocean meets land at low tide above the sea level & underwater at high tide. Here at Dwarka, a large number of scattered blocks were noticed south of Gomoti Creek during the time of low tide. Here archaeologists found two circular structures of a huge size diameter of 2M & height of about 1M, they also found some anchors of various types named composite, ring structure & grapnel stones. The onshore exploration & excavation also found prehistoric poetry which suggests that the lost city of Dwarka could be found further seaward.[3]

Off-Shore Exploration

The exploration was taken off between 21 December to 26 December 1984, within the seaward of approx 400M range of the Samudra Narayana Temple(Temple of Sea God). It is marked as the landmark of ancient Dwarka. exploration conducted in & around this area is considered the 3rd site as Mul Dwarka from where artefacts are found under the Arabian Sea. The topography of shallow water consists of rock & dense forest & the topography of 200M beyond the depth of water is sandy & has rock boulders without vegetation. The documentation of underwater like videography, photography, drawing, etc, can only be possible through diving. Archaeologists use two types of methodology in their exploration of Dwarka- first SDDE (Surface Demand Diving Equipment), which permits divers to cover long shallow areas underwater without running short of air. The dividers also use the underwater scooter Aquazzepp) to explore the sites of more desired depth areas. second - SCUBA (Self-Contained Underwater Breathing Apparatus) this method came later than the method of SDDE. this allows divers to dive without any severe hindrances, this system is very useful for archaeologists to have underwater surveys especially when they use underwater scooters & they are also able to operate cameras in underwater sites.[1] The divers use the SDDE method to carry out this exploration of Dwarka. divers also measure the submerged blocks of ancient Dwarka. The artifacts which were found during exploration helped in determining the period & culture. The artifacts like seals, inscriptions, anchors etc were found & they are dated 1500 BC. the Dwarka falls in such a zone that it is not much affected by waves & currents, the city plan of Dwarka has been ascertained within the area of 1x0.5 KM has been explored so far. The technique of eco-sounding was also used, a technique which use to discover an object underwater by sending pressure in waves & record the sound of echo returns. In this system of eco-sounding the sound travels through water at a constant speed. this technique is carried out around the Sandra Narayan Temple between the water depth of 4M to 20M to obtain a profile of sea bead & after that diving operations were done. Each dive covers a circular area of radius 50M.

The findings of offshore excavation are divided into two locations- A & B(Fig 1) the location Ais around the opposite Gomati River & on the southern side of Samudranarayan Temple. This area is densely covered by seaweeds & vegetation. The archaeologists noticed a large number of stone blocks & many of them were found buried in sediments. location B is located on the western side of Location B, the exploration & excavation helps in noticing a large number of anchors of various types & sizes for the first time during the period 2000 to 2001. Before this the area was covered by sand.[1]

Results of Exploration

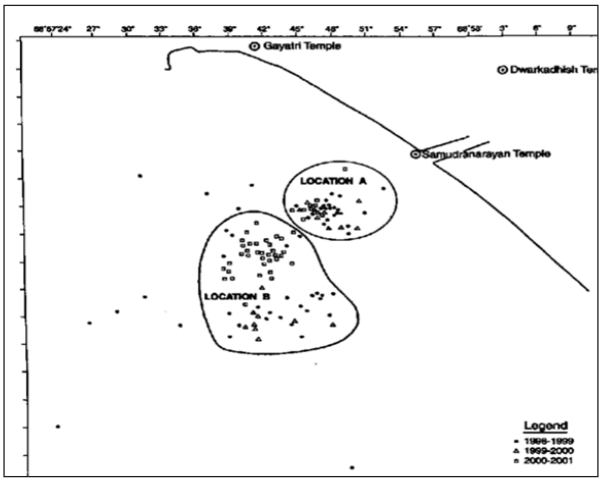

Figure 1.based on archaeological findings entire area devide in two locations- A & B[2]

The archaeological exploration in Dwarka resulted in finding various different types of stone anchors. There is brief description on this stone anchors:

- **Composite Type:** they are the anchors of thin limestone & are of triangular shape. These anchors often have three holes, a circular upper hole & two are of lower ones which are either of rectangular or square shape. The biggest anchor of this type has the maximum length of 1.8m with its maximum width is 86 cm & weight is of approx 496kg. Archaeologist also found anchors of more than three holes. Archaeologist found approx 34 of this type of stone anchor & they are grouped together in this
- **Grapnel Type:** Archaeologist retrieve of 63 of such anchors from Dwarka water. Most of them are made up of local limestone & few are found which are made up of basalt rock. They are often cut from a long prismatic block. This type of anchor has an upper hole & two lower holes which are cut in form of square or rectangular shape. These types of anchors are termed as Indo-Arabian type because it is believed that this type of anchor has been introduced by Arabian navigators & they are used in Indian Ocean

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- **Ring-Stone Type:** this stone anchors were scattered in inter tidal zone of 16m depth water. They are in circular form with an axial hole, its base is flat with top has semi circular form rising at certain height. Many ring stone anchor are exposed around the seabed but they partially buried in sediments[1]

Discussion

the findings of archaeological exploration over Dwarka are discussed here, the present exploration was conducted in an area of 225 x 275M in 4-6M depth. the reports show that structures are scattered only those structures which are made up of gypsum are in intact condition even after falling. Some of the structures were discovered by Dr Rao during his exploration in 1987, 1990 & 1999. the structures or artefacts found in Dwarka are from the prehistoric to historic period as archaeologists also found some artefacts from the Harappan period. There were some submerged artefacts which were directed around the survey exploration of 1889 - 90, now they are buried under the sand. some of the artefacts are now lost or are in destructible condition because of the fury of the sea. the excavation at Dwarka states that the site was twice submerged in the sea. Mr Rajan, an archaeologist diver & Mr Sirsath a photographer together discover a massive rubble wall in the area of the lowest tide near Samudranarayana Temple

Conclusion

According to legend Ancient Dwarka city is famously known as Swarn Nagri. It is also known as Dvaravati which means: door to enternal bliss. The Dwarka city is rich in both aspects of its history & culture. The region of Bet Dwarka has suffered repeated effects of cyclones. The Gujral coast is associated with several creeks & seasonal river which helps in promotion of safe harbors & it is also rich in marine resources which accommodates major economic sector. Marine archaeology has been conducted not only in Dwarka & Bet Dwarka(situated in okhamandal & entrance of Gulf of Kachchh) but also in areas like in Miyani, Visawada, Somnath, Kodimar etc. Dwarka was the first site where marine archaeology exploration took place & it is continued for almost two decades from which various artifacts were discovered especially during the exploration of inter tidal zone of between 3m to 16m. The underwater exploration was conducted near Bet Dwarka which resulted in findings of various artifacts.

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