

Indigenous Knowledge: Understanding the Ecological Knowledge and Fishing Techniques of Kaibarta Community, Odisha

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Abstracts: Kaibarta is one among the traditional fishing community of Odisha, subsisting livelihood in catching and selling fish. The long-standing interaction and ties with water resources such as seas, rivers and wetlands for sustenance, they have acquired knowledge on fishing ecology based on live experimentation and transmission through generation. Therefore, the present research makes attempt to delve into the ecological knowledge of Kaibarta community that shape their fishing techniques. To the sustainable harvest of aquatic animals and harmonious living with ecosystem the practical knowledge on variation of aquatic animals and their breeding practices, wind flowing, seasonal changes, depth of water resources and use of fishing techniques including size and structure of nets and tides are important. However, at present due to mechanization of fishing practices for commercial purposes bring a threat to the life, livelihood and traditional knowledge system. The research emphasis that the traditional knowledge on ecosystem is core for the sustainability of water resources and livelihood of Kaibarta community. The villages of Biswali and Balisahi in the Jagatsinghpur district of Odisha's Kujang block are selected for study. This article describes in depth the numerous net fishing techniques that have evolved through time, drawing on both conventional wisdom and anecdotal evidence. As an indestructible component of national marine identity, the traditional knowledge held by the Kaibarta people must be preserved and enhanced.

Keywords: Kaibarta, Fishing nets and traps, Fishing calendars, Tidal periods

Introduction

Fisheries and aquaculture are two of the fastest growing food sectors, playing important role in economic development like food, nutritional security, national income, employment opportunities, as well as generation of livelihood options. A traditional

fishing community is generally defined as a group of people who share identity and closeness toward one another and interact on a continuous basis to perform activities along fishing practices value chain based on experiential knowledge accumulated over time and passed along generations. Traditional fishing is any kind of small-scale, commercial or livelihood-sustaining fishing practices using traditional techniques (D.A. Ramesh,2024). Kaibarta community is one of the caste-based traditional fishing communities in Odisha. Most of the Kaibarta inhabitants are found in coastline and riverine areas. Traditional fishing practices among Kaibarta fisherfolks have been passed down through generations, representing not only a vital source of livelihood, but also a deep connection to cultural identity and the environment. They acquire traditional knowledge from their elders like father, grandfather, and fore father on the structure and size of the water resources, tidal nature, wind patterns and specific aquatic species harvesting season wise. So that they apply suitable fishing nets to catching aquatic species. Jagatsinghpur is one of the coastal districts of Odisha share about 67kms coastline area. Total number of fishing families in Jagatsinghpur is 17848, among which 14052 are traditional fishing families, where total population of fisherfolk is 79644 (MFC,2016). In Jagatsinghpur, there are various other kinds of traditional fishermen: Gokha, are a Hindu caste-based fishing community, among the migrants, there are Nolia, who have come from Andhra Pradesh, the Bengali Hindu fishermen from Bengal, and the Bangladeshi Muslim fishermen. The study is based on two villages: Balisahi and Biswali, which contain the highest density of Kaibarta population, constituting 365 and 371 families respectively. The livelihood of Kaibarta is complicated, dynamic and adaptive in the sample area, unlike the fishermen in other parts who engage in fishing full-time and all year-round, Kaibarta fishermen engaged in fishing only for 8 months, and are completely dependent on seasons for fishing every year. Mostly during rough climatic conditions, they refrain from fishing, and invest the time fishermen in net repairing, net fitting required material based on size and structure. The other livelihoods within the community activities include agriculture, betel leaf farming, aquaculture, cattle farming, shop keeping, government and private company job, handicraft making, wage labourers, migrating to other cities, states, and countries for earning etc. Kaibarta fishermen generally use small boats with or without engine, sails, and oars, while simultaneously facing competition from large, commercial-scale fisheries. The paper examines the importance and role of traditional fishing practice among Kaibarta fishing community. Kaibarta people have the traditional knowledge that needs to be protected and strengthened as an indefectible part of national maritime identity.

Study area and the Methods

This research is primarily qualitative in nature, that is carried out by focusing on Balisahi and Biswali village of Kujang block, Jagatsinghpur district, Odisha in the month January to June 2024. The reason for choosing the two cluster is that the high density of Kaibarta people inhabits and taking up fisheries on subsistence and commercial purpose as secondary occupation. The primary data collected through various anthropological methods like participation observation, in-depth interviews, focused group discussion and key informant methods. Processes of data collection and analysis include; discussion with the fishermen and fisherwomen at the landing point, observation of both fishing activities and instruments used, systems of trading and selling, interviewing responders about fishing-related queries and processes, conducting focus group discussions, and interviews with key informers chosen by members of the society that have been in contact with the researcher. The secondary data collected from various research journal articles, books, and governments reports.

Types of Water Resources and Fishing Equipment Found in Sample Area

In the study area Kaibarta people use various types of water resources like within 5Kms of sea shoreline area, estuarine area, tidal riverine area, ponds, canal and creeks for conducting fishing. Their knowledge of fishing equipment, skills, and fishing methods are all extremely central to the scientific, moral, and judicious exploitation and management of fishery resources. Fishing nets and gears are referred to the devices that have different shapes and sizes and are used in the water bodies in order to capture different sizes of fish species (Ch Sebastian Raju, et.al,2016). The Kaibarta community within the research area uses two kinds of boats: traditional such as *Huli*, and *Dangi*, and motorised such as *Bhutbhuti* and *Tapa*. Ensemble of a boat such as entails oars called *Kata*, *Kelara*, and *Halisa*. Along with the oars, they carry with them a saucer-like object fashioned out of plastic bottles to use when water gets into the boat. The boat also has a mast-like *Seda Pala* in its front end, which helps sailing with the direction of the wind. Fishing related instruments include various types of nets with small and big mesh size, depending on the size of fish captured. Other essential, miscellaneous items are ice box(syntax), plastic rectangular tray and *Keppa* (small ring nets structured for collects catches), tobacco, diesel oil, drinking water, and food. Since most of them return from fishing within a day, only a small amount of food is carried. Seasonal changes, nature of the water body, types of fish accessible, efficiency of the gear, characteristics of the material used for the preparation of gear are the important factors determine the selectivity of the gear used. All the fishing gear are designed in a way to sustain fishery

resources of the water resources avoiding capture of small fish, fry and eggs by enabling them to grow well until they contribute to the fishery potential.

Traditional Way of Fishing among Kaibarta Community

Kaibarta fishing communities have commendable knowledge of the water resources, their conditions, their structure, familiarity with the patterns of depth of a water body, and seasonal patterns like that of the movement patterns of different kinds of fish, the types of fish present, knowledge about the patterns of tidal waves each day, efficient fishing techniques, and a keen observation of weather, which helps them decide when it is safe, and profitable to go to fishing. They make these decisions based on their understanding of signs of the weather, such as change in wind direction, change in sky color and cloud behaviour (Alwi, et al. 2023). Using the horizon and plane of the clouds and the land, as essential elements, they measure angles, and the nature of rain is calculated from the wind direction. The same is also predicted by using the behavioral patterns of other animals, such as flocks of birds that tend to gather and fly in the opposite direction of the winds during storms. Bad weather, such as storms, high waves, or strong winds, can threaten the safety of fishers and their boats in the near creek or shoreline area. Storms accompanied by the eastern or northern winds result in high tide in oceans, further leading to increase in water level. Although accompanied by storms, the northern and eastern winds facilitate the movement lots of aquatic species came into rivers for food, safety, play, and reproduction. Storms bring with them the peak time of high tide and low tide periods in between fishing hours, during which the Kaibarta fishermen often stay hidden inside creeks and riverbanks for safety. Fishing starts soon after the monsoons from November to June (Margashira to Jyeshtha). Most of Kaibarta fishermen start first worship of the on the eighth day of the Krishna Paksha of the Margashira month. Then according to astrologer (*Pandit*) one of the auspicious days: Monday, Tuesday, Wednesday, and Friday, are generally thought best for fishing.

Living closely with the habitations and long interaction in the fishing ecology, the fishermen community have acquired knowledge on the surrounding and wind pattern. According to the sample population there are three patterns of wind blowing in the fishing area. They categorized the wind flowing in the fishing surrounding traditionally on 3 categories. The months of Kartika, Margashira, Pausa, and Magha are accompanied by the western winds in the morning, 4 am to 3 pm and 4pm to whole night with northern wind. On the other hand, the following months of Phalguna, Chaitra, Baisakha, and Jestha witness to southern winds and give reliefs from summer temperature. The latter three months accompany short-lived storms locally known as *Dhadara* or *Dhumalia*

based on Northern- western wind. Finally, Asadha, Shrabana, Bhadrab, and Ashwina months generally experience winds from all directions. This period begins with the dominance of northern winds starts rainfall, transforms into severe storms that are brought by the eastern winds, while the southern winds at the end finished the storm. However, they have been experiencing the changes of wind blowing last 10 years.

Seasonal Availability of Migrants' Aquatic Species

Margashira, Pausa, and Magha (November, December, and January) that bring northern winds generally sees a rise in the number of seabass (*Vekti*), mangrove red snapper (*Rangua/Alata pottei*), croaker (*Borei/ Tatara*), mullets (*Khainga*), Indian salmon fish (*Shalapanji*) and Indian Shad (*Ilish*). In Phalguna, Chaitra, Baisakha, and Jestha on the other hand, a lot of migrant fishes are found. Species such as rainbow sardine (*Kokal*), white sardine (*Chaara*), sardine (*Khasuli*), Pomfret (*Chandi*), Indian mackerel (*Marua*) and various types of anchovies are more in number. Finally, in Asadha, Shrabana, and Bhadrab all kinds of fishes and their varieties move up and down the rivers. *Ilish*, for instance, come to fresh rainwater for food and reproduction. Freshwater fish also reproduce during this period, leading to a rise in their activity.

While this form of knowledge has been helpful to the fishermen and the environment for apply appropriated nets, due to unpredictable climate change and its aftermath, the behavioral patterns of the winds and the fish are misaligned in accordance with the unsystematic routine of the seasons. This has been impacting the practices and livelihood of the traditional Kaibarta fishermen significantly. If the weather conditions are, good they go for fishing, when fishing does not take place, the fishermen spend most of their free time repairing their nets and boats. According to responders, because of impacts of climate change, winters arrive late, leading to a flat in the arrival of the northern winds. Moreover, since the monsoons are unsynchronized, their traditional calendar is thrown into a disarray. Due to the general impact of rise in atmospheric temperature during the summer, the subsequent southern wind that is believed to soothe the heat is rendered ineffective. The rise in temperature also lead to a rise in the temperature of the aquatic surfaces, which hamper the behaviour of the fish, and consequently, fishing activities.

Table 1: Fishing Calendar

English name of Lunar day	Local name of the lunar day	Tidal nature
Full moon	Purnima	Peak time of high-water current
1 st lunar day	Pratipada	Gradually water current decreases in high water current
2 nd lunar day	Dwitiya	High water current

<i>English name of Lunar day</i>	<i>Local name of the lunar day</i>	<i>Tidal nature</i>
3rd lunar day	Trutiya	High water current
4th lunar day	Chaturthi	High water current
5th lunar day	Panchami	Low water current
6th lunar day	Shasthi	Low water current
7th lunar day	Saptami	Low water current
8th lunar day	Ashtami	Low water current
9th lunar day	Nabami	Low water current
10th lunar day	Dashami	Peak low water current
11th lunar day	Ekadashi	Gradually water current increases high water current
12th lunar day	Dwadashi	high water current
13th lunar day	Trayodashi	high water current
14th lunar day	Chaturdashi	high water current
New moon	Amavasya	Peak high-water current

Source: Fieldwork

The above (table.1.) states about the tidal nature of the whole month. Mainly the high-water current reaches the peak time during the full moon and the new moon day in every month of the year. Subsequently, the water current gradually decreases from 1st lunar day to 5th lunar days (Pratipada to Panchami) but Kaibarta fishermen consider high water current. Then, the low water current which emerges from 5th lunar day (Panchami) to reaches the peak low water current 10th lunar day (Dashami). Then again from the 11th lunar day (Ekadashi) the tidal water current starts to increases and reaches the peak during the full moon or the new full moon day. The same names are used again for the lunar days between the full moon and the new moon day. The high water current tidal phases from 11th lunar day to the 4th lunar day, both the new moon and full moon phases the catches high. Based on tidal condition suitable types of nets are operated by the Kaibarta fishermen.

Types of Net found in the study area

Each region has its unique variant of traditional fishing gear based on the kinds of water resources available, the size, species and type of fish available, and the local culture. These traditional fishing gears are often based on understanding and techniques passed down from generation to generation. Traditional Kaibarta fishermen use various nets based on their traditional knowledge of the environment, the tidal cycle, topography and size of the water resources.

Bhauri Jala

Bhauri Jala is a cast net, commonly used fishing gear in all types of water bodies throughout Odisha. It is Known as *Phinga Jala* in Ganjam as well as in the studied area known as *Bhauri Jala* (Sridhar and Muralidharan, 2013). It is a circular net in the shape of a large umbrella. A strong rope is attached to the top of the net, and a number of lead or iron weights are fixed along its circumference. To cast it, the fisherman throws the net in a way that it spreads and opens fully over the water, while holding the long rope in his left hand. This has to be done very skillfully so that the net falls on the surface of the water spreading through the largest surface area possible. The net sinks to the bottom and the circumference closes due to the weights attached to it. All kinds of small sized fish are caught in the net, which is then pulled out by means of the rope. The cast net is extensively used in ponds and rivers and all along the estuarine area of the sea, but cannot be used in places full of weeds or with rocky bottom. The material of the net thread can be both nylon or disco and mesh size varies from 28 to 34 points. Mesh size may be differed for catching targeted big fish in shoreline area.



Fisherman engaged Fishing by *Bhauri Jala*

Munduli Jala

Munduli Jala, is a kind of scoop net used by the Kaibarta women for their traditional way of fishing during before and after 30 minutes of pike time of low tide cycle in daytimes only. It is a simple handheld net, round in shape and it does not have a handle. It is made by bending a bamboo stick or aluminium wire to form a round scoop of about 50 cm diameter and a piece of webbing net about 1m it fixed to the bamboo

frame using a twine. With smaller mesh size about 12mm, they scoop fish out of the water on the shore during 1 to 2 hours of peak time of low tide in river, estuarine, and creek area. This fishing method is community based for home consumption. Most of women of the Kaibarta community use this technique to catch small fish, prawn, and crabs from the shallow waters. While this net is generally used by women to collect fish for their families, the surplus is still sold.



Women engaged in fishing by *Munduli net*

Phasha Jala

Phasha Jala is well known as gillnets, it depends on the species targeted as well as design and configuration of net, fishes are caught in gillnets by four types of catching mechanisms, viz., gilling, snagging, wedging and entangling (Thomas, S. N., 2019). The net is set in transverse direction of the migrating fish, so that when the fish tries to swim through a net wall, the meshes form a noose round its head and fish is caught. As the fish tries to escape, it gets stuck up behind the opercle, hence these nets are called gill nets. In order to be efficient, the meshes must be of right size and shape for the fishes to be caught (Khanna, 1993). *Phasha Jala* are mainly operated in low current of water, 30 minutes before and after peak time of both



Phasha Jala (net)

high tide and low tide by floats on the surface of water and its operation is completed after 2-3 hours in every day. Gillnets are typically rectangular, much longer than their height, with a float line attached along the upper edge and a thick rope securing the net. A line of lead sinkers of clay and cements (weights) are attached along the lower edge, attached by a thinner rope with a hanging rope. The net is usually set with mesh sizes between 28 points to 200 points, with knots evenly spaced both lower and upper edge of

net. According to various process of fish catching in the sample area different gillnets like *Chandi Jala*, *Suta Jala*, *Tiniandia Jala*, *Vekti Jala*, and *Tinipati Jala* are found for all types of fishes about 100gm to 5 kg (table.2.). The process of operating all nets is different. These nets that float on the surface of water, are called floating nets (*Bhasa Jala*). They can be set at any desired depth water and fishermen sometimes let the floating nets drift freely in rivers, lakes and other water resources with attached weight sinkers. These are called *Buda Jala*. When the current of water is strong, most of Kaibarta fishermen in the evening, the nets are stretched across the river banks or creeks area fixed by two or more pole in semicircular structure. Then in the early morning they collect their catches, if the unwanted aquatics captured in the nets they released to the respective rivers. They wash the gillnets properly after fishing, *Bhadi*, a structure made out of bamboo is used to drain water out of the net. The fishermen don't put the nets under direct sunlight, so as to save them from being damaged, since it might lead to issues in its durability. Mainly 3-4 people are needed for a boat to operate these nets.

Table 2: Various types of Phasha Jala

Local name of the gillnets	Thread and Mesh size	Targeted fishes
<i>Chhandi Jala</i>	Disco, 95-100 points	Indian shad, Mulletts, and other aquatic species of about 500gm -5kg above
<i>Tiniandia Jala</i>	Disco, 65-75 points	Sheat fish, Spotted Scat, Long whiskers, and other aquatic species of about 200gm -5kg
<i>Suta Jala</i>	Disco, 28-38 points	Various types of Sardines and other aquatic species of about 20gm to 1 kg
<i>Vekti Jala</i>	Nylon, 100-205 points	Seabass, Mangrove red snapper, Croaker, Mullet, Indian shad and aquatic species of about 500gm to 10 kg
<i>Tinipati Jala</i>	First layer Nylon-100 points, second layer disco-36 points, third layer Nylon-70points,	All small to big fishes weighing about 100gm-5kg in particular water area

Source: Fieldwork

Binti Jala

It is a conical with a circular mouth net. This net is generally used by fishermen during the return of the high tide from river to sea, an event they call *Ohalapani*. The process of its operation is carried out in shallow waters, where two iron rods are fixated into the sandy riverbed, and the big net is opened widely, and attached to these anchors, resembling the open wing of a bird in flight. The widely gaping mouth of the net is attached to two long and flexible bamboos known as *Soli badi*, the vertical bamboo

is attached to the middle of the lower lip and passes upward through a ring in the upper lip of the net. The net is suspended from a boat and the mouth is kept open by putting pressure on the bamboo pole. Another fisherman sits holding the rope attached to the pointed end of the net, investigating the weight of the fish caught. After collection of required amounts of fish is completed, the mouth is closed by releasing pressure on the bamboo poles thereby shutting the mouth of the trap. The net is tied between stakes at the peak time of high tide cycle Sabara and is hauled just before the cycle ends about 30



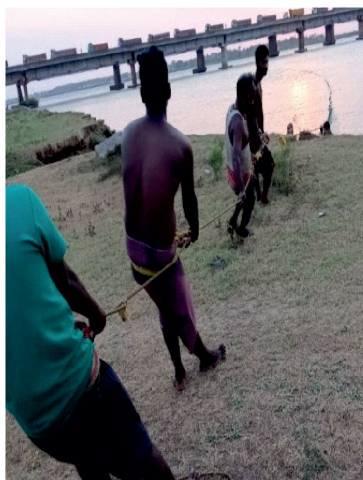
Binti Jala

minutes before the peak time of low tide (*Tangara*) in the deep water about 4-5 hours, where two iron pole or strong wooden plough like sticks attached with ground soil which known as *Nahangara*. As floaters, the fishermen use two plastic barrels along the wing of net and two flexible bamboo sticks (*Soli badi*). Mainly 2-3 Kaibarta fishermen use the one net from Ekadashi tithi to Chaturthi tithi of both new and full moon for 5 hours in two times in a day. This net, made from polyethylene fibre, with mesh size is very small, around 20 to 22 points.

Sareni Jala

Sareni Jala is a hauling net, based on net structure, there are two types of Sareni nets is found: Sareni with pocket (Ghai) known as *Ghudughudia Jala* and without pockets is called simple Sareni Jala. The *Ghudughudia Jala* upper edge of net consists floats with thick rope and lower edge consists with pockets like bags, thin rope with iron leads (*Murdanga sisha*). The simple Sareni net consists upper edges strong long strong rope with plastic and polystyrene floats and lower edges consists strong rope with weightage sinker both cements and clay. Both nets are mode of operation is same manner in the study area. After selection of shoreline area during 5th lunar day to 10th lunar day (*Panchmi tithi to Dashami tithi*) peak time of both tidal cycle, one end of the net remains on the bank of the river or sea shore, while a boat carries the rest of the net to spread it out in the water, covering a large, semicircular area about 1-2 kms area. The fishermen onshore pull the opposite end of the net towards them by *Antakhanja* in a row by each

side. This coordinated effort allows the capture of various aquatic species present in the operation area. The two ends of the net are then slowly dragged by two parties of fishermen towards the shore, collecting all the fish in the area within the net. This coordinated effort allows the capture of various aquatic species present in the operation area.



Mode of Fishing Operation



Sareni Jala

This technique primarily captures in Sareni Jala is small juvenile species about 5gm to 100gm only, whereas all 100gm to 5kg aquatic species in Ghudughudia Jala, which tend to gather in the middle portion of the net. Both Ghudughudia Jala and Sareni Jala exemplify traditional, labour-intensive fishing practices that utilize the tidal cycle before 30 minutes both peak time of tidal cycle, same times the water current is very low to maximize catch efficiency while preserving local fishing knowledge and culture. The unwanted aquatic species they are released in the water resources. The net's mesh size ranges from 30-36 points for Ghudughudia Jala, and Sareni Jala mesh is 12 points and it is made of nylon and plastic multifilament threads.

Bera Jala

Bera Jala, as explained by Sridhar and Muralidharan (2013), is a type of tidal wall net fishing method, locally known as Malo in Puri and Bheti Jala in Kendrapara. This is a type of net that is used in the shoreline by Kaibarta fishermen. Usually, the fishermen group which utilize this type of netting while catching fish are large, and consist of 12 to 16 members in one group. Similarly, 3 boats are used, out of which, one is a large



Bera Jala

motorized boat, and the other two are smaller boats, also known as *dongy* boats. The fishing operation typically lasts 7-8 days in a particular area during new moon and full moon periods, from Ekadashi to Trutiya Juara. The fishing expedition starts with long sticks having a pointy end at one side called “*Kila*” being loaded onto one of the boats. The second boat carries the net, and a wooden plough, spades, and other tools required for the casting of the net. The third boat carries fishermen and essential like drinking water, medicines, torch lights, firewood, and other fishing equipment. The fishing spot is usually selected in such a way that during the peak of high tide, tidal water in that area reaches the height of 5 – 10 ft, and during low tide, it dries down. Fishermen within the group plant bamboo or other types of sticks at intervals of 2-3 meters the pointed ends of the sticks on the opposite side of the net, towards the face of the river. By then, a high tide would be on its way, and by the time the entire process of casting or planting the net and sticks would be over, the tidal water would reach knee height. The fishermen return and rest till the time the tidal waves reach their peak. Once the waves reach their peak, the 2 traditional boats or Huli boats spread out, one on each end of the net, carrying 2 men in each boat respectively. The men lift the upper end of the net by a rope running through the top most grids, which has been placed there so as to not exert any extra pressure on the netted threads. The men then drag the net from both the sides towards the middle like a crown. Upon reaching the middle point, the net is pulled completely, covering the area from the sides and the top, wherein the fish inside the net get trapped and have no way to escape. The next step in this entire expedition starts once the water level decreases. During the peak of low tide, the water recedes and the ground beneath

the net would be either dry or has too little water been of no help to the fish trapped inside the net. The group reaches the netted area to collect the fish which can be found to be flopping inside the scoop net. The group returns to their shanty and repeat this process for 8 days at a stretch in the one lunar period which is followed by a resting period of 7 days, and is resumed for the next 8 days in another lunar period.

Since the mesh size of the nets being used currently becomes a bit suffocating for the fish that are caught, the smaller species such as the seeds are unable to sustain life along with the larger fish. Because of this issue, for the conservation of smaller species, the union of traditional fishermen society has informally banned the usage of nets with smaller mesh, and has suggested the usage of a net with larger mesh size (i.e. 28-36), but in the study area, a few fishermen still use the conventional nets even today.

Jalei Jala

Jalei Jala is a kind of push net with a conical lower edge and a conical upper edge, known as tongue of the net. This net is attached to the ground with the help of a rope with small clay sinkers, such as stone known as (*Totala*), these sinkers make sure the net touches the bottom. This net is most utilized in the study area for catching shrimps and small fish in shoreline of rivers, estuaries, creeks and mangrove swamps during low tide period. The thread of the net multifilament of combination of nylon and plastics. The mesh size of the net is very small, around 20 to 25 points. It is pushed through flow of the water by two fishermen; the operation of the net is labor-intensive and requires skill and knowledge to avoid underwater obstacles such as rocks that could damage the net or injure the fishermen. The operation of the nets only occurs during low tide period when the water flow from the river to the sea, that is, from Dasami to Chaturthi.



Jalei Jala

Pelana Jala

Pelana Jala is one of the triangular push nets. The net fixed with bamboo sticks crossed over each other like scissors. To keep the net open, two poles of bamboo about 5-10M long, depending on the size of the net, are tied so as to form an inverted V-shape, ending in one flat, narrow piece of wood known as *pata*, which helps avoid obstacles in mud. The thread of the net is made out of polyethylene material. The net has very small meshes like mosquito net. When in operation, the net is pushed over the bottom in shallow waters, especially to catch small fishes and shrimp or shrimp seeds. Generally, the fisherwomen use the net for catching the bagda shrimp seed collected for selling the produce in local markets and other aquatic species like small fishes, crabs, other variety of prawn like gajachingudi, marandichingudi, kantalachingudi, and nethachingudi for their own consumption. This net is only used in shoreline and creeks area during before one hour of peak low tide cycle from April to August (Baisakha to Bhadrab).



Pelana Jala

Shidi Jala

Shidi Jala is structurally conical with a rectangular mouth. The mouth of the net is to a stair like bamboo structure, which faces the water current and keeps the net's mouth open. The thread of the net is made out of polyethylene material like mosquito nets. When the high tide starts its cycle, the net fitted is with traditional boat's bow with a strong pole and the net is operated in the estuarine and tidal river area during Ekadashi tithi to Panchami tithi. The net use for seed collection of aquatic species in surface water

current during high tide cycle about 6 hours two times a day and collects various seeds like *Khanga* fish seed in December-March, *Bagda prawn* in June-September, *Arua* crabs in December-March. The union of the traditional fishermen has banned in the study area informally for the conservation of the aquatic species. But very few fishermen still use this net and this method for seed collection, and subsequently selling the collected harvest to the local pond farmer in the study area.



Shidi Jala

Hook Fishing

Kaibarta fishermen of the sample area mainly used three types of hooks fishing. These hooks can be used individually or in multiple numbers with a bait by using small fish sardines (kokala machha), earth worm, prawn, crab and others. This type of fishing is generally found in estuarine, river, pond and even at sea on the surface of the water along the shoreline area about 1-2km long.

The Kaibarta people purchase the small or big hooks from local net shops for capturing of fish in near shore waters. The edge of the hook is usually made very sharp and pointed. These hooks are strong and non-corrosive and are used up to one year. Hook sizes are commonly denoted by a number on a scale of 5 to 20, 5 being the largest and 20 being the smallest for round bent -type hooks.



Phopada kanta fishing

Single hooks attached to a bamboo stick by the help of fishing line is known as *Banishi kanta* fishing. Long handline of long plastic line along with a single sinker is used to catch the fish is known as *Phopada kanta* fishing. Finally, a series of hooks attached to a single fishing line forming a row, it is known as *Hara kanta* fishing. *Hara Kanta* fishing allows the fishermen to move into the middle of the river in a boat, and stretch the fishing line through a wide area. Each hook is attached with a bait, and contains a floater, which keeps the hook at the surface of the water.

In this method fishermen target big fishes such as *bhekti*, *khainga*, *Ilisha*, *Khuranta*, *chandi* etc. using baits. Live bait attracts the fish the most, but is not always available, hence dead bait is used often. Hand lines also carry several hooks to increase the chance of bite. The bait is an essential part of line fishing, and has to be carefully selected as to attract the fish by its colour, smell or movement, and depends upon the type of fish or its physiological state. A mixture made of flour or baked rice and pieces of fish flesh is also used.

Kankada baska

The trap in the attached picture is made of iron wire and is webbed net in the shape of a box, locally known as *Kankada baska*. It is placed only creek area where the water runs during tidal period, in order to collect the crabs. It is placed in the creek in the evening, or when the low tide period is at its peak, left there throughout the hightide period, or overnight, and then removed after the high tide ends. The trap is fixed with a bait within, made of dry fish like Eel, sardine fish and wastes such as hen stomach. The trap is made in such a way that only allows entrance to the crabs by attracting them in with the smell of the bait, but does not allow it to exit.



Kankada baska

Andhuni Baska

In the study area lowland paddy fields, ponds, canals freshwater are sometimes found with *Andhuni baksa* set within them, with the intention to collect small fishes, particularly during rainy season. It is design in a way that bamboo splits are cut into required length and width, and plastic thread like mat is woven around these splits. There is a certain skill required for the making of this box. It is rectangular in shape: two opposite sides of this box have small openings measuring around 6 slits, which act as entrance to the fishes. Length of the box is about 150 cm and breath is 75 cm. It is placed along the direction of slowly flowing water overnight. The muddy soil creates a bridge on one side of the trap, so that only water can escape through it, and top of the trap is covered with muddy soil to protect it from the flowing the water.



Andhuni baska

Modern challenges and Adaptation

Kaibarta fisherfolks livelihood are complex, dynamic and adaptive in the sample area. Kaibarta fishermen's livelihood consists cultivation along with fishing. Paddy is the primary crop being produced and consumed in the sample area. A decade back, green gram, and other pulses, and vegetables were cultivated after the paddy harvest. However, due to the increase in salinity, lowered the quality of soil, leading to lesser production. Since the area under the coastal zone agricultural land has transformed to aquaculture the livelihood is in danger (D.A., Ramesh, et al, 2024). The economic background of family, supports system of the agency officers and the social group play a

significant role in the promoting the use of mechanized fishing equipment's among the fishermen (Fadzil, et al., 2019). Modern technology in fishing sector mainly includes introduction of traditional boats into motorised boats, use of advanced machinery nets , improvement in marketing facilities like ice usage for reduce post harvesting loss and others, like smart weighing machines, GPS facilities to identify the moving fish fleet, weather predicting technologies in boats etc. The use of fishing technology increases the productivity and income of fishermen, allows the fishermen to shorten their fishing operations. Mainly traditional method referring to the position of the stars or tidal nature are less accurate in detecting fishing locations. GPS can give early warnings of the potential threats and hence help the fishermen to navigate safely to the landing points (*Jetty*) in case of bad weather. Meanwhile, communication devices such as wireless sets or mobile phones help them call for help in case of emergency and to collect price value of markets on specific aquatics products. The fishermen community faces several obstacles and limitations when it comes to utilizing fishing technology in their fishing operations. One apparent limitation is their technological illiteracy; this shortcoming forces the fishermen community to continue fishing based on their traditional and old fishing methods. These implementation demands high monetary expenses from the side of the fishing folk communities. Now the efficiency of the nets evolution considerably by using transparent polyamide nylon, Plastics, Disco in such ways developed instead of natural fibre. While natural fibres used in nets are biodegradable, the wastes produced upon their final use broke down easily. The modern materials, however efficient and easy, are nonbiodegradable, and hence, cannot be broken down into the soil, leading to pollution in shoreline area.

The major issue found prevalent in the community is the unaffordable equipment's required for operating modern, mechanical boats. While the government does provide 40% subsidy for nets and 60% subsidy for boats, the fishermen in the study area still complain, it is not enough for them.

The government also funds training programs for the traditional fishermen to be familiarised with modern, mechanical boats. While these training programs are somewhat useful, the knowledge of training is not carried beyond the program into a practical application. The fishermen stay helpless when it comes to the application of the same techniques they were trained for during the program.

Moreover, the oil leaking from the boat, and the sound pollution caused by the motor of the boats carrying materials through the waterways lead to unwanted contamination, consequently destroying the habitats of the fish. Furthermore, since using motorised boats save hours, by increasing efficiency by multiple folds, the fishermen tend to utilise

these hours in fishing in a different patch. This process leads to overfishing, putting a heavy toll on the environment. The uncertainty of fishing, modern technology uses, water pollution, overfishing, entry of migrants and other non-caste fishermen, and lack of interest among younger generation of Kaibarta people, have created issues in sustenance of fishing activities.

Conclusion

Indigenous fishing techniques are eco-friendly and cost effective. Each nets possesses a unique pattern of operation and is highly variable according to the fabrication material, area and depth of water bodies as well as season of operation resources which avoiding capture of small fish, fry and eggs (Ganguly A et al. 2022). The uncertain nature of fishing, modern technology uses, water pollution, overfishing, entry of migrants and other non-caste fishermen, and lack of interest among younger generation of Kaibarta people, have created issues in sustenance of fishing activities. The government and other stakeholders must encourage such indigenous, eco-friendly, cost- effective approaches with modern technology for the conservation of bioresources.

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