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A Study on the History of Boat and Ship Building in Odisha

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Abstract:*Odisha, located in the eastern part of India, boasts a 480 kilometer coastline and is enriched by numerous rivers that flow through the state. This geographic advantage has enabled Odisha to be a prosperous maritime trading state since ancient times. As a result, traditional boats are commonly seen throughout the region's rivers and seas. The people of Odisha have historically excelled in the art of building boats and ships for use on rivers, lakes, canals, and open oceans. Existing literature highlights a variety of traditional boats, including Pota (dugout), Nouka (boats), Bhela (rafts), Chapa (canoes), and Padhuas. The ocean tides and river currents give rise to distinct characteristics of the boats found along the northern coast of Odisha compared to those on the southern coast. This paper provides a detailed overview of Odisha's indigenous boats and ship-building traditions from ancient times. It covers their terminology, the various types of vessels crafted for maritime expeditions, and the navigational technologies used for seafaring. Local traditions and existing literary sources have been referenced to explore Odisha's unique boat construction styles and technologies.*
Key Words: *Boat and Ship-building, Craftsmanship, Navigation, Maritime Trade, Odisha etc.*

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Introduction

The history of boat construction is as ancient as the relationship between humanity and the ocean. It is widely believed that sailors predated farmers and potters. During prehistoric times, humans likely used watercraft to navigate rivers and seas. It is estimated that humans began to explore the oceans around 60,000 years ago when sea levels were lower. Individuals utilised buoyant rafts to traverse these waters. The advent of civilisation marked the beginning of the construction and use of traditional boats for maritime travel, commerce, fishing, and warfare. The Harappans are recognised as the first sailors of the Indian

subcontinent, engaging in trade with the Sumerians and the Mesopotamians. Evidence from seals, vessels, and pottery found in Harappan sites confirms that these inhabitants had the knowledge and skills to construct and operate boats. Substantial evidence of ship-building, navigation, and maritime activities exists throughout ancient history. Images of boats and ships can be found on coins,[1] Seals,[2] terracotta seals,[3] pottery, amulets, caves,[4] paintings,[5] graffiti on potsherds,[6] sculptures, temple walls,[7] stupas,[8] hero stones, and other architectural forms.[9] These depictions suggest that boats were used for marine trade, fishing, and transport across rivers, lakes, and seas during different historical periods. Many traditional boats have been present throughout the Indian subcontinent, particularly in its coastal regions. Indian epics and regional literature reference various types of vessels and their uses. Like other coastal states in India, Odisha is rich in references to traditional boats.

Decoding Boat-Making Process: An Archaeological and Hermeneutical Analysis

While archaeological excavations in Odisha have not yet provided evidence of water transport, numerous examples of watercraft can be illustrated on the sculptural panels that adorn the temple walls throughout the region. Noteworthy sites featuring these depictions include the 'Ratnagiri Mahavihara in Jajpur from the 8th to 9th century, the Brahmeswar Temple in Bhubaneswar from the 10th century, the Jagannath Temple in Puri from the 12th century, the Sun Temple in Konark from the 13th century, Suvadia in the Bhadrak district from the 14th to 15th century, the Marichi Temple in Ajodhya, Balasore district, from the 15th century, and the Jagannath Temple in Deokund, Mayurbhanj district, from the 19th or 20th century.'[10] The earliest representation of a boat in Odishan art can be traced back to the 10th-century Brahmeswar Temple in Bhubaneswar. The panel, currently located in the Odisha State Museum in Bhubaneswar, depicts ships transporting an elephant. A relief from the 12th-century Bhoga Mandap of the Jagannath temple in Puri depicts a ceremonial boat. The 13th-century sculpture found in the Konark temple's Jagamohan parapet depicts *Martanda-Bhairava* dancing on a boat. The statue from Konark, located in the Indian Museum in Kolkata, depicts four men rowing a boat with a royal figure seated alongside an elephant. A similar sculpture can be found in the Victoria and Albert Museum in London. It depicts a boat with a canopy positioned just behind the middle and supported by substantial, column-like structures. Under the canopy, there is a royal figure holding a bow. The boat also features three rowers and a helmsperson, each wearing conical headgear. Sculptures in

Odisha depict boats, suggesting the use of reverse clinker construction techniques. The reverse clinker technique is still used today, as evidenced by a boat painting by B. Solvyris from the early 19th century. Currently, reverse clinker boats are found along the northern coast of Odisha, specifically between the Dhamra and Subarnarekha rivers. However, this method is not applied to boat building on India's southern and western coasts. Nonetheless, similar boats continue to be found in present-day West Bengal and Bangladesh.

Kalidasa, the great poet of ancient India, mentions the king of Kalinga in the Raghuvamsam as the Mahodadhipati, or Lord of the Sea.[11] The Buddhist scripture *Aryamanjushrikalpa* mentions that all the islands of the Kalinga Sea represent Kalingadesu. Similarly, the eastern sea, including the Bay of Bengal, was once known as the Kalinga Sea, and many Kalinga ships sailed in it. The Chinese traveller Fahien documented the presence of several tall-masted, large sail-equipped vessels in Kalinga, each capable of accommodating up to 200 individuals at once in the 4th century A.D.[12] According to his description, a small boat was tethered to the larger flagship, which served as a lifeboat in case of an accident aboard the main vessel. The Periplus of the Erythrean Sea (60–100 AD) describes wooden boats used along the coast of Coromandel. It details vessels made from logs with plank sides, outrigger boats, and twin canoes that were connected. Additionally, it mentions the use of masula boats around the Coromandel Coast.[13] Pliny the Elder (23-79 AD) mentioned the use of log boats in India, which are still used today. Mookerji (1912) notes that the earliest depiction of a planked ship can be found on the east entrance of the Sanchi Stupa, built in the 2nd century BC. However, no concrete evidence of plank boats was recorded until the 16th century. Duarte Barbosa (1480-1521) described sewn boats traveling from Malabar to the Red Sea. Additionally, Balbi wrote about ships on the Coromandel coast that operated in the surf zone, transporting goods and passengers between the mother ship and the shore.[14] Thomas Bowery (1669 to 1679), a spice merchant and sailing master, described catamarans in his writings. He noted that these vessels were constructed from four to six pieces of wood tied together, with the central piece being longer than the others. Catamarans were propelled using paddles.[15]

The *Yuktikalpataru*, also known as Vrksayurveda, mentions the construction of sewn boats that do not use iron nails. This construction method is similar to that found in Masuli boats.[16] Avoiding iron nails is due to concerns that submerged magnetic stones in the sea could attract them. Consequently, ships designed for sea voyages are sewn together using fibres and ropes. According to myth, Raja Bhoja noted that iron nails could come loose from any ship passing near a magnetic mountain. *Yuktikalpataru* lists various vessels used for

maritime navigation in Odisha, including the *Tariksh*, *Plava*, *Bariratha*, *Tarandhuha*, *Bhelak*, *Nuah*, and *Bahana*.

The *Datha Dhatuvamsa* mentions that the Tooth Relic of Gautama Buddha was transported from Dantapura in Kalinga to Sri Lanka using a large, sewn-plank ship.[17] The ship featured a broad, high mast and was crewed by skilled sailors. Dantakumar and his queen travelled to Sinhala by boat from the port of Tamralipta. The *Trikandasesha Purushottamdev* Dictionary lists various boat names used for sailing in Odisha's rivers and for coastal navigation. Dinakrishna Das's Prastavasindhu details different types of boats, their construction, and carrying capacities. The poet Upendra Bhanja's *Prema Sudhanidhi* describes various types of boats designed for joyous and entertaining journeys. The *Chary Padas*, or *Doha* songs *Kambalapda*, referred to vessels laden with merchandise and indirectly alluded to ship operations.[18]

The scholar Zhu Fan Zhi from the Sung Dynasty of China provided a detailed account of the thriving maritime trade networks established by the ships of Kalinga, referred to as Kia-ling, in his note 'Records of the Foreign People' in the early 13th century. In the early medieval period, the traveller Al-Masudi observed the operation of sewn boats along the Indian coast. These boats were constructed by tying planks together with rope and coconut fibre. The work titled *Tilakmanjari* describes how broken planks were tightly secured, and it was the chief sailor's responsibility to check all the knots before the vessel set sail. Additionally, the holes in the boats were filled with wax and cotton.

Additionally, four palm-leaf manuscripts from the Jayadeva Museum in Bhubaneswar contain images of boats showcasing different sizes and depictions of sailors. Out of eight boats illustrated, six are of the same type, while one features a bird's face, another an elephant's face, and the two remaining ships are adorned with different figures on their prows. Although five boats share a similar construction, the other three differ. Notably, four out of the eight ships were propelled by women, which is a significant achievement.

The forests of Odisha provided ample timber necessary for constructing ships and boats. Iron and fabric were readily available for this purpose. Moreover, numerous shipwrights living in various regions of Odisha contributed to a robust workforce of shipbuilders. During medieval times, Balasore and Harispur, in particular, were significant hubs for ship-building and repair. In the 17th century, William Bruton, a Britisher, noted that Balasore was a coastal town where ships were built.[19] Vessels were constructed in Balasore for commercial and military purposes, making it a significant hub for ship-building in the region. In 1634, the English

East India Company needed a small vessel to transport goods to larger ships in the Bay. They acquired an unfinished ship of around 100 tons from the Governor of Balasore and expedited its construction. This vessel was named Thomas.[20] Balasore was also a location where repairs were conducted on commercial ships. In 1638, agents from Masulipatam, Thomas Dark and Richard Hudson, instructed Thomas Godfray, the Master of the Coaster, to go to Balasore to refit the vessel.[21] *Paik Kheda*, written by Kanhai Champati Ray in the 17th century, highlights the Paiks' war traditions, including their naval warfare practices. It also discusses the organisation and training of the Odia navy, noting that nine different types of warships were utilised in the maritime force. The battleships among them were *Lanjua*, *Rajpura*, *Chaturi,* and *Nandia*. Historian R.D. Banerjee asserts that Kalinga maintained a naval fleet to protect commercial vessels at sea.[22] Several works, including the *Odia Mahabharata* by Sarala Das, *Parimala Kavya* by Narasimha Sena, *Tika Govinda Chandra* by Yosawant Das, *Lavanyavati* by Upendra Bhanja, and *Rasa Kollola* by Dinakrushna Das, reference maritime terminology such as *Boita*, *Naha*, *Nouka*, *Sadhava*, *Sadhavani*, *Manga*, and *Nabika*.[23] Near the Deuli Matha, by the sea in Kakatpur, there stands a tall sand stupa called Boita Kud. It is believed that boats used to dock here in ancient times.[24] The coastline of Odisha featured several ports, ranging from Tamluk to Chilika. Key ports along this coast included Subarnarekha, Narekha, Sarago, Chhaluya, Balasore, Lochanapur, Chadaman, Dhamra, etc.[25] Unfortunately, the Odia merchants who traded by sea did not leave behind much documentation of their activities. However, glimpses of their journeys can be found in various historical sources. The memory of their travels to distant lands is still preserved today. Each year on Kartik Purnima, the people of Odisha commemorate these traders by floating boats made of paper and banana leaves in rivers and ponds.[26]

Types of Boats and Their Classification

Traditional boat and ship-building in a particular location depends on the availability of facilities to assemble essential resources such as steel, fuel, fabric, and lumber.[27] Timber was a crucial resource during the Ancient and Middle Ages, allowing vessels to be built wherever suitable wood was accessible. In Odisha, the availability of these materials facilitated the growth of boats and ship-building. The Odisha State Maritime Museum notes that literary references and specific writings, such as Arnaba Vihara Vilas and Ratnakara Vihara Vilas, highlight a robust legacy of boat construction in ancient Odisha, encompassing both riverine

Sl No	Name of the Boat	Length (in cubit)	width (in cubit)	height (in cubit)

and maritime vessels. *Yuktikalpataru*, authored by King Bhoj, is widely considered the most well-known treatise on ship-building in India. The above book classifies the ships of Kalinga into two main categories:[28]

A. Samanya (traditional boats) that navigate rivers, lakes, canals, or coastal areas.
B. Vishesha, Arnab Pota, or Boita (specialised ships) are much larger and designed for deep-sea navigation.

References to wooden ship-building by King Bhoja can be found in the Madala Panji. It suggests that Odisha adopted the same boat and ship-building techniques outlined by King Bhoja in his work, *Yuktikalpataru*. Based on this text, Radhamukunda later authored an English book, *Bharatiya Arnab Pota*. Identifying wood is crucial when building a boat. According to *Ayurveda*, there are four types of trees,[29] namely:

1. Brahmin is light and soft and can be easily fixed with other types of wood.
2. Kshatriya is light and strong and cannot be easily fixed with other types of wood.
3. Vaishya-soft and heavy.
4. Shudra- strong and heavy.

In this order, the right tree is selected to build a boat.

According to the construction, Samanya, or standard boats, are divided into 10 types.[30]

1	Kshyudra	16	4	4
2	Madhyama	24	12	8
3	Bhima	40	20	20
4	Chapala	48	24	24
5	Patala	64	32	32
6	Dirgha	88	36	36
7	Bhaya	72	44	44
8	Patraputa	96	48	48
9	Garvara	112	56	56
10	Manthara	120	60	60

The unique ship Vishesha, also known as Arnab Pota or Boita, was explicitly built for sea travel and is further divided into two types.[31]:

1. Dirgha (long or large ship)
2. Unnata (advanced ship)

Dirgha ships are further divided into 11 types:

Sl No	Name of the Ship	Length (in cubit)	width (in cubit)	height (in cubit)
1	Dirgha	42	21/4	21/4
2	Dirghika	32	4	16/5
3	Tarani	48	6	24/5
4	Lola	64	8	31/5
5	Chatwara	80	10	8
6	Gamini	96	12	47/5
7	Tari	112	14	56/5
8	Janghali	128	16	64/5
9	Plabini	144	18	72/5
10	Dharani	160	20	16
11	Begini	176	22	108/5

Unnata or advanced ships are further divided into five types:

Sl	Name of the Ship	Length (in cubit)	width (in	height (in

No			cubit)	cubit)
1	Urdha	32	16	16
2	Anurdha	48	24	24
3	Subarnamukhi	64	32	32
4	Garbhini	80	40	30
5	Manthara	96	48	48

At that time, it was customary to decorate ships and provide various facilities to increase passengers' comfort. Gold, silver, copper, and alloys of these three metals were used to decorate the vessel, resulting in four distinct colours.[32]

1. Four-masted ship (white colour)
2. Three-masted ship (red colour)
3. Two-masted ship (yellow colour)
4. One-masted ship (blue colour)

The faces of the ships varied in shape. These ships had cabins or rooms. Boats with cabins are divided into three types:

A. Sarba Mandir: The royal treasury, equines, and ladies were transported aboard such vessels.

B. Madhya Mandir: The monarchs utilised these vessels for travel, particularly during the monsoon season.

C. Agra Mandir: These vessels were primarily used in warfare, while individuals travelled in them during summer and winter.[33]

The Process of Boat and Shib-building

In Odisha, the construction process for boats and ships involves several essential steps. The following boat-building method is mentioned in the *Prastabsindhu*, written by the poet Dinakrishna.[34]

1. First, the type of wood is carefully selected, along with the appropriate amount of ageing for optimal quality. High-quality wooden planks are arranged for use in the construction.
2. The planks are cut to the desired dimensions and shaped accordingly for finishing.

3. The wooden planks are bent by heating and applying pressure at specific intervals to create curves and particular shapes. Planks are gradually joined using internal support to achieve the required breadth, side inclination, and other features.
4. Iron nails fix the joints, and waterproofing ensures durability.
5. Once the boat has been shaped and sized according to specifications, it is moved to the waterfront to facilitate floating.
6. Before the boat's departure, a series of rituals is conducted as part of the tradition.

Different Types of Boats in Odisha

The notable boats mentioned in Odia literature include Pota, Nouka (boats), Bhela (rafts), Chapa (canoes), Padhuas, Nouka, Danga, Catamaran (Teppa), Padhua (Masula), Patiya, Salti, Sabado, Kusli, and *Patua*. These traditional vessels serve not just as a means of transport; they are an integral part of the culture, providing access to the lush shores of the Bay of Bengal, the calm coastal waters of Odisha, the winding rivers, and the beautiful Chilika and Ansupa lakes.

Nauka or Danga

Nouka or Danga is a clinker-type boat that does not have ribs, a stem, a stern, or frames.[35] Its maximum length is 14.30 meters, its width is 2 meters, and it is 50 to 60 centimetres deep. The planks used in its construction are 1 to 1.25 inches thick. Both iron and wooden nails are utilised in building the boat. The length of the minimum plank determines the specifications for the various parts of the boats.[36] Nails are spaced 5 to 6 inches apart, with joints requiring a spacing of 3 inches. Local artisans measure the length of the Nouka using their hands, fingers, and feet. The Nouka or Danga is constructed using traditional techniques that emphasise simplicity. Planks are arranged horizontally. During the building process, a specific plank section is heated for a certain amount of time to prevent warping. Once sufficiently heated, the plank is shaped using wooden and metal bars, making it suitable for planking. The planking technique is straightforward and involves cutting the planks into sections, sometimes arranged in an overlapping pattern. Cotton is applied during the nailing process to ensure the boat is watertight. The outer planks of the boat are exceptionally sturdy. The lowest plank is called the *tali*, while the two lower side planks are called *dasi*. The dasi extends from the tali on both sides, with the ends of both the tali and dasi bent upwards. Each side extends approximately five cubits wide, a process known as seka. The lower side plank is *bedha*, which connects to the upper side plank of the boat known as *hahuti*. These planks

are secured with *khera*, which are thin, small planks. Additionally, six horizontal planks, called *poland*, are placed between the *hahuti* to enhance structural rigidity. The wooden pegs that secure the poland to the outer surface of the hahuti are known as *khila*. *Jata* refers to the tapered ends of the Nauka. The planks that surround the boat are called *chapundi* and are used for movement. The sizeable triangular plank at the front is marked as *muhala*, which is intended for sitting. The boat's front part is called *agamanga*, while the rear part is called *pachhamanga*. The boat is used for transporting passengers and cargo, as well as for fishing. It can carry five to six quintals of freight. It is a traditional boat found in Chilika Lake, well-suited to the environment of Chilika.

Potas

*Pota*s (dugout) are *Bisesha* boats, specialised vessels in lakes, rivers, and seas. They are widely used in calm and shallow waters, as well as for maritime trade and navigation. *Pota*s possess regional names such as *Nouka*, *Kathua*, *Sapei, Sapuadanga*, and *Dengi*.[37] A dugout or canoe can be constructed from a single tree or wood, dug out or scooped from its trunk. As carved directly from a wooden trunk, they are much more durable than other traditional boats. It resembles the narrow feeding trough traditionally used for cattle in the countryside, known as the Kunda or Dangi. Their shape resembles a long tube, and their bottom resembles a half circle. It is more useful in shallow, motionless waters than in river currents that are rushing, yet its utilisation during floods has been observed in several regions of Orissa. Smaller boats, also known as Huli Danga, are a consequence of the same evolution. Adzes are used to hollow out the interior of palm or coconut trees, and then the bark or the outer skin section of the trunk is removed. The lower or outer section of the canoe is shaped like a sphere. The prow, which is the front part of the canoe, protrudes from the vessel's butt end and is designed to help propel the canoe forward. Fishermen primarily use this canoe, although it occasionally accommodates a few passengers. However, it can be challenging to control, making it more prone to capsizing in moving water. Additionally, it is not suitable for use in the ocean. *Pota*s are most effective in tranquil and shallow waters.

Catamaran

A catamaran is a boat constructed from logs of identical dimensions, roughly or beautifully shaped, and secured together by lashing.[38] It is a long, narrow raft made of several pieces of wood tied together and propelled by paddles, sometimes using a triangular oar. In northern Odisha, it is referred to as *Teppa*; on the southern Odisha coast, it is called *Katamaran*,[39]

which translates to "wooden oar." Generally, catamarans are found from the coast of Odisha to Cape Comorin in Sri Lanka. The middle piece of wood is longer than the others, and the structure is typically made from light woods such as Albizia stipulata and Erythrina indica. This construction helps the catamaran achieve positive buoyancy, ensuring it never sinks. The logs are loosely connected, allowing water to escape as waves splash over the surface of the board. Catamarans, used for fishing, are flat and broad and designed without side walls. Catamarans are typically between 4 and 5.5 meters long and are operated by 3 to 5 crew members. In favourable weather conditions, fishermen can catch fish 8 to 10 km from the coast using catamarans. These boats are utilised in all seasons.

Bhela

Bhela resembles a catamaran and is used in some regions of Odisha, particularly in confined and shallow waters. The middle timber of the raft is fixed at the bottom, while other timbers are tied slightly above it, creating a sloped front and back. This design allows the boat to cut through waves smoothly. Oars propel it, and due to its lightweight construction, it never sinks to the bottom. The timbers are tied together so that water entering the boat is automatically released through small gaps.[40]

Chapa

Multiple catamarans are connected to form a larger platform, enabling the transfer of additional goods and allowing the vessel to undertake longer voyages. This boat type is called *Chapa* in southern Odisha and *Dui Dulia* in northern Odisha.[41] *Chapa*s are larger boats used for transporting goods and travelling at sea. The construction style of *Chapa* boats provides indirect evidence of boat-building technology in Odisha. The bottom of a *Chapa* is shaped like the English letter "U," and wooden cages, known as Pakhi, are attached to both sides. The wood in these boats is joined through stitching. *Chapa*s are notably used during the Chandan Yatra festival in Odisha, and historical texts, such as the Madala Panji, describe how Lord Jagannath was transported to Chilika to protect them from attacks by Muslim forces. Nonetheless, the flat outboard of Chapa was deemed inadequate for maritime voyages or fishing activities in the open sea.[42]

Masula

The traditional *Masula* boats, a hallmark of coastal craftsmanship, grace the waters from Odisha to Karaikkal. Known locally as *Padhua* or *Padua*, these vessels are distinctive not only for their function but also for their intricate construction.[43] Measuring between 6 and 8 meters in length, they possess a flat bottom and are uniquely designed without a keel or

frame. Instead of sails or masts, they rely on the skilled hands of their sailors, who use round paddles or large oars to navigate. The artistry of Masula boats lies in their construction, a stunning assembly of wooden planks stitched together in a zigzag pattern, bonded by coir made from coconut or palm fibres, and occasionally using cotton for added strength. Each Padhua boasts specific dimensions of 8 meters long, 2.5 meters wide, and a mere 1.5 centimetres deep, with planks of 5 centimetres thickness. The careful alignment of the bottom planks ensures the structure is functional and aesthetically pleasing. These boats are a common sight along the picturesque Coromandel Coast, where they dance on the waves, especially during favourable weather when they are used for enchanting beach sailing. As the availability of teak wood dwindles and prices climb, skilled boat builders have turned to robust mango (Mangifera indica) and resilient sal (Terminalia tomentosa) woods, enhancing the durability and longevity of these remarkable vessels in the vast sea.[44]

Patia

Patias are the fascinating counterpart to *Masula* boats, crafted in a unique reverse clinker style. This design helps them navigate the waters and enhances their beauty and functionality. In Odisha, based on their size and carrying capacity, these boats are known by two other names: *Botala* and *Dang*. Commonly found in the Balasore and Bhadrak regions and weaving through the serene waters of the Subarnarekha River near the West Bengal border, patias are an essential part of the local fishing culture. Tailored for various purposes, patias come in three main types: those driven by sails or oars for navigation at the river's mouth, others designed for fishing near the shore using oars, and motorised versions venturing into the deeper seas. Traditionally built from sal wood, these boats are now often reinforced with thick tar, skillfully affixed inside and out to ward off pesky insects and ensure resilience. With the rising cost and decreasing availability of sal wood, many builders have adopted a robust alternative called *babla*, which lends strength while maintaining flexibility. The design features of Patias reveal an elegant silhouette; their stern and stem rise almost vertically, bestowing a bold character. Variations in length, width, and depth depend on their specific design crafted for seafaring journeys, often adorned with rectangular sails that catch the wind flawlessly.[45]

Constructing a patia is an art form, beginning with the careful placement of the plank keel. Artisans then link the planks together in a chain, meticulously forming the hog, which rises beautifully above the keel to create a striking stem and stern. The construction process

culminates as the eighth plank is fitted and bound, typically requiring a collection of 16 to 18 planks to bring each patia to life, ready to brave the open sea.

Padhua or Kosala

Brajnath Badjena's *Samar Tarangini* mentioned the *Sulupa* boat, later identified as the *Padhua* or *Kosala* boat. It was historically used for trade and commerce. These boats were found in western Odisha and are named after the ancient region of *Kosala*. It is believed that the people of *Kosala* used this boat in ancient times to navigate the Brahmani, Mahanadi, and Baitarani rivers. The planks of the *Padhua* or *Kosala* boat were joined using stitching, similar to a caravel. The joints were connected with wooden nails and secured with palm and coconut fibre ropes. Long branches and bamboo were used for reinforcement on both sides. In the seventeenth century, a mast was added to allow the use of sails, enhancing its functionality.[46]

In the picturesque landscapes of western and central Odisha, two distinctive types of traditional boats gracefully traverse the waters: the *Kusli* and the *Patua*. These vessels, elegant in their design and purpose, are primarily employed for transporting goods along the region's rivers. Though they may differ in appearance, their craftsmanship reveals a substantial similarity in construction. The *Patua* boat stands out with its charming roof, offering a sturdy shelter for cargo and crew, safeguarding them from the elements as they navigate the waterways. In contrast, the *Kusli* boat is open, embracing the air and water, allowing for a more direct connection with the surrounding environment.

Flat-bottomed vessels such as *Patila*, *Purgua*, *Malangi*, and *Hola* load and unload goods from the mother ship moored in the sea. The typical keeled caravels constructed in North Odisha are *Chuat*, *Dinghi*, *Salti*, and *Sabado*. The sails of these vessels are built from wood, and both the sails and the ship exhibit diverse forms. Rectangular sails are employed for *Chuat* and *Dinghi*, whereas lug sails are utilised for *Salti* and *Sabado*. *Chuat* and *Dinghi* traverse 20 to 30 kilometres from the shore in both favourable and poor weather conditions, whilst *Salti* and *Sabado* are utilised during the tranquil seas from October to February. All traditional boats of Odisha include triangular, rectangular, and log sails equipped with oars and pedals.

Conclusion

The design of boats and ships has undergone significant evolution in recent years. Traditional sails and oars have been primarily replaced by motor-driven engines, which utilize materials such as metal, plastic, or synthetic materials. In Odisha, boats can be categorised into two geographical regions: northern and southern. In the north of Odisha, reverse-rigged and flat-bottomed vessels are common, while catamarans and paduas dominate in the south region. The traditional boats found along the shores of Odisha, Bengal, Andhra Pradesh, and Tamil Nadu share similarities; however, the materials and methods used for planking and caulking their hulls differ. Boat construction in Odisha, much like marine commerce, has ancient roots. A water transport system has existed since antiquity, connecting the sea, lakes, rivers, and canals. As a result, boat manufacturing in Odisha has flourished; however, there is limited information available about the production of boats, ships, and their prototypes in the region. Therefore, it is essential to investigate Odisha's historical practices surrounding boat and ship-building. The structure and design of traditional Odisha boats have remained unchanged for several centuries. Various conventional boats have been documented across different regions of India, reflecting the unique coastal landforms, wind patterns, and current dynamics. Hence, a detailed ethnological examination of boats and ships in this region is necessary.

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