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A historical evaluation of shipbuilding heritage in the Bengal region: A geographical perspective

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ABSTRACT

Shipbuilding is an ancient art of many hundred years in the Bengal region. The rich history of shipbuilding has started with wooden boats used as modes of transportation and reflections of relationships in Ancient India. The principal aim and objective of this study was to look up the history of shipbuilding in the Bengal region. To achieve the aim and objective the history was split into three broad periods: pre-colonization, colonial, and post-colonial. Besides, this study looked at the rise and fall of shipbuilding from the initial to present, as well as the national and international importance of the Bay of Bengal region. This study had performed through secondary data that were collected from various secondary data sources e.g., literature, books, research article, newspaper, online archives, and performed the 'content analysis' method to define the brief history of the shipbuilding heritage Bengal region. The shipbuilding history in the Bengal region began with wooden boats in the ancient period when the ship was the primary mode of communication and transportation for natives. During the colonial time, the local shipbuilding underwent a turning point as technological advancements from the western world like the steam engine. However, during the post-colonial period, the shipbuilding sector saw noteworthy improvement, which was followed by a strong boost led by private entrepreneurs. At present, due to some noteworthy advantages over 200 shipbuilding companies have operated in Bangladesh, with the majority of them centered in Dhaka, Chittagong, Narayanganj, Barisal, and Khulna. This region had a strong history of shipbuilding, as well as a high potential for future market expansion. A concerted effort by both government agencies and private businesses is the only way to gain a foothold in the worldwide market. To attract Foreign Direct Investment (FDI) in this industry, proper standardization and long-term planning are required.

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1. Introduction.

Shipbuilding is defined as the construction of all types of marine vessels, including naval vessels, bulk carriers, cruise ships, tankers, and small offshore vessels. The operation of shipbuilding is typically conducted in an advanced facility designated as the shipyard (Van Schendel, 2020). The world shipbuilding history is possibly started during the ice age era when modern humans arrived on Borneo by sea 2500 years ago (Davids and Schippers, 2008). Almost all the ancient cultures and civilizations have begun at the riverbank or seaside, and boats are one of the primitive inventions by them (Broadside, 1996; Hossain, 2010). The modern shipbuilding industry was developed around the world after the second world war (Davids and Schippers, 2008). During the 1960s to 1980s, Japan established itself as the number one shipbuilding country by providing the majority of the oil carrier fleets around the world (Hossain, 2010). Consequently, the world shipbuilding market shifted eastward. China, South Korea, and Japan dominate shipbuilding world-

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wide past the 2000s (Collins and Grubb, 2008).

As a shipbuilding nation since ancient times, the Bengal region has a glorious past and heritage (Zakaria et al., 2010b). In the very early days of the Egyptian and Greco-Roman empires, shipbuilding in Bengal was liberated (Unger, 2013). Between the 15th and 17th centuries, the Bengal region was dominated as a central hub of the construction of ocean-going vessels in Asia (Berthet, 2020; Kimura, 2019). Ibne Batuta, a Moroccan traveler, sailed back in the 14th century with a timber ship constructed in Bengal (Hasan et al., 2017; Rahman, 2017). Chittagong's shipyards were used in the 17th century to build ships for the Sultan of Turkey (Berthet, 2015). Chittagong was designated as the 'Porte Grande' (the front door) by the Portuguese to establish a new reconciliation (Polo´nia and Oliveira, 2019; Ray, 2011). Many warships were also constructed by the Royal Navy in Chittagong and some of these were also used in the Battle of Trafalgar in 1805 AC (Bari, 2010; Zakaria, 2012). For its design, speed, durability, and artfulness, the wooden ship designed in Bengal was internationally renowned. After meeting local demands, these vessels were also exported, in particular for the use of overseas trade and sea battles by European countries (Charney, 2019). The primitive shipbuilding industry emerged in Bangladesh in the mid-1950s and has achieved tremendous headway and endeared with international buyers (Hasan et al., 2017). The shipbuilding industry was characterized by several state-owned companies in the Pakistan period and most of which operate in the river-side cities, e.g., Khulna, Dhaka, Narayangonj, Chittagong, and Barisal (Hasan et al., 2017; Islam, 2018). After the independence, to regulate water transport and shipbuilding activities, a specific legislative authority i.e., the Department of Shipping (DoS) was established in 1976. At the same time, the Inland Shipping Ordinance (ISO) was enforced which was the first legal instrument in the country, and in 1983, the Bangladesh Merchant Shipping Ordinance (BMSO) entered into operation (Kimura, 2019). In the meantime, the shipbuilding industry has incessantly broadened in the building of different categories of inland water vessels (e.g., ferry, cargo vessel, passenger vessel, fishing fleet), i.e., mostly contributing to the domestic need (Zahid et al., 2019). In this maritime-terrestrial scenario, boat technology and culture provide perspectives for a better assessment of Chittagong's communication and trade trends, where shipbuilding and navigation were serving as modes of transportation and reflections of interactions (Berthet, 2015).

The history of world shipbuilding is documented in numerous publications. Bengal had a long history of overseas trade (Hamilton, 1930). Several studies have shown that the shipbuilding industry is first started by which country and who dominated the world shipbuilding market from past to present. In addition, the general history of shipbuilding in the Bengal region and the past and present status of specific shipbuilding companies in Bangladesh have been documented in several studies. However, there is not any particular study to gather the exact shipbuilding history within the Bengal region. This study aims to fill the gap by analyzing the historical secondary data followed by a field study investigating the past as well as the challenge and prospects for the future of shipbuilding in the Bengal region. The present study has addressed the shipbuilding heritage in the Bengal region detailing the historic presence and evaluation of the shipbuilding in this region. This study also covers the contribution of shipbuilding, the importance of different shipbuilding regions, and finally, provides the recommendation for conservation of the shipbuilding heritage in the Bengal region. This form of analytical research can be used significantly in many sectors to conserve the shipbuilding heritage in the Bengal region as well as to establish and enhance the shipbuilding environment. In a different study, the shipbuilding history in the Bengal region is narrowly mentioned, covering mostly the situations after liberation. The present study attempted to lock back at the past, starting from the pre-colonization up to today.

2. Context of the study.

Regardless of the long-standing prominent position of Bangladesh in the shipbuilding sector, the possibility of a shipbuilding industry has only been revealed for a decade (Siddique et al., 2019). This initiation was led by a few shipbuilding companies who have proven efficiencies by building a few ocean-going ships for foreign buyers (Zahid et al., 2019). As a nation in the Bay of Bengal (BoB), Bangladesh has a lot of potential in the shipbuilding industry, not only for the domestic economy but also for overseas markets (Hasan et al., 2017; Islam, 2018). Consequently, local ships begin to be exported in recent years (Azam et al., 2015). With 12 nautical miles of territorial sea and 700 rivers flowing from surrounding 15000 miles of inland waterways (Zahid et al., 2019), water transport plays an important role in Bangladesh's economic growth (Azam et al., 2015). According to recent statistics, more than 10,000 inland and coastal ships carry about 90% of the total oil product, 70% of cargo, and 35% of passengers across the region (Iqbal et al., 2010; Zahid et al., 2019). Most of the inland ships are built and repaired in local shipyards due to the prevailing amenities. The majority of the domestic shipyards have the capacity to design and manufacture ships up to 3500 deadweights (DWT) that meet local market requirements. Further, recently, few local shipyards have fulfilled the capacity to manufacture 10000 DWT ships (Iqbal et al., 2010). In 2008, when a 2,900 DWT ocean-going ship was exported from Bangladesh, the Bangladesh shipbuilding industry received a boost (Hasan et al., 2017). The first export was to Denmark by Ananda shipyard, competing with giant rivals such as China, India, and Vietnam (Zahid et al., 2019). Following that, during the last decade, Bangladesh has also exported ships to Mozambique, Germany, Netherlands, and Finland to proclaim herself as a shipbuilding nation (Saki et al., 2019).

In Bangladesh, there are more than 200 shipyards and marine workshops currently in operation. Among them, approximately 70% are operated on the side of the Buriganga, Shitalakha, and Meghna River Bank, i.e., in and around Dhaka and Narayanganj district. 20% of shipyards are situated on the side of the Karnapuli river in Chittagong Division, 6% are in the Khulna Division along with the Poshur riverbank, and rest 4% are in the Barisal division (Hossain et al., 2016; Iqbal

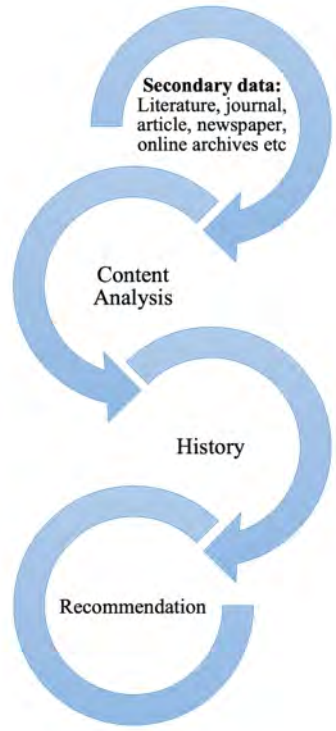
et al.,2010; Zakaria et al., 2010b). These shipyards and marine workshops are building different vessels such as fast patrol boats, dredging barges, passenger vessels, landing crafts, tugs, supply barges, deck loading barges, speed boats, cargo coasters, troop-carrying vessels, pilot boats, pontoons, and water taxis (Hossain and Zakaria, 2008). After covering the domestic business requirements, Bangladesh's shipbuilding sector has additional capacity to serve the international market (Thiede and Thiede, 2015). STX of France, Fincantieri of Italy, China's shipbuilding and an offshore company, Damen shipyards of the Netherlands, and Daewoo of South Korea have already expressed enthusiasm for the construction of their vessels from Bangladesh (Siddique et al., 2019; Thiede and Thiede, 2015). After the liberation, the Narayanganj Dockyard & Engineering Works (NDEW) (Siddique et al., 2019) was tasked with building five small patrol boats. Khulna Shipyard (KSY) was tasked with building and rehabilitating as many commercial vessels as possible (Bari, 2010). The results were significant and KSY built and/or rehabilitate vessels in various categories namely the multipurpose vessel, swift patrol boat, container vessel, freight vessel, tanker, dredging barge, ro-ro ferry, passenger vessel, landing craft, tourist ship, tug, supply barge, deck loading barge, pleasure craft/yacht, crane boat, speed boat, deep-sea trawler, self- propelled barge, inspection vessel, cargo coaster, troops carrying vessel double-decker passenger vessel, hydrographic survey boat, pilot boat, hospital ship, water taxi, pontoon, etc. (Zakaria et al., 2010a). Besides, most of the inland ships are built and repaired in local shipyards due to the prevailing amenities. The majority of the domestic shipyards can design and manufacture ships up to 3500 deadweights (DWT) that meet local market requirements. Bangladesh has exported 44 ships to 14 countries since its liberation and received USD 170 million in revenue (Iqbal et al., 2010; Rabbi and Rahman, 2017; Thiede and Thiede, 2015; WMSL, 2018). While Chattogram Dry Dock Ltd (CDDL) is considering strategies to build warships, Khulna shipyard Ltd is already ahead to build large petrol craft and petrol craft (Mahmud, 2021). The Workboat World acknowledges the high-tech offshore patrol vessel 'Doria' as the 'Best Big Petrol Boat Build in 2017' based on its unique construction and efficiency (Mathew, 2017; Wade and Tana, 2012). Chittagong based Western Marine Shipyard Ltd (WMSL) constructed this vessel for the Kenyan govt. In addition, in recent days, Bangladesh is also constructing environment friendly Tanker and LNG vessels that comply with international maritime standards (Zahid et al., 2019).

3. Methodology.

This study has been completed through secondary data to achieve the research objectives. Since the research context is related to history, various secondary data sources e.g., pieces of literature, books, research article, newspaper, and online archives have been reviewed to define the brief history of shipbuilding heritage within the Bay of Bengal (BoB) territory. Figure 1 shows an overview of the research method for this study.

In the first phase of this study, various kinds of literature have been reviewed. Besides, the researchers have been to libraries to search for relevant historical data from old newspapers and other archives. Finally, digital archives containing relevant data have been analyzed to enrich the secondary data sources. All these data have been analyzed using the 'content analysis method'.

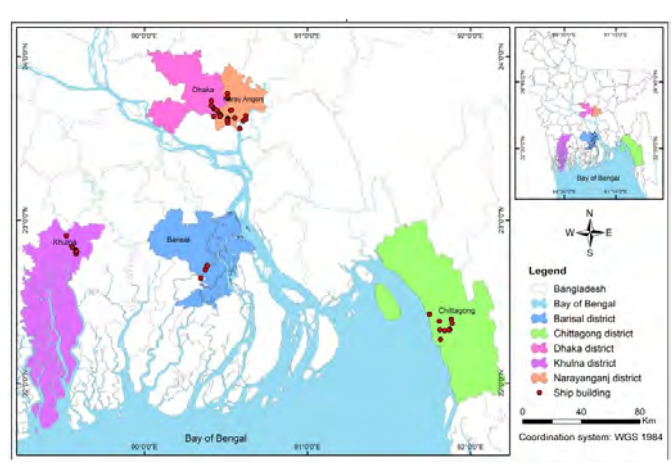
Figure 1: Research method.



Source: Authors.

At present, there are five major shipbuilding regions in Bangladesh namely Dhaka, Narayanganj, Chittagong, Khulna, and Barisal. Figure 2 has demonstrated the major shipbuilding regions, which are mostly on the riverbank in these areas.

Figure 2: Map of major shipbuilding regions in Bangladesh.



Source: Authors.

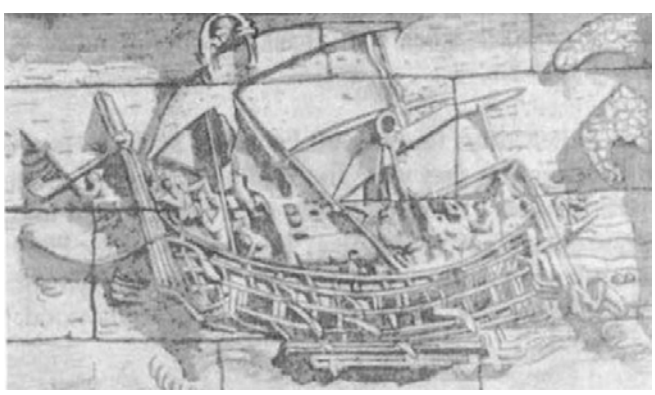
4. The History of Shipbuilding in the Bengal Region.

Shipbuilding is not a new industry in the BoB region. The shipbuilding heritage in this region can be found back in ancient days, even up to the period of Before Christ (BC). The shipbuilding heritage of the BoB region has been distributed into four-time segments namely the ancient time, the middle age, the colonial age, and, the modern era that have been described in two segments e.g., Pakistan rule in Bengal and modern Bangladesh.

4.1. Ancient time (326 BC – 1204 AD.

Boatmaking and shipbuilding industries were found in India since ancient times. In ancient India, three widely separated regions had been developed as shipbuilding hubs due to geographical influence. These were Bengal, the Indus valley and delta, and Tamilagam-the extreme south of the Deccan peninsula. On the East coast and the Coromandel coast, in particular, the shipbuilding activities were fantastic. Like the Mahavamsa, the Pali Books of Srilanka refer to oceangoing vessels carrying 700 passengers. Without a strong fleet, such regular intercourse and colonization through the ages could not have been achieved.

Figure 3: Pencil rendering of the boat in the ancient period.



Source: Christie, 1957.

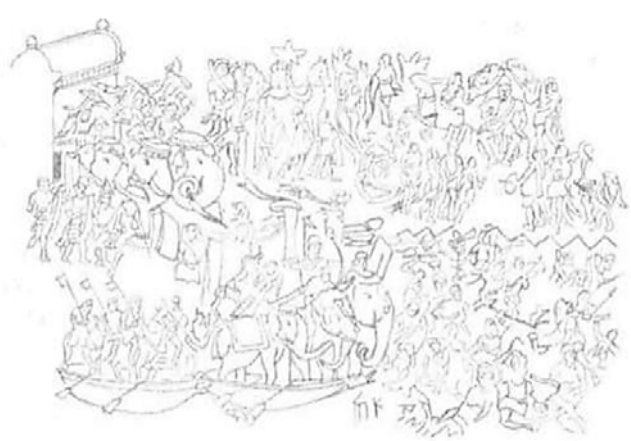
Examples of ships as a war force are not rare in philosophy. In the Vedic period, the sea was frequently used for trade purposes. The boats and ships were frequently mentioned by Rig Veda. The classical example frequently cited by any author on this subject is Bhujya's naval expedition, sent by his father with a ship of hundred oars. He was rescued by the twin Asvins in their boats when the ship sank (Suhrawardi, 2015). In the Shanti Parvan of the Mahabharata, the navy was mentioned as one of the parts of the complete army. When Vidura sensed danger to Kunti's five sons, he made them escape to the forest with their mother, crossing the Ganges in a boat equipped with weapons and having the power of withstanding wind and wave. The Amarakosa lists a variety of nautical words describing the ship: anchorage (naubandhana); ship's helm (naukara); and ship's helmsman (naukarana); (naukaranadhara). From the significant word navatakseni, occurring in a copper plate grant of Dharmaditya dated 531 AD, it could be inferred that there were shipbuilding yards in different parts.

Figure 4: Pencil rendering of the Naukarana boat in the ancient period.

Source: Christie, 1957.

In the Manusamhita, when the theatre of hostilities was abundant in water, it was laid down that boats should be used for military purposes. Manavadharmasastra relates to sea wars and testifies to the use of ships for naval warfare. As eminently suited for naval warfare, Yukti- Kalpataru specifies one class of ships called agramandira (because they had their cabins against the prows). It is found that the Raghuvamsa frequently refer to boats and ships, moving on to other literary evidence. Raghu conquered Bengal in the course of his Digvijaya, which was protected by a fleet (nausadhanotyatan). There are many references of using ships and vessels in the Puranas. The Purana of Markandey talks of boats rolling around at sea. In pursuit of pearls and oysters, the Varahapurana refers to the people who sailed deep into the ocean. The ships drifted every day in deep, fearful seas, in the oceans shoreless.

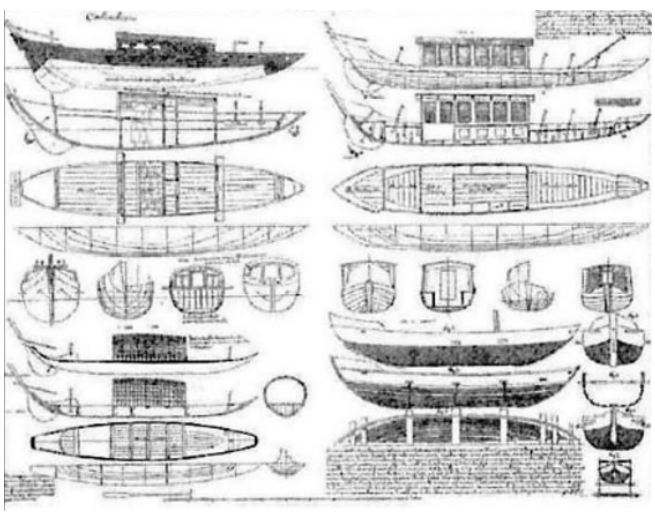
Figure 5: Pencil rendering of ships landing of Prince Vijaya in Srilanka at 543 B.C.



Source: Christie, 1957.

However, in the later novel, the 'Bhoja Yuktikalpataru,' there were three kinds of ships: Sarvamandira, Madhyamandira, and Agramandira. Sarvamandira was named the first because it had apartments all over. The Sarvamandira used to bear treasures, birds, and court ladies. This was the vessel ordinarily used in times of calm by kings. The Madhyamandira (Middle- heart) was so called because the living quarters were situated in the middle. It was a sports vessel and used in the rainy season in general. The vessel of the third kind, the Agramandira, took its name from the circumstance that the living room was located in the front or at the top of the vessel. The Agramandira was for distant and perilous voyages and the sea fights. There are also other references to ships in 'Yuktikalpataru'. There are twenty-seven types of ships listed here, with the largest measuring 276 ft*36 ft*27 ft and weighing approximately 2300 tons.

Figure 6: Some of Bengal boat drawings.



Source: Suhrawardi, 2015.

It can be inferred that ships were engaged in warfare at least as early as the Rig Vedic period in ancient India. The fact that there was a naval department in the Mauryan era is indisputable. A considerable shipbuilding activity was evident on the West coast of India, also as noted in Sangam works of the Tamils. Yavana ships laden with articles of Merchandise visited the West coast frequently. The Sangam classic point to the profession of pearl diving and sea fisheries on a large scale. It is already known that the shipwrecks of the early Tamils were saved now and then by Manimekhalai, the goddess of the sea. According to the 'Rajavali', Vijaya was a prince of North India, who was banished from the Kingdom by his father. Passing through the Southern Magadha country he sailed to current Srilanka; in a fleet carrying more than 700 soldiers, defeated the Yaksas, and settled there permanently. Numerous ships carried the troops of Rajendra to Sri Vijaya and its dependencies which he conquered. This story is illustrated in the Ajanta Frescoes.

It is evident from di*ff*erent records that Indian shipping had grown very much in the first century AD. In ancient times Indian shipping sailed to Malaya, East Africa, and the Persian Gulf beyond which they could not continue owing to the constraints imposed by the Arabs. We have the description of Hiuen Tsang coming later, who noticed a fleet of 3000 ships belonging to the king of Assam. The famous Venetian traveler Marco Polo stayed in this harbor while visiting India in the thirteenth century. Friar Odoric of Pordenone, an Italian monk who visited India in the fourteenth century, refers to ships carrying 700 people in the script of his voyage across the Indian ocean. From the time of the Agathareids (171 BC) to the sixteenth century, great-sized vessels were designed according to Dr Vincent India built. No wonder, then, that the Portuguese were taken away by excellent Indian boats when they first landed on the West coast. In addition to mathematics and astronomy, India has excellent cloth, metal and paint manufacturing skills that brought the Portuguese here.

Figure 7: Carvings depicting a gracefully shaped passenger boat.

Source: Suhrawardi, 2015.

According to Herodotus, Darius launched a maritime expedition under the Skylax of Caryanda to the Indus Delta around 517 BC, and it has been mentioned again during Alexander's time about the citizens of Punjab fitting out a fleet. Besides, Arrian's testimony shows that one of the Punjab tribes, the Xathroi (Kshatri), provided Alexender with thirty oared galleys and transport vessels constructed by them during his return journey (Rapson et al., 1922; Suhrawardi, 2015). Northern European ships started to be designed with a straight sternpost sometime around the 12th century, allowing the mounting of a rudder, which was much more robust than a steering oar kept over the side. Shipbuilding prospered in the Islamic world in Basra and Alexandria, the dhow, felucca, baghlah, and sambuk were examples of prosperous maritime trade across the Indian Ocean; during the Abbasid period (750-1258) from the ports of East Africa to Southeast Asia and the ports of Sindh and Hind (India). From the year 1000-1300, sea routes were increasingly taken place rather than land routes and during that period the needle compass was soon distributed across Southeast Asia and India by Chinese sailors (Suhrawardi, 2015). It is said that during the time of Alexender's return voyage, an autonomous tribe living on the Indus supplied thirty oared galleys as transport vessels constructed by them. There was an abundance of timbers fit

for building ships in the neighboring mountains, allowing Alexender to create the famous flotilla that sailed under Nearchus' command down the Indus (Suhrawardi, 2015). According to the Arrian (Arrianus, 86-160 AD), this fleet consisted of 800 vessels in number; around 1000 vessels according to Curtius (Rufus, 41-54 AD) and Diodorus (Siculus, 30 BC). According to Ptolemy (Ptolemy, 90-168 AD), 8000 troops, several thousand horses, and large quantities of supplies could be accommodated on this fleet. This huge fleet was made entirely of Indian wood and designed by Indian shipbuilders. Pliny refers to an interesting navigational overview. Among other items, excavations at Mohenjo-Daro on the Indus yielded a potsherd and a pair of steatite seals, each bearing a depiction of a ship or a ship incised on it. The discovery of a dockyard at Lothal in Gujrat provides the most substantial evidence by far.

4.2. The Middle Age (1204 AD - 1757 AD).

In 1204, Nadia was unexpectedly attacked by Bakhtiyar Khalji, and King Lakhsman Sena and his family secretly fled through the back door barefoot and went by boat to Bikrampur of Munshiganj district of East Bengal and took shelter there (Muhammad Selim, 2019). Between 1221 and 1295, the travel records of Marco Polo provided Europeans with their first knowledge about India, especially about India's eastern coast (Suhrawardi, 2015). Back in the 14th century, Moroccan traveller, Ibne Batuta sailed on a timber ship and reached the Bengal. In 1368, under the command of Admiral Zheng He (1371-1433, also known as Cheng Ho), who went into the mouth of the Persian Gulf, the Chinese Ming dynasty attempted to conquer the Indian Ocean. It is also assumed that he landed in a part of Bengal-what is today's Bangladesh-around 1413 to 1415 (Suhrawardi, 2015). Vasco da Gama arrived in Calicut in May 1498, under the direction of an Arab navigator.

Through Islamization, Cambay's main port as well as the other eastern ports of Bengal became Islam's stronghold, hosting large settlements of Muslim merchants. European traveler Caesar Frederick recorded that during the mid-15th century, Chittagong was a shipbuilding center (Rahman, 2017). When Babur established the Mughal rule in India in 1526, the Portuguese fleet was already operating in India (Hossain and Zakaria, 2008; Suhrawardi, 2015). A naval engagement in Bombay harbor in 1529 resulted in the Mughals' full occupation of the harbor by the year 1534. Emperor Akbar founded the Mughal navy. To look after the sea and riverine navigation, he founded the imperial naval department named 'Nawara'. There were only warships used in the rivers to support the land forces in many campaigns before the Mughal rules (Suhrawardi, 2015).

During the fourteenth century, passing through ports of Kozhikode, and Srilanka, Malaccan items were exported for trading in India. From there, they were transported westward to Hormuz in the Persian Gulf and Jeddah in the Red Sea, through the ports of Arabia to the near east, and often to East Africa, for many purposes, including burial cremations. As entry ports to India and China, the Abbasid used Alexandria, Damietta, Aden, and Siraf. Merchants coming from India to the port city of Aden paid tribute to Ibn Ziyad, the Sultan of Yemen, in the form of musk, camphor, ambergris, and sandalwood (Suhrawardi, 2015).

Between the 15th and 17th centuries, the Bengal coast was the base of Asia for constructing oceangoing vessels. Chittagong shipyards were used to build ships for the Sultan of Turkey in the 17th century (Zakaria et al., 2010b). Many warships were built in Chittagong for the Royal Navy, and some of them were even used in the Battle of Trafalgar in 1805 (Azam et al., 2015). Large flat-bottomed vessels sailed between Patna and Hughli with saltpeter, salt, and other goods with a capacity of 100 to 200 tons. Large flat-bottomed vessels, plying up and down the Ganges in the seventeenth century, and Baleswar or Balasore was an active shipbuilding center where merchants from Bengal had constructed their ships. By the eighteenth century, watercrafts known as 'burs' in Bengal were used to transport cotton and other bulky materials. These were lighter boats without a keel or side timbers that were capable of carrying 50,000 pounds or more cargoes. On the other hand, Gujarat and Surat were the most important shipbuilding centers, with Surat capable of building large ships of up to 1000 tons at the end of the seventeenth century. This port also constructed and repaired ships for Arabs, Indians, Persians, and later Europeans (Rapson et al., 1922).

India has an ample supply of timber as well. Ships designed by India were superior as they were made of teak, which persisted for a very long time resisted the effects of saltwater and weather. Lieut. Col. A Walkers' paper- 'Considerations of India's affairs', published in 1811, had excellent comments on the building of ships in Bombay. He noted that it was estimated that every ship in Britain's navy is renewed every 12 years. It was well known that ships constructed from teakwood sustained fifty years and upwards (Suhrawardi, 2015). After running for fourteen or fifteen years, several ships constructed by Bombay were brought into the Navy and were considered stronger than ever. He further noted that the ships constructed by Bombay are one fourth cheaper than those built at English docks. Madapollum was another shipping hub that flourished. Thomas Bowrey, an English traveller who visited India during the 1669-79 century, notes that many English merchants and others constructed their ships and vessels annually at Madapollum (Suhrawardi, 2015). Cesare De Fedrici was a sixteenth century Venetian traveller who noted that shipbuilding materials were abundant and cheaper in this region. Thus, the Sultans of Constantinople wanted to have their vessels constructed in India than in Alexandria. In the fifteenth century, Nicol Conti, who visited India, was fascinated by the quality of Indians shipbuilding. He noted, 'some ships larger than ours, with five sails and many masts, were designed by the nations of India are capable of containing 2000 butts'. To withstand the force of the tempests to which they were heavily exposed, the lower part was built with triple planks.

Even before colonization, while doing business in this region, the English also noticed that the small ships used by the natives and built by them could be of tremendous benefit. Boats and rafts were used for loading and unloading ships as a means of conveyance (Qaisar, 1968; Suhrawardi, 2015). Approximately 4200 big boats and 4400 small boats were there. Large-

sized vessels were there that could also hold elephants. The boats used by kings and nobles were designed to look artistic. It was credited with a carrying capacity of more than one hundred people by a fourteenth-century account of an Indian ship, providing a reasonable idea of both the shipbuilding skills and the maritime abilities of a seaman who could handle such a large vessel successfully. Another account of the early fifteenth century describes Indian ships as being designed in compartments so that they could accomplish the voyage even if one part was broken. This could be described as the precursor to the modern-day subdivisions of ships into watertight compartments; a concept that was then entirely foreign to the Europeans (Andaya, 1996).

Figure 8: Bengal waterways of the eighteenth century.

Source: Suhrawardi, 2015.

Approximate one million boats docked in various Bangladeshi water bodies during the 18th century, 75% of which are riverine and about 25 percent sea-going vessels. This world's largest delta basin encompasses a massive river system. Therefore, the area has always been rich in boats, boat construction, and customs related to water-based transport. Although exotic designs were adopted by sea boats from the BoB due to the influences of foreign merchants, the wooden boats of the inland waterways formed their shapes and forms for more than fifty types of vessels free of foreign influences (Suhrawardi, 2015). As foreign travelers such as the Chinese, Arabs, and later the Western conquerors did not dare wander into the country's mighty and dangerous rivers, the authenticity of the design remained intact. Bangladesh's riverboats remained the same until the twentieth century, constructed using skills and innovations that were passed down from generation to generation by boat builders. Boats were cut out of large logs (like a canoe) in earlier periods, and later boats were constructed of bundled cane and bamboo. In later times, in boat construction, timber species such as Jarul, Sal, Sundari, and Burmese teak were used. Baka (the floor), Quina (the bilge framework), Gocha (the side frame), and Gura (the deck beam) are the transverse structural elements.

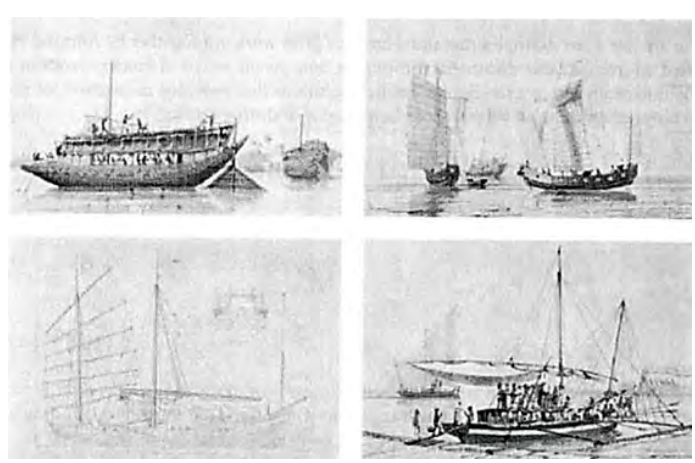
4.3. The colonial period in Bengal (1757 AD - 1947).

In the history of India and the Indian Ocean trade, many changes were brought in the 18th century, particularly after the 1750s. This influenced the shipbuilding in Bengal as the English were the largest carriers of Bengal's trade with other parts of Asia. It was in their interest to have their ship constructed in Bengal by the British in that region.

Vice admiral Francois Edmond Paris (1806-1893), was a French naval officer who made significant contributions to naval engineering during the transition from sail to steam. He traveled to South Asia during the early 19th century and wrote extensively on the boat buildings in various parts of the then Indian subcontinent. He sketched, drew, collected measured sketches, and commented on several of the surrounding vessels.

Paris was best known for his fascination with Indigenous boats. He drew plans and scenes of watercraft in many different places such as Senegal, the Seychelles, India, Malaysia, the Strait of Malacca, Vietnam, China, Singapore, the Philippines, Indonesia, Australia, Chile, and Brazil. The craft he encountered along the Indian coast also attracted Paris as it was small, squat, high-sided cargo ships, called 'tank-boats'. They were occupied with two-mast -a larger was mounted by the mainmast, and the smaller mast was fully positioned aft. He saw and portrayed another two-mast coaster of around twenty meters in the same waters (Suhrawardi, 2015).

Figure 9: Two-masted 'tank boats' in Bengal.



Source: Suhrawardi, 2015.

On his family Bajra, Rabindranath Tagore crossed the giant

rivers where he found solitary moments rejuvenating his poetic talents and creating some of his masterpieces. In reality, Tagore's 'Padma boat' was a houseboat with living and dining rooms. Tagore lived on and off on this boat between 1890 and 1891 and received guests such as Acharya Jagadish Chandra Bose, Lokendranath Palit, and Surendranath Tagore. Sitting on the deck of the boat Padma, he wrote essays, letters, and published articles. Most of his 'Galpo Guchho's stories and various famous poems, like 'Sonar Tari' was a prolific time of his life and assumed as the creations from those boat life. On the other hand, 'The Chapala' was another 'dinghy'(small boat) attached to the boat Padma. The poet used it to travel into narrow strips of water where the Bajra couldn't go' (Suhrawardi, 2015).

Figure 10: Tagore's family Bajra.

Source: Suhrawardi, 2015.

4.4. Pakistan rule in Bengal (1947 - 1971).

Ames Hornell (1946) dealt with several aspects of the transport of water from South Asia. Between 1950 and 1959, Basil Greenhill carried out fieldwork in west Pakistan and East Pakistan which is present in Bangladesh (Sarkar, 1990; Suhrawardi, 2015). Greenhill divided the Bangladesh river craft that Basil Greenhill encountered into six classes the second of which consisted of the round hulled ships with reverse clinker planking. There had a problem with the 'reverse clinker' technology. According to Yves Marre, that was only noticed in Jaflong, Sylhet area. All the other types of boats that he witnessed were built with planking, side by side, attached with staples, including the Shoronga, and others (Suhrawardi, 2015). These boats were usually found in the northern part of Sylhet, on the Brahmaputra/Jamuna and the Meghna. Others were seen on the river Pasur, south of Khulna, in the western part of Mymensingh district, near the Brahmaputra/Jamuna, and possibly at Dhaka near Mograpara hat. The reverse clinker boats known as 'Shoronga' were used in the northern Sundarbans, in Kishoreganj, Brahmanbaria, and Habiganj districts. These boats measured 52 to 62 feet in length, 10 to 18 feet in breadth, and 4 to 8 feet in-depth, and they had a cargo capacity of 800 to 1500 maunds (29 to 56 tons) (1 maund = 0.04 ton). In recent years, reverse clinker, round hulled boats known as 'Sylheti Kosha' carried stone, sand, and paddy by river from Sylhet to Dhaka, and returns to Sylhet with consumer goods. These boats could carry 350 to 400 maunds (13 to 15 tons) and measured 35/45 * 8/10 * 4/5 feet (Suhrawardi, 2015). In the stone trade between Sylhet and Dhaka, 'Bajitpuri' or 'Sylheti Patam' boats have also been used recently. These ships are about twice the capacity of the 'Sylheti Kosha' and seem to have been 'Binekata' (smooth-skinned) rather than 'digekata' (reverse-clinker).

4.5. Modern Bangladesh (1971 - 2020).

Two major technological 'revolutions' occurred in the twentieth century that changed Bangladesh's riverscape from vibrant rivers-sceneries with hundreds of sails to a bare noisy one. In the 1980s, as their efficiency enabled the boats to become more economically viable, cheap diesel engines imported from China began being used as inboard engines for riverboats. This resulted in sudden riverboat motorization and allowed the crew to save mast and sails on the coast. It also meant, however, the loss of all the wonderful and special riggings of our vessels in less than five years (Suhrawardi, 2015). The second 'revolution' happened with the transition from wood to steel welded sheets of boat-building material. Boat-builders were forced to use steel-welded sheets to build their new boats by rural electrification and the political will to protect forests, and wooden boats quickly became too costly and less economically worthwhile. Wooden vessels are also no longer designed with the expectations of a few types of boats, such as salt carriers. The typical shapes are no longer even copied (Saki et al., 2019; Suhrawardi, 2015). Bangladesh's primary transportation infrastructure is its vast inland waterways. In FY 1986, some 18.9 million cargos (around 21% of the total) were transported by water transport. The country had 8430 kilometers of navigable waterways as of the beginning of 1988, of which up to 3058 were key cargo routes. A fleet of more than 480 vessels was operated by Bangladesh.

Figure 11: Passenger launch plying from Dhaka to Matlab on the Dhonagoda River.

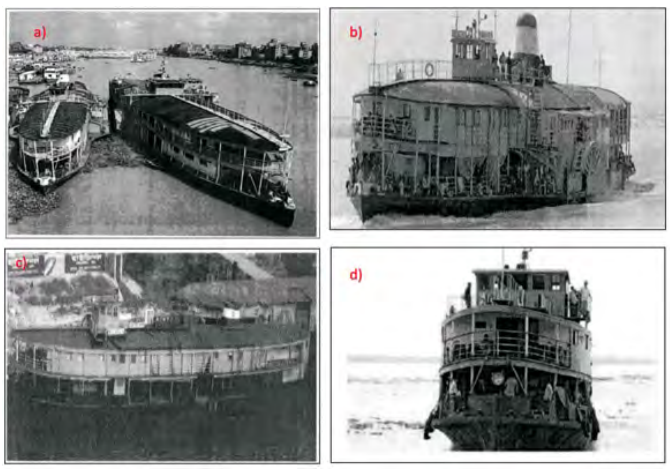
Source: Suhrawardi, 2015.

Inland Water Transport Corporation (BIWTC) as of 1987; around half were inland and river barges and the rest were used for coastal trade. Country ships operating primarily in perennial waters are key sectors of the IWT. Within the nation, over

975,000 country boats are operated (BBS, 2003). Of these 350-.000 are cargo-carrying boats and 625000 carry passengers. Some of the historical steamers operated by BIWTA are illustrated in Figure 12.

Bangladesh's shipbuilding yards now export small and medium - sized ships to the highly competitive European market. Bangladeshi yards have since manufactured and exported more than 500m worth of ferries, cargo vessels, and ocean- going multi-purpose ships (Suhrawardi, 2015). The ships were designed for countries like Denmark, Germany, and Finland, among others.

Figure 12: Historical steamers operated by BIWTA - a) River passenger (private) launches b) Paddle Steamer Pstrich, pride of the Rocket Service c) Paddle vessel d) Rocket steamer.

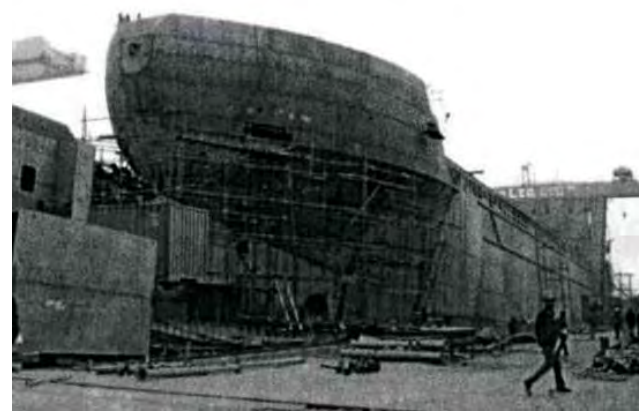


Source: Suhrawardi, 2015.

The country has plenty of skilled manpower and our labor cost is cheaper than many other countries. On average ship owners can save at least 15% of the production cost here, said Shakhawat Hossain, Managing director of Western Marine Shipyard in Chittagong. Although several Bangladeshi shipyards now can build vessels for the international market, Western Marine and Ananda shipyards and slipways, based near Dhaka, have been leading the way for overseas buyers in production (Suhrawardi, 2015). They can manufacture ships of approximately 10000 tons at the moment and are working to expand their facilities to build larger ships. Western Marine is currently constructing a cargo vessel that will soon be flying across the frozen waters of Europe's North Sea and Baltic Sea. Experts claim approximately 70% of the country's cargo and 90% of total oil products are transported via its coastal and inland waterways by small ships, cargo vessels, and tugs. To travel from one part of Bangladesh to another, hundreds of thousands of people use ferries and steamers, and most of these vessels are constructed in the region (Islam, 2018; Suhrawardi, 2015).

Industry owners are optimistic. They believe that their national market can help to overcome the tide. With the Bangladeshi economy increasing at an annual rate of about 6%, new smaller ships and cargo carriers are required to transport goods and other raw materials to different parts of the country from the main port of Chittagong. The shipbuilding industry here hopes that it provides enormous potential if the global economy recovers. Experts say more than 50% of the ships in the world are more than 20 years old and need to be replaced soon (Suhrawardi, 2015).

Figure 13: Expanded shipbuilding facilities to produce larger vessels.



Source: Suhrawardi, 2015.

Ananda shipyard and slipways limited (ASSL) established in 1983 on the bank of the Buriganga river, became the first Bangladeshi shipbuilding company to export an Ocean (Integrated Management System) accredited company in Bangladesh. More than sixty ships were built for coastal and inland use and more than thirty ships in progress were built for new construction. They include trawlers for deep-sea fishing, utility port vessels, tugs, inland cargo ships, inland tankers, and passenger's vessels. They recently signed a contract for the construction of a passenger ship with an aluminum body for Tanzania. This is a type of catamaran built for twin-hull ships (Suhrawardi, 2015).

Karnafully Shipbuilders (Pvt) Limited (KSBL) was founded in Chittagong in 1994 and has one of the largest private shipyards in Bangladesh. The shipyard was constructed over eight acres of land, with completely equipped machine shops and two 650-foot-long slipways each. It is possible to berth two vessels of up to 3500 tons each at a time. The only privately owned dockyard in Bangladesh is under construction by KSBL. The dock named 'Karnafully Dry Dock' is expected to be able to handle vessels up to 100,000 tons. It must also be noted that the 'Chittagong Dry Dock' operated by the government can only accommodate vessels of 20,000 tons. The services provided by KSBL are now: dredger design, drawing, and construction, tugs, barge, cargo ships, fishing trawlers, passenger vessels, fuel and pilot vessels, naval craft crew boats, etc (Suhrawardi, 2015). KSBL is Bangladesh's leader in the construction of tug boats and dredgers. KSBL has repaired/renovated about 450 during the past eighteen years and constructed sixty-two new vessels of different styles. In 2009, KSBL formed a joint venture consortium with the world-renowned Dutch German Company VOSTA LMG BV for dredger technology. Three

450mm Cutter Suction Dredgers (CSD) were first manufactured in Bangladesh under this Joint Venture and delivered to BIWTA. Recently, two more 650mm CSDs have been shipped to BWDB. Thirteen more dredgers are currently being developed for BIWTA and BWDB (Siddique et al., 2019; Suhrawardi, 2015).

Dockyard & Engineering Works (Siddique et al., 2019), Narayanganj, was ordered to build 5 tiny patrol crafts after liberation. As a result, two ships (BNS PABNA and NOAKHALI) and three ships (BNS PATUAKHALI, RANGAMATI and BOGRA) were commissioned in 1972 and the remaining three ships (BNS PATUAKHALI, RANGAMATI, and BOGRA) were commissioned in a few years, all of which are still operational and currently run by the Coast Guard (Rahman, 2017). Khulna Shipyard (KSY) was assigned as far as possible to build and rehabilitate commercial vessels that sustained losses year after profiting from taka 1.25 crore in the 1974-75 financial year (Rah man, 2017). Chittagong Dry Dock (CDD) was able to begin operating in 1981.For several reasons these three public shipyards could not continue as profitable and were ultimately put on the privatization board for financially viable, but for efficient management, the privatization board handed over the KSY, DEW, and CDD to Bangladesh Navy in 1999, 2006, and 2015 respectively.

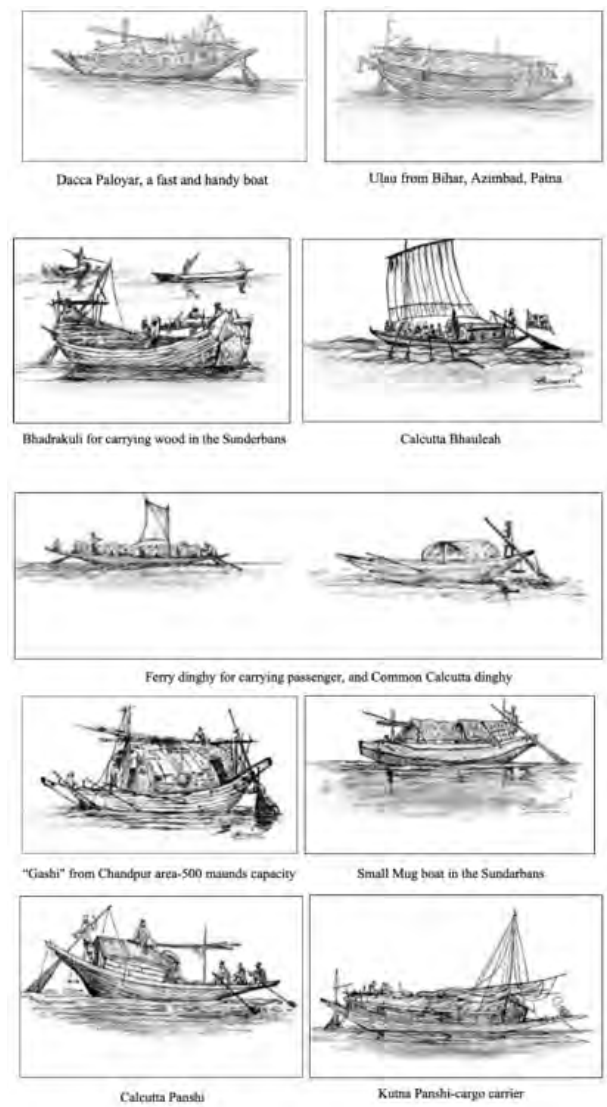
4.6. General history of Bengal Boats.

Bengal boats can be graded in the categories of skiffs for rowing and racing, houseboats for travel, or ceremonial barges. Other very common classes of boats are rafts, dugout canoes, cargo carriers, and large fishing boats. Numerous terracotta plaques of Bengal were found in various temples and Raj Baris, which described boats found at the time (Suhrawardi, 2015). Some were historical renderings drawn from imagination. These depicted memories of Bengal River activities, adventures, plunder, and depredations by pirates (Maghs and Portuguese) as well as a dim recollection of proud and majestic European ships, highly gilded and decorated with carvings, always armed as warships and generally acknowledged as the Lords of the ocean (Suhrawardi, 2015).

For how the parts are classified, there is no satisfactory Scheme. They are usually called 'deshi nauka'- the country boat. Local people and boatmen think of a specific boat shape when describing a boat. Consequently, two boats that appear similar to external eyes may be referred to by their respective operators or owners as distinct names (Suhrawardi, 2015). Conversely, the same types of names can be given to outwardly distinct vessels. Some were much more frequent than others in the range of names reported. Such types as the ghashi, soronga, dinghi, panshi, patam, kosha, malar, raptani, and bachari were among the most common. In addition, Sylheti nauka, barki, the motorized barki, chhataki nauka, the motorized chhataki nauka, khasia boat, the Sylheti nauka and the barki, and also larger craft were common boats. At Ganeshpur, species of wood known as jam and mango are used for bottom planking and gumma for the side strakes (Suhrawardi, 2015). In the early part of the 12th century, Bangladeshi boat builders used 'sal and teak'. But as these timbers become rare to obtain, various trees namely Sundari, Gajari, Zarail, Kathal, Shilkoroi and Koroi are now used (Jiang et al., 2013; Suhrawardi, 2015).

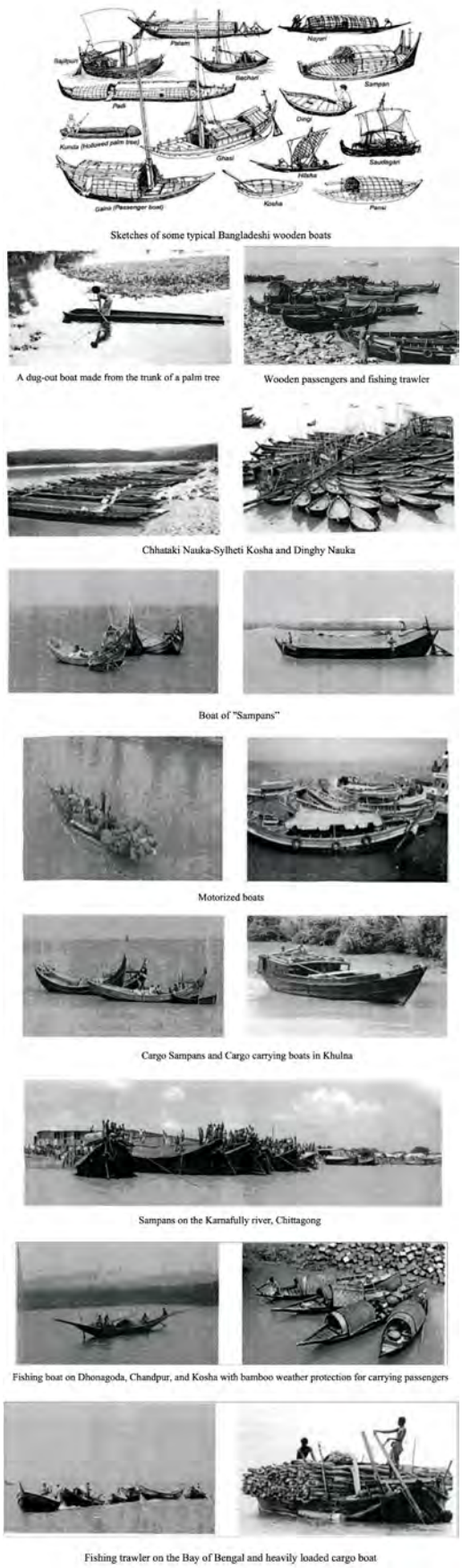
Boat building begins with the owner raising money to provide at least 50% of the expense from different sources. To do this, the boatman may refer to family sources, perhaps land or cattle sales, or land mortgage sales. The money lenders who charge exorbitant interest rates are favored over these outlets. The balance of credit shall be issued by the merchants by way of credit for the purchase of timber, staples, etc., and by deferral of payments to the shipbuilders. A large network of boat owners, wood dealers, and boat builders has historically existed. The boat builders had a close association with boat owners and suppliers of wood and played an intermediary role in the arrangements (Suhrawardi, 2015). Here are some of the country ships' pencil renderings that occurred in greater Bangla and parts of Bihar and Orissa.

Figure 14: Some of the country ships' pencil renderings that occurred in greater Bangla and parts of Bihar and Orissa.



Source: Kirk, 1953; Mathew, 2017; Suhrawardi, 2015.

Figure 15: Some wooden boats in the Bengal region.



Source: Suhrawardi, 2015.

Figure 16: Wooden boat construction in Chittagong.

Source: Suhrawardi, 2015.

Conclusions.

Shipbuilding lies in the heritage of the Bay of Bengal region. As documented by historical evidence as well as with the field study, the shipbuilding history of this region can be found from the ancient period, of course in a very different form than as it is now. In ancient times, in this delta region, the ship was the main means of communication, transportation for the locals as well as of the foreign traders who explored Indian territory to extend their trades initially. During the colonial period, shipbuilding experiences a new paradigm when technological advancement from the western world enriched the local shipbuilding. Though the local technician was already popular to build wooden sailboats that lasted for a hundred years technology like the steam engine took it to another level. With the extension of global communication and trade, necessities were modified. Locally built small wooden boats were not enough for longer routes. Both the size and capacities were increased.

During the post-colonial period, shipbuilding has seen two different passages. Firstly, a moderate move with government initiatives during the pre-liberation period, later a sharp boast up lead by the private entrepreneurs. By this period, two major changes also took place on the ship constructions- a. wooden body replaced by the steel body and b. steam engine replaced by Diesel engine. Initially, only small boats were built locally and larger boats were imported to fulfil the domestic needs. With the flow of time, local shipyards gathered the necessary skills and confidence to move for large ship constructions. Presently, almost all domestic shipbuilding necessities are served by the local shipyards. Even, Bangladesh building its naval vessels by now. At the same time, our private entrepreneur's success-

fully exported ships to the international market including Europe where the standards are often high. But the export market and our local capabilities are not yet strong which resulted in a sharp decline in export quantity in recent years.

The time period of the study was mostly within the global pandemic that arises due to the Coronavirus diseases 2019 (COVID-19). Consequently, there were strong limitations on movement and communication, which resulted in less flexibility on data collection processes. Since, many of the libraries were close during the data collection period, the authors mostly have to rely on online data sources to gather the historic data on ship building heritage on the Bay of Bengal region.

A collective move by both govt. bodies and private entrepreneurs are the way out to overcome this situation. Govt. need to give policy support to encourage local production. e.g., import embargoes on smaller vessels that are being built locally, low-interest long term finance, quality assurance and monitoring, etc. At the same time, the private sector needs to prepare them for the global market. Worker's skills need to be improved and well maintained so they get recognition by the classification's societies. Proper standardization and long-term preparation shall be taken to attract Foreign Direct Investment (FDI) in this industry. There was a long history of shipbuilding in this region as well as a strong potential for future expansion of the market. The industry needs to prepare itself to address the demands satisfactorily.

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