International Journal of Humanities & Social Science Studies (IJHSSS)
A Peer-Reviewed Bi-monthly Bi-lingual Research Journal
ISSN: 2349-6959 (Online), ISSN: 2349-6711 (Print)
Impact Factor: 6.8
Volume-XII, Special Issue, April 2026, Page No. 375-391
Published by Scholar Publications, Sribhumi, Assam, India, 788711
Website: http://www.ijhsss.com
DOI: 10.29032/ijhsss.vol.12.issue.specialW.306

Traditional Mud Crab (Scylla olivacea) collection and livelihood opportunities in the Indian Sundarban

Manotosh Gayen
Independent Research Scholar, Kolkata, West Bengal, India

Received: 05.04.2026; Accepted: 07.04.2026; Available online: 10.04.2026

Abstract

Mud crab (Scylla olivacea) collection is an alternative, profitable livelihood option for the coastal fisherfolk in the Indian Sundarban. According to the survey, mud crabs are primarily collected from wild sources by men, who prefer traditional methods such as hooks and baited lines (done and thopa) while fattening crabs in tidal rivers, fisheries, and earthen brackish water ponds. Most of the respondent persons have their own fisheries and rearmost crabs, collecting crablets from the riverside as a partial livelihood option. The practice of fattening crabs is based on discarded mud crab congeners of the genus Scylla, specifically Scylla serrata (Forskal, 1775), Scylla tranquebarica (Fabricius, 1798), and Scylla olivacea (Herbst, 1796) without separating species. In this context, it is believed that understanding species-level identity is essential for sustainable wild harvest, including the fattening of mud crabs that are discarded, which is significant to the rural economy of the Indian Sundarban. The majority of crab fishers sell crab in the fishing market, but the majority of them are exploited by middlemen and aratdaars. This paper attempts to highlight the traditional harvesting methods related to rules, rituals, experience, issues, and a cost-benefit marketing value chain analysis of different crab cultures in the Sundarban region of West Bengal.

Keywords: Mud crab (Scylla olivacea), Species identity, the Sundarbans, traditional methods, Marketing chain

1. Introduction:

Coastal ecosystems are complicated and dynamic systems that are continuously impacted by a variety of factors, including population growth, pollution, development plans, pressure from tourism, and biophysical changes (Campbell et al., 2006). The coastal ecosystem supports crucial agricultural and fishing communities' livelihoods (Roy et al., 2021). The Sundarbans are one of the unique mangrove-dominated deltaic seaside ecosystems situated in India and Bangladesh along the Bay of Bengal (BoB) coast. Mangroves also provide natural barricades by absorbing storm surge impacts during extreme weather events such as hurricanes, cyclones, waves, tidal bores, and tsunamis (Sandilyan and Kathiresan, 2015). Mangroves can also remove salt through ultra-filtration over their roots (Krishnamurti et al., 2014). They can help to prevent shoreline erosion, stabilize the coastal ecosystem, and play an important role in human sustainability and livelihoods, particularly in developing countries (Alongi 2007). Mangroves store a lot of carbon in their soil over millennia, avoiding greenhouse gas (GHG) emissions and as long

as a large underground reservoir of nutrients. Mangroves also provide a lot of sediment, and the rate of soil growth in mangrove forests is at present-day keeping up with the rate of mean sea level rise (Atwood et al., 2017). These tidal forests are important nursery grounds and breeding grounds for birds, mammals, fish, crustaceans, shellfish, and reptiles, as well as a renewable source of wood and sites for sediment, nutrients, and contamination accretion (Manson et al., 2005). Mangrove litter contains valuable bioactive substances, which when they fall into the river water form an energy-rich detritus that supports the growth and survival of aquatic life (Viswanathan and Raffi, 2015). Mangroves provide a favourable habitat for the proliferation of many juvenile organisms such as zooplankton, fish, shrimp, crabs, etc. According to Bandekar (2021), mangrove forests provide a wide range of ecological niches for crabs, which frequently separate themselves in both space and time to lessen food competition between different species (Kathiresan and Bingham, 2001). The local, thriving coastal community depends on these bio-resources for a living because the Sundarbans are remote and inaccessible.

Crab collection is a major livelihood option for the coastal fisherfolk in the Sundarbans (Roy et al., 2021). Wild mud crab (genus Scylla De Haan, 1833; Crustacea: Decapoda: Brachyura: Portunidae family) is traditionally fattened in common mangrove areas in brackish or coastal waters along the shoreline, rivers, estuaries, canals, and intertidal swamps of the Sundarbans (Kamal et al., 2008). It is in high demand throughout the world, mostly in Southeast Asian countries. This seafood delicacy is considered one of the tastiest of all crab species. This is available worldwide and is mostly sold live in global markets. Mud crab is one of the most valuable crustaceans in both domestic and export marketplaces (Christina et al., 2019). Today, mud crab harvesting in the forest's narrowest creeks is one of the most indigenous technologies, based on the indigenous knowledge as well as the practices, culture, customs, and norms of the Sundarban peoples. The crabs of the Indian Sundarban are more important than those from other regions.

2. Materials and Methods:

The present study was carried out through a field survey at monthly intervals from March to September 2024 in Gosaba Block (one of the ecological hotspots for fishing, farming, and embankments) at three landing centres: Satjelia, Lahiripur, and Dayapur in the south 24 Parganas district (Figure-1). The study acquired primary empirical data from a direct field survey following semi-structured questionnaire-based individual interviews, along with focus group discussions (FGD) with a checklist and key informant interviews (KII). Obtain data from fishing activities, in particular mud crab collection, as well as social, economic, and environmental factors influencing crab fishers and their daily activity. A semi-structured questionnaire interview included fishers' name, age, experience, and techniques used (with a focus on harvesting rules, traditional rituals, culture, and methods, the male-female ratio, the survival crisis, production, price, income, and politics), marketing intermediaries, local middlemen, retailers, depot owners, exporters, and other relevant issues in the study area. In this area, people mostly use traditional methods like thopas and dones for crab harvesting. During the crab-harvesting period, small fish were used as bait at each station in the rivers. Secondary data were gathered from various scholarly articles and related literature via professional academic social networking sites (ASNS) such as academia.edu, ResearchGate, Google Scholar, LinkedIn, and Mendeley, as well as

ScienceDirect, a full-text database scientific website published by the Dutch publisher Elsevier.

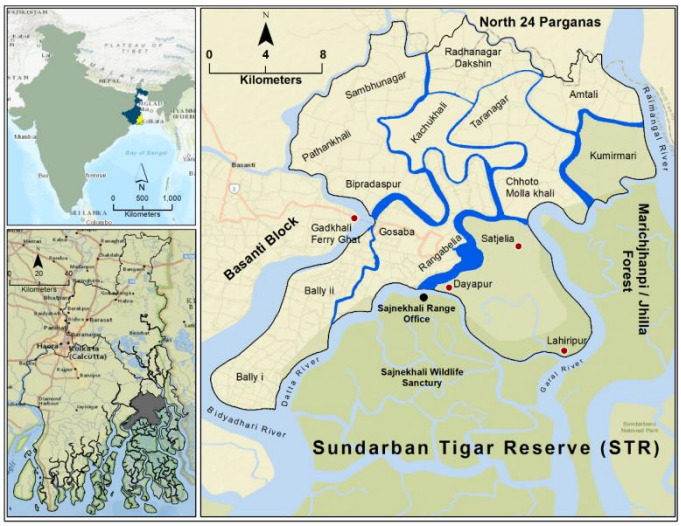

Figure-1: Location of the study village in the Sundarban Biosphere Reserve (SBR), West Bengal, India.

3. Result and Discussion:

Distribution and general features of mud crabs

The mud crab (genus Scylla), generally known as green crab, mangrove crab, "Habba kakra" or "Silla kakra," (Kamal et al., 2008) and locally called 'Kankra,' (**Figure-2**) is one of the most popular, important, and costly sea foods in the South-East Asian countries (Pripanapong and Tongdee, 1998). There are four commercially important and globally renowned mud crab species: Scylla serrata, Scylla tranquebarica, Scylla olivacea, and Scylla paramamosain (Keenan et al., 1998). These species, one of the biggest crustacean decapods in the Portunidae family, may attain 2 kg in weight (Piatek, 1981). Among these, Scylla serrata, the largest species, can grow to a size of over 1.5 to 2 kg, measuring 180 mm in length, and is commonly known as the green crab. It is widely distributed in the Indo-West Pacific region. Scylla tranquebarica occurs frequently in the South China Sea and is also found in some specific locations in the Indian Ocean and the Pacific Ocean. Scylla olivacea moderately common species, with orange to reddish coloration in the claws and carapace, can reach a maximum weight of 1.2 kg and is frequently found in the South China Sea, but have also been reported from specific locations throughout the Indo-West Pacific. Scylla paramamosain only the continental coasts of the South China Sea, Central Java, and Vietnam have been reported to have a high abundance.

However, the species of the genus Scylla are extensively dispersed in the tropical waters of the Indo-Pacific estuarine regions as well as the Indian Ocean coast (Keenan et al., 1998), particularly in the estuaries and swamps of the Sundarbans' natural habitat (Overton et al., 1997). The subtidal and intertidal areas of mangrove wetlands are the typical habitat for the genus Scylla (Rouf et al., 2021). More specifically, juvenile crabs are primarily found in the mangrove intertidal zone, while adults are found mainly in the sheltered inshore or deeper sub-tidal estuarine areas. Of the four, two species, Scylla serrata and Scylla olivacea, are available, while S. serrata was considered the most common after followed by

S. olivaceae in India and Bangladesh sundarbans (Bhuiyan et al., 2021). Since crab spawning occurs in the deep sea, the abundance of the larval population escalates as one move away from the coast and toward the ocean (Sara, 2010).

There are 822 species of crabs found in India and 135 species in West Bengal and 11 species of crab have the highest economic importance (Christina et al., 2019). Of these, Myla, Habba, Sila and Setra crabs are known to contain a lot of vitamins. Some of the different edible species of crabs found in the Sundarbans are *Partunas peljicas, Partunas saiguilontas, Baruna littarata, and Sartorimana spiniza* (Nandi et al., 2016). Sundarban crab fishers generally catch mud crabs, which are one of the most widely consumed and economically valued crabs in the Indo-Pacific region.

Black mud crab

Gray mud crab

Green mud crab

Greenish mud crabs

Orange mud crab

Brownish mud crab

Figure-2: Different features of mangrove mud crabs, *scylla serrata (forskal, 1775)*.

Crab fishing permit related rules

During the crab harvesting season, I went to a field visit in Lahiripur and met different crab collectors. They said, In the summer month, crab fishing is not allowed in the STR as crabs breed during this time. The crab season remains closed from April 1st to June 30 (Patel and Rajagopalan 2009). Fishing is only allowed within the four buffer forested areas like Arbesi, Jhilla, Khatuajhuri and Harinbhanga blocks under the Basirhat Range. Fishermen can only use non-mechanized wooden boats (dinghy or nauka) in this permitted zone of fishing. The usual length of a dinghy used for crab collection ranges between 18-20 feet. Fishing in the core and sanctuary of the STR is considered illegal. This restricted areas illegal fishing, is recorded under the Compounded Offence Report (COR) by the STR. For CORs, fines are collected from the fishers. In cases of COR, offenders are not taken to court (Ibid). According to Chatterjee et al., 2009, crimes like poaching, illegal wood collecting, tree felling, and illegal honey collection can also be included in this report.

Crab fishing in the Sundarban is usually a team work. Generally, three to four people form a team under the direction of a team leader (Sainder), with in a small sized nauka and conducted two fishing trips in a month, specially 15 days of Full Moon and the New Moon cycle.

For catching crabs, the STR forest office renews a boat license certificate (BLC) for a maximum of four people per boat. Every year, from June 16 to June 30, the BLC is renewed. After July 1, the fishermen started catching fish and crabs from STR. The Sajnekhali Forest Office is where BLCs are renewed. The duration of each pass in STR is six weeks (42 days), i.e., one and a half months. If someone wants to visit the forest after one and a half months, they must renew their pass before that time.

For collecting crabs, BLC is mandatory. In addition, everyone should carry a voter ID card or Aadhaar card with them. Without it, entry into the forest is declared illegal. Poor fishermen, who do not have their own BLCs and wooden boats, must hire them. The rent for a BLC for one year is Rs. 70,000, and the rent for a boat is Rs. 20,000 (Field Survey 2024).

Rituals related successful crab collection

Crab collectors in the Sundarbans follow some customary norms, laws, and rituals. They believe that if these guidelines are followed, they will be safe from the forest's various threats. For example, on Saturdays and Tuesdays, the days of the full and new moons, the first and last days of the month (as per the Bengali calendar), the crab fishers never set out on their first trip of the collection season. When three lunar days *(tithis)* fall on the same day, it is known as a "triple touch," and it is for this reason that crab fishermen avoid going into the forest. Because *'Terosparsha'* is typically regarded as an unlucky day in Hinduism.

One respondent [Srimanta Sardar (name changed), 69 years old, crab collector, illiterate] from Lahiripur village's Purba parashmani says,

> "Using a Bangla calendar, we follow the *tithis*, days and dates movement before going to the forest. We give worship to *Ma Banabibi* at the bow of the boat every Friday evening while in the forest. We also worship the *Dakshin Rai* (Tiger God or "king of the Sundarban"), *Gazi Saheb or Ali Madar* (Muslim Saint), and the *Kastha Devi* (Wood Goddess, that is, the boat). In addition, on the first of *Maagh* (Bengali month) every year, we offer worship to *Ma Banabibi*. We don't use soap as long as we are in the forest. We also do not clean our clothes with soap or soda. We don't eat crabs as long as we live in the forest. As long as we are in the forest, the women of our house (Hindu women) do not put vermilion and use comb on their heads. They don't even wash clothes with soap or soda. We abide by all the norms to protect ourselves from the apparent dangers of the forest. *Ma Banabibi* is our protector."

Over the course of the approximately seven-day crab collection period inside the forest, the fishermen carry on the boat rice, vegetables, drinking water, and other goods for their daily meals. Locals referred to this consignment as *"trip" or "khep"* in their native tongue. Some refer to it as the *"kankra marar party"* (crab collecting party).

Indigenous traditional knowledge

For collecting crabs, the locals make use of various traditional knowledge. Achin Paik (name changed), a 49-year-old, crab collector from Bidhan Colony in the village of Lahiripur, claimed that

> "Canals that are deep and narrow with lots of Hental bushes (Phoenix paludosa) on both sides and lots of holes on the banks of the river, are

places where crabs are more common. In shallow and wide canals, crabs are less common."

When inquired about the availability of crabs, it is revealed that during the monsoon season (July to September), crabs are more frequently found in the rivers. The high intensity of rainfall reduced the salinity of the river water and increased the tidal water height, which caused the river current (upstream) to be stronger, causing the crabs to emerge from their burrows in search of food. Crabs are lighter in weight and have fewer shells. On the other hand, crabs are less available in the winter season (November to February). Because the intensity of the winter in the water increases during this time, the crabs go into the hole. Another reason is to decrease the river's low velocity and tidal water height. Currently, the female crab lays eggs. crabs mating in the holes. Crab shells and their weight are high.

Traditional harvesting methods

The Lahiripur crab fishers use a variety of native and traditional methods for collecting crabs, including done (tying tiny fish to lengths of plastic or nylon) and thopa (a single baited line). People enter the forest through very narrow creeks, which are often so narrow that the vegetation must be cut and cleared while moving forward. The *Hental, Garjan* (Rhizophora mucronate lamk), *Goran* (Ceriops decandra), and *Gewa* (Excoecaria agallocha), etc. trees on both sides of the creek have such dense foliage that it is impossible to spot a camouflaged tiger, where tiger attacks are often possible. Three people catch crab on the boat. One person stays at the head of the boat (*gaulirlok*), the second stays in the middle of the boat (*majarlok*), and the third stays behind the boat (*pachharlok*). The following are some major traditional techniques:

(A) Done [(Soft pronunciation of D pronounced as ɖ (ড়)]

Done is a long rope, which is tied to a short rope after two and a half arms' length and hung. There is a loop at the head of the rope, where crab saplings (bait or food) are given. At the interval of five arms of the long rope heavy objects are tied. This is so that the done reaches the ground under the water due to the weight of the dulu. A brick or other heavy object is tied at the very end of the done so that the done does not go anywhere else. Floating objects are kept afloat with separate ropes at the two ends of the done, acting as symbols. There are different types of dones, some are 500 to 1000 arms' long, while some use 1500 to 2000 arms long. Length is determined by the fishing location and the anglers' preferences. Residents use a variety of dried eel fish, such as *Kaikshell, Bogi, Baim, or Cuchia* (Asian swamp eels), *Bine* (Anguilla bengalensis), *Bangos, or Bamus* (ophisternon bengalense), and *Salbine* (Mastacembelus armatus), as bait for crabs that are cut into small pieces. Crab collectors buy these baits from local aratdaars for Rs. 120 to 130 per kg. For a trip of eight to ten days, they take 10 to 20 kg of bait with them.

When the tide rises the done is thrown into the river because at this time the crabs come out of their holes in search of food. Sanjoy Mondal (name changed) 60 years old said it takes 20-25 minutes to drop a 200-arms' length done, where the done ends. There he waits for about 10-15 minutes, then starts picking up the rope. The done is not picked up in a hurry. Slowly, with a soft hand the done needs to be lifted; otherwise, the crab will escape.

Figure-3: The Done method of crab catching Photo source: Mehtta, 2021

Experienced people are needed to prepare dones. Someone who is sitting at the head of a dinghy boat (galui) slowly picks up the done and they have a net (a spoon-like vessel called a *jalti*) in one hand **(Figure-3)**. If a crab has been caught, then the crab will pull the rope. Accordingly, the rope should be gradually brought close to the hand, and from a certain distance, the crab should be scooped up with the jalti from under the water. After that, the crabs are collected and placed aboard the boat "*Dora*" (dinghy's middle section), another name is *khol* or *khop* (hold). In this way, catching crabs continues. The chelipeds are tied with a nylon string before being placed in the khol so that the crabs do not harm the fishermen or anyone else. Water is sprinkled on the crabs every alternate day so they can stay alive for up to 8–10 days at a stretch. Besides, *garan* trees' twigs (Ceriops spp.) were used for the preservation of crabs during the fishing trips in the forest. Garan twigs were used to separate one crab from another and stop them from fighting. Garan was selected over other mangroves because it could resist decay for a longer time. Done is laid and picked up taken 6-7 times a day. At low tide *(sesh bhata),* when the creeks are dry, and at high tide *(bharna joaar)*, it is not practiced.

(B) Thopa

This is an easy way to catch crabs. Things that are required to make a *thopa* are, firstly, a 6–8-feet wooden or bamboo stick, a 10–12-feet thin nylon rope, bait at the end of the rope, and a 200–250-gram brick piece *(dulo)* tied a little above the bait. One end of the rope is tied to the top of the stick. As bait at the other end of the rope, the locals use frogs [such as *Sona bang* (Hoplobatrachus tigerinus) and *Kuno bang* (Duttaphrynus melanostictus)] cut into small pieces. People who go to the forest everyday use this method often. Women and children catch crabs in local rivers in this manner.

Figure-4: The Thopa method of crab catching

When the tide rises in the river, one end of the twig is buried firmly in knee-deep water in the river. Threads tied at the end of the twigs are thrown towards the river. Each thopa is planted 20-25 arms' length away from each other. After some time, when the twigs start to move and the rope gets pulled, one can understand that the thopa has caught the crab; the crab is pulling. The locals then, with a jalti in their right hands, start pulling the rope slowly with their left hands **(Figure-4)**. When they can see the piece of brick tied to the thopa, they then catch the crab by gently inserting the net into the water with their right hand. As the tidal water rises, the thopas are planted increasingly upwards, towards the land. This process continues if there is high tide. When the tide starts to lower, crabs could not be caught, because crabs then go into their holes. The locals go to the river at low tide and return home at high tide. About 5 days before and 5 days after the new moon and full moon of the fifteen-day lunar cycle, crabs are captured with

thopa. Bent iron rods (*hook or sik*), aatal, hat done and loop netting are further techniques used for gathering crabs.

(C) Aatal

An aatal, or "jal backso," is a type of fishing trap/cage made by looping nylon rope. It is typically as long as a one and a half-handed and as wide as a one-handed. Bait (*char*) is kept in between, where the crab is lured into the food and gets stuck. This method is now widely used by crab collectors due to increased tiger attacks in the Sundarbans. Crab fishermen stand on wooden boats in the rivers, estuaries, and canals to catch crabs easily with the help of "Aatals."

(D) Hat done

The same as the done method. The "done" method involves catching crabs while seated on a boat, whereas the "hat-done" method entails wading through the canals to catch crabs. It has a length that varies from 200 to 400 cubits or more. This method is used in shallow canals or rivers when tidal water enters. To collect crabs, crab gatherers wade through the canal waters, which range in depth from knee-to waist-level. In this case, the crab fishermen collect the crabs with the jalti in one hand and the done in the other. They keep crabs in aluminium pots (*handis*), which are tied to a small rope around their waists. It floats effortlessly on the water and is easily pulled.

(E) Hook (*sik*)

The hook is a 0.5–1.2 m-long, 4–8 mm-diameter iron rod with a J-shaped bend at one end and a wooden handle at the other. In the intertidal mudflats, it is used to extricate mud crabs from their burrows. Crab fishermen first identified crab holes in the intertidal mudflats. They then used spades (*kodals*) to cut bigger and deeper holes. When the rods are placed into the burrow, the crab grips the rod with its claws, and then fishers slowly take out the rods and collect crabs. Sometimes the crab being agitated firmly clings to the hook with its strong chela. Crab fishermen, with their experience, can easily pull the crab out of the hole. Hook is mainly used by local tribal community in sundarban **(Figure-5)**. This method is most advantageous from Shashti to Dashami when the tidal water rises less in the river or estuaries.

Figure-5: Tribal women use the Hook method to catch crabs

(F) Manual (hand-catching)

Local men and women traditionally hand-catch a small species of crab directly from the mangrove trees on the nearby river banks, which are used exclusively for feeding. These crabs' name is "*gecho-kankra*" (tree-climbing crabs) in the native phrase of the "entire Sundarban" **(Figure-6).** The specialty of these crabs is that they live almost exclusively on mangrove trees (stems and canopy), which are restricted to Rhizophora of the mangroves. Most crabs rely mainly on fallen leaves for food. During high tide, some crab species hide in their burrows in the soft sediment surrounding the root system. while others remain out of the water by climbing up mangrove trees. Climbing the trees allows the crabs to avoid aquatic predators. Another specialized arboreal representative that frequently climbs on aerial roots.

Figure-6: Different features of gecho-kankra (Sesarmidae and Grapsidae families).

Experience

A huge amount of crab is available five lunar days before and after the new moon and full moon; these days are known as "*tithi*" in Bengali. Before five tithis such as *Ekadashi, Dwadashi, Thrayodashi, Chaturdashi, and Panchadashi* (full moon and new moon) and after five tithis such as *Pratipada or Prathama, Dwitiya, Tritiya, Chaturthi, and Panchami*.

During the period of fifteen days between the Full Moon (*Purnima*) and the New Moon (*Amavasya*), when the tide is high, crabs are collected. The first fortnight between full Moon Day and new moon day is known as "*Gaura Paksha,*" also referred to as "*Shukla Paksha,*" the period of the brightening moon, and the second fortnight of the month is called "*Vadhya Paksha,*" also referred to as "*Krishna Paksha,*" the period of the fading moon. The timing and duration of the tides during the crab fishing season regulate the movement of fishermen. This paksha are divided into short spans. The period of five tithis from the start of Shukla paksha and Krishna paksha is the time when the tide is strongest (locally known as *Bharani*) and the catch of crabs is highest. During this period, the river creeks are inundated. The large percentage of crab collectors go out to collect, During this time. For five days (*Shashti, Saptami, Ashtami, Navami, and Dashami*) after that the tide is weaker (locally known as *Marani)*, and the catch is less. During the preceding few days of full moon or new moon (*Ekadashi, Dwadashi, Thrayodashi, and Chaturdashi*), the tide is again very strong and crabs are abundant. The crab collectors usually start on the *Dashami* of the fifteenth day cycle, i.e., five days before Amavasya or Purnima and come back on the Shashti or Saptami after the Amavasya or Purnima. The water level of the rivers gradually rises each fifteen-day cycle before the full moon and new moon; this process is known to locals as goon or goon mukh.

Another respondent [Arup Mistry (name changed), 43 years old, male, crab collector, resident of satjelia village, educated] says,

> "Usually let us leave for the destination on the day of Dashami. We catch from the Ekadashi (Eleventh lunar day) to Panchami (fifth lunar day). In the Shashti (six day) we return home. During each period (trip) we collect crab for nine days, in between two days are spent in travelling; hence a total of eleventh days in one phase. We must stay in the forest for a total of 22 days in two fifteenth day lunar cycle in a month."

On each trip, fishermen also bring a mobile phone, a radio, flashlights (*torchlight*), choppers (*Da*), axes (*Tangi or kurul*), forceps (*chimta*), Scoop nets (*jalti*), a caste net (*Khepla Jal*), bamboo baskets (*Chakon, khara, jhuri*), utensils, bedding, and mosquito nets. To survive in the forest, they carry the following items to cook food and to worship Ma Banabibi,

Dakshin Rai, and Kastha Devi: sweet cake (*batasa)*, puffed rice (*muri*), incense (*dhup*), rice, black pepper, onions, garlic, ginger, sugar, batteries, biscuits, salt, water, oil, turmeric, and bidi (a type of cigarette produced from tendu leaves in India), etc.

Labour division

Some division of work can be observed in the STR areas. There is a division between both men and women. Young boys and girls also venture into the forest for fishing and crab collection. Short fishing trips are more popular among women than longer ones. Only men go on long fishing trips in the forest in groups **(Figure-7)**. One trip is completed in nine to eleven days.

Figure-7: Crab collection expedition in the deep forest.

Kousik Mridha (name changed) is a skilled crab hunter, who lives in a small hutment in Chargheri Lahiripur village on the embankment, explained that

> "There are a lot of norms and rules one has to follow when in the forest to catch crabs, which are impossible for women to follow." Moreover, there is danger in the forest (especially pirates and tiger attacks). "This is why we don't take women with us."

Some older men and women regularly collect crabs from the buffer zone and transition zone and return home normally. Most of them are 40 to 70 years old. The regular crab collection in the forest is called Nityamari by the locals. Most women catch crabs with the help of 'thopas' in the local Garal River **(Figure-8)**. In the village of Chargheri, Lahiripur, some adult male and female (between the ages of 40 and 60) also catch crabs here by 'thopa'. Adivasi men and women have been seen digging holes in local areas to collect crabs.

Figure-8: Different crab collection techniques in the local area.

Marketing

The mud crab is one of the most popular, tastiest, and economically important coastal aquatic species in India, with high prices (from 8 to 25 USD) and huge demand in the local, national, and international markets (Pripanapong and Tongdee, 1998) (**Figure-9**). It focuses

on market collaboration amongst various suppliers, producers, processors, and buyers who hold different degrees of market power (Mangubhai et al., 2017). Although crab fishers are the main actors in collecting the crab from the Sundarbans, they are a marginalized community in this region. Instead, the middlemen (*Fure/Bapari*) and *Aratdars* are the biggest beneficiaries in the current value and supply chain (Ferdoushi et al., 2010). The existing mud crab value chain is long and unstructured, and crab fishers are exploited by middlemen and aratdaars. This study aimed to analyse the marketing system and supply chain of mud crab in the Sundarban region, focusing on the mud crab culture and harvesting from natural sources.

Figure-9: Pre-marketing preparation of crabs.

(A) Grading system and crab fishers

The price of crabs in various grades is set by exporters depending on the dominant price in the international market. Both males and females weighing more than 100gm were considered for export. Usually, hard-shelled, meat-filled male crabs and meat-filled female crabs with a hard carapace and the entire gonad were considered for shipping. Crab fishers sell crabs in two ways: per kilogram and per quintal, at *Arat or Khoti (the* business places of *Aratdaars*) (**Figure-10**). They sell the collected crabs to middlemen, depot owners (*khoti-malik*), and suppliers at low prices. Presently, the crab harvesters sell two categories of crabs to the local *Fure/Bapari*, *chamber malik* and *aratdaars/khoti-malik*: large crabs (above 100 grams) are 450–500 rupees, and small crabs (below 100 grams) are 100–150 rupees per kg. Seasonally, there are two types of prices for crabs sold per quintal (100 kg). In the monsoon, the average price per quintal ranges from Rs. 45,000 to Rs. 50,000, and in the winter, the average price ranges from Rs. 90,000 to Rs. 110,000.

Figure-10: Local business place (Khoti) along the embankment.

(B) Middleman (Fure or Bapari)

Middleman purchased crabs from the crab fishers, sometimes also from the *chamber malik*, and sold their products to individual depot owners and suppliers. Most of them had verbal agreements with. Middleman all crabs (male and females) below 100 grams are considered

rejected and all crabs above 100 grams are considered of proper grade and buys crabs in cash.

(C) Crab fattening and chamber-malik

Crab fattening is an additional source of income for Sundarban mangrove forest peoples; these crab fattening operations are known locally as *chamber chas, kankrar fisheri*, *Nonajaler Kankra chas*, and those involved in crab fattening are also known as *chamber-malik* (fishery owners). Chamber-malik purchased soft-shell or eggless crab from crab collectors at low prices, raised the crabs for a short period of 15-20 days in their own or rented small shallow brackish water ponds (1–1.5 m water depth and ranging from 0.01-0.1 ha, usually adjacent to the river embankments, where inlet and outlet systems are available along the estuarine course and are utilized) to meet the increasing demand for gonad development **(Figure-11)**, and then sold the products at high prices to depot owners, suppliers, dealers and commission agents.

Figure-11: Crab fattening chambers along the embankment.

(D) Aratdaars or khoti-malik

Aratdaars sell the crabs at higher prices to suppliers and traders at local fish markets in the cities. *Aratdaars* first contacted suppliers and traders through mobile phones to determine the exact selling price. Then, for their own convenience, they sell these crabs in a variety of markets like Gosaba, Gadkhali, and Canning, from where traders auction them and send them to Kolkata, where they are packaged and frequently exported from Kolkata Airport to other international destinations.

(E) Suppliers and dealers

Suppliers are licensed traders and relatively large traders, and these stakeholders play a vital role in the value chain by providing product value and transporting products from the root level to Kolkata and international markets. They purchase a large volume of crabs from large depot owners, small depot owners, *fure* owners, and *chamber malik* owners and sell them to Kolkata exporters.

(F) Retailers

Retailers typically pick up low-quality, rejected mud crab from various depots (rejected for its small size, softness, and broken wings) and sell it in the local market for domestic consumption.

(G) Exporter

Exporters provided the ultimate services for domestic and international marketing channels in the mud crab value chain. They transport the live crab to Kolkata and then to global markets such as Beijing and Shanghai (China), Singapore (Singapore), Hong Kong

SAR or HKSAR (China), Taipei (Taiwan), Bangkok (Thailand), the Philippines, Malaysia, the United States, and Canada.

The value chain starts with crab harvesters, who collect mud crabs from wild sources and then sell them to *Fure or Bapari, aratdaars or khoti-malik, chamber-malik*, and then sold their catch directly to foreign consumers **(Figure-12)**.

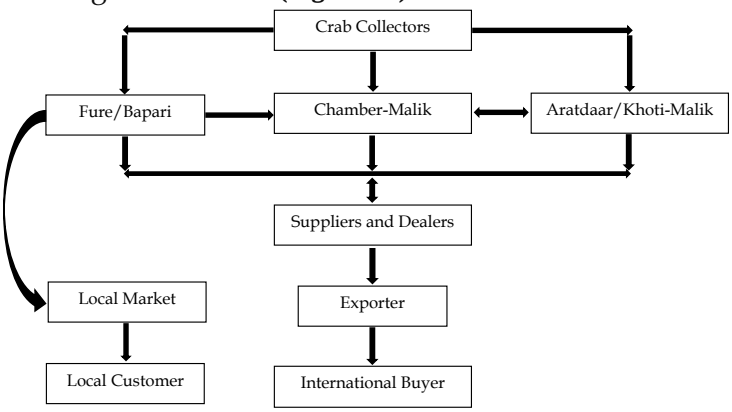

Figure-12: Supply chain of mud crab (Scylla olivacea) in the Sundarban region of India.

4. Problem and politics:

BLCs and harvesting related issues

The following paragraphs also examine the harvesting-related issues of local crab fishers and those associated with boat licensing certificates (BLCs), a particular license required for fishing in the STR. Every fisherman who goes fishing in the STR should annually register their boats with the Forest Department.

(A) Aratdaars and fishers

Relatively poor fishermen who do not own a BLC are thus exploited in the hands of Khoti-Malik and other wealthy BLC holders in the village who either have a lot of land or work in government services. Rich people locally known as Mahajan. Additionally, it forces people to work as migrant laborers outside of West Bengal and the Sundarban region. Rich BLC owners do not catch fish into the forest. The fishermen rent BLC from local khoti-malik in nearby villages and cannot repay their debts instantly at the beginning of the fishing season. Instead, they sell their catch at a low price to the local khoti-malik throughout the entire fishing season, which is not profitable. Before handing over the BLC to a fisher, a local khoti-malik may occasionally demand advance payment. Poor fishermen frequently borrow money from their local khoti-malik for a variety of reasons, and as a result, they are forced to sell all their catch to that khoti-malik for the duration of the fishing season.

(B) Forest department and fishers

Despite having BLCs within the core area, fishermen must pay a fine if they get caught by the forest guards. In the STR's official records, this fine is referred to as "compensation" (Patel and Rajagopalan 2009). The department does not mention the fine amount, but the forest guards write the name of the forest block in the English language on the back of the BLC. Until 2020, a person was charged Rs. 500 if he was caught for the first time (within the 42-day fishing period) in an area that was not permitted for fishing. The fine was Rs. 600 if the same person was apprehended a second time (Field Survey 2024). The amount of the fine varies from Rs. 500 to Rs. 1,000 or more, depending on the forest official, the

number of prior offenses, the seriousness of the offense, and the outcome of the negotiations between the official and the fisherman. Fines should be paid 8–10 times in a 9-month fishing season. On the other hand, the same enactment is implemented if a person ventures into the buffer area without a BLC.

Besides, the forest department has the legal power to cancel the BLC if necessary. They can impose a maximum of Rs. 1500 from the confiscated BLC.

Poor fishermen who cannot rent a BLC and who do not even have a boat frequently rent a dinghy, form a team, and fish in the STR. If these fishers are caught by the forest officials, the officials confiscate their dinghy as well as their fishing gear, including their net (*jal*), rope (*kachhi*), anchor (*graphi*), choppers, axes, fishhook (*borsi*), and multiple baited line (*done*). In this instance, the fishermen can obtain their dinghy back by paying a fine to the forest range offices (Chatterjee et al. 2009). However, there is no chance of getting the boat back if you find any raw wood or raw leaves. Boats are also confiscated if any lasso or jaggery is found in them. In the past there have been cases of deer poaching with lasso and tigers killed by poisonous jaggery. So, if these things are noticed in the boat, that is considered a serious offense. The family members of illegal fisherman killed by tigers in the forest do not receive any compensation or an extrait payment (of Rs. 100,000) from the Forest Department (Patel and Rajagopalan 2009). This compensation has been given since 1975 for any wildlife deaths in the Sundarban Tiger Reserve (Das and Bandyopadhyay 2012). If fishermen or beekeepers are killed by tigers in the STR, they are both eligible for extrait payments. To be eligible for the compensation, the fishermen must present valid fishing licenses (BLCs) and documents for Janata Personal Accident Insurance (Sen and Pattanaik 2017) Similar to illegal fishermen, illegal honey collectors are denied any compensation from the Forest Department.

As was previously stated, crab and fish collection is only allowed in the buffer zone and is absolutely forbidden in the core zone. Without a BLC, no one is allowed to enter the Sundarban Reserve Forest. If anyone is apprehended by a forest guard patrol boat without BLC, then collectors will face numerous difficulties, such as having their boats and fishing gear confiscated and being forced to pay a ransom as punishment. But it is seen that many fishermen enter the forest without BLC. Furthermore, they continue to enter the core area despite a variety of restrictions. The fishermen's perceptions and adaptations in the dense forest and in the solitary environment of gathering resources create an incredible sense of excitement. Additionally, the role of forest guards is essential for maintaining and overseeing the Sundarban reserve forest. Fishermen and forest guards' mutual interaction and negotiation have been given special priority in this situation.

When asked about the catching crabs in the absence of BLC, the respondent pointed,

> "We must dare to catch crabs. There is no way to run my family without this. Moreover, no one takes BLC in the buffer areas (the mangrove forest in the buffer zone is locally known as 'khola bada'). Only those who have BLC go to catch crabs in the core and sanctuary areas (locals refers to the mangrove forest in the core zone as 'bandho bada')."

What if the forest workers see us?

> Then they call us names. They tell us to get out through the creek. We do not go out. We return home with crabs. The forest staff leave after some time. The next day, we go the same way.

If caught in the hands of forest workers (forest guards),

> They impinge on us. They get very angry. "When we cannot find a way, I or we sell the crabs at a lower price or sometimes give them the crabs for free."

Another respondent, Brojen Baidya (name changed), age 64, male, crab collector, resident of Satjelia village, uneducated states,

> "Entry is not allowed in the bandho bada, but we see that the local crab collectors enter more in that area." In the khola bada, there is a lot of pressure from the locals. Good crabs are not found in this area. "We go into the bandho bada in the hope of getting more crabs, since there is less pressure from people in that area."

He further pointed,

> "Penalties have to be paid for entering the reserve forest." Along with that, we must keep the forest officers happy to collect fish and crabs. "Fish and crabs can be collected only if the employees are happy."

*When asked w*hat they do to keep forest officers happy, he states,

> "When working in the bandho bada, we behave nicely when we meet the forest guards." We respect them. We give them good fish and crabs without charging any money to keep the officers happy. Sometimes they buy good, big fish and crabs from us at low prices. "Before I go to work in the forest, I go to their office and tell them the name of the place where I will work that day." He further said that "I have a good acquaintance with the forest officers." They know my name. When they see me in the forest, they call me and speak to me. They also want to know whether we are catching fish or crabs now.

In this way, crab collectors in the Sundarbans have developed relationships with forest guards engaged in forest and forest care and have adapted themselves to the hazardous environment.

Marketing related issues

Crab fishermen face some political threats while crab celling. Crab collectors do not get a fair price when selling crabs. They are deceived by the storekeeper. Storekeepers buy crabs at lower prices and sell them at higher prices in the market. In local markets, the aratdaar is one of the dominant and profitable groups with little intervention. The grade or weight of a crab determines its price. The price of a crab increases with weight. However, the store owners do not purchase crabs from crab collectors as any grade. They generally pay the same price for crabs of a certain weight that they fix. In addition, storekeepers pay a lower price for crabs weighing 100 grams or less.

One respondent, Montu Kayal (name changed), 53 years old, male, a professional crab collector and resident of Dayapur village, replied,

> "Crabs weighing more than 100 grams are all priced the same." Female crabs and male crabs are not bought at different prices. The current market price of one kilogram of female crab is between 1000 and 1200 rupees. The aratdaars buys from us for only 450 to 500 rupees per kilogram. Later, they pick these crabs and sell them at a higher price in the market. He further said: "In the forest, we risked our lives to grab crabs from the faces of tigers. If you think about it, you will understand that we do not gain anything."

5. Conclusion:

Mud crab harvesting is an alternative livelihood option of the Sundarbans residents. People collect the crabs from muddy soil, saline wetlands, tidal rivers, inundated inlets, and outlets. It was found that the production of mud crab in the Sundarbans mangrove ecosystem carried on throughout the year, although the Sundarbans Forest Department banned mud crab fishing from April to June, because this period is considered the breeding seasons. The nearby mangrove forest communities engage in crab or fish harvesting, with two harvesting periods: Purnima-Amavasya monthly and summer and winter on a seasonal basis. The results of this study show that traditional crab collection is a profitable marketing venture. This finding is anticipated to be made available to stakeholders for the creation of sustainable policies, including crab fishers, intermediaries, depots, exporters, and managers. Besides, the socio-economic advancement of marginalized forest communities in the Sundarbans, the benefits of alternative activities like crab fattening, significant challenges related to the harvesting and marketing of crabs in harsh environments, lucrative market potential, and real knowledge of dense forests are emphasized.

References:

1. Alongi, D.M. (2007). 'Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change.' Elsevier Ltd. DOI: 10.1016/j.ecss.2007.08.024.
2. Atwood, T.B., Connolly, R.M., Almahasheer, H., et al. (2017). 'Global patterns in mangrove soil carbon stocks and losses.' Nature Climate Change. DOI: 10.1038/NCLIMATE3326.
3. Bandekar, P.D. (2021). 'Tree-climbing mangrove crabs of Karwar west coast of India.' IJFAS. 9(3): Pp. 186-189. DOI: https://doi.org/10.22271/fish.2021.v9.i3c.2476.
4. Bhuiyan, Md.S. et al. (2021). 'Mud crab (Scylla serrata Forskal 1775) value chain analysis in the Khulna region of Bangladesh.' Aquaculture and Fisheries. Pp. 330–336. https://doi.org/10.1016/j.aaf.2021.01.004.
5. Campbell, J., Whittingham, E., Townsley, P. (2006). 'Responding to coastal poverty: should we be doing things differently or doing different things? CAB International Environment and Livelihoods in Tropical Coastal Zones.' (Eds C.T. Hoanh TP, Tuong Gowing JW, Hardy B): Pp. 274-292.
6. Chatterjee, P., N. Bhuinya, and S. Mondal. (2009). 'Traditional Fishers in the Sundarban Tiger Reserve: A Study on livelihood practice under protected area.' Kolkata: DISHA.
7. Christina, L., Balasubramanian, C.P. et al. (2019). 'Mud crab farming: An alternative livelihood in the Indian Sundarban.' Volume 23 No. 3, July-September 2019. Pp. 20-29.
8. Das, C.S., and S. Bandyopadhyay. (2012). 'Sharing Space: Human-Animal Conflicts in Indian Sundarban.' Kolkata: Progressive Publishers.
9. Ferdoushi, Z., Zhang, X., & Hasan, M. R. (2010). 'Mud crab (Scylla sp.) marketing system in Bangladesh.' Asian Journal of Food and Agro-Industry, 3(2): Pp. 248–265.
10. Kamal, D., Khatun, M. et al. (2008). 'Comparative Study of Mud Crab (Scylla olivacea) Production in the Sundarbans and in Traditional Shrimp Ghers of Bagerhat District, Bangladesh.' Khulna University Studies. 9(1): Pp. 101-110.
11. Kathiresan, K. and Bingham, B.L. (2001). 'Biology of mangroves and mangroves ecosystems.' AMB. (40): Pp. 81- 251. DOI:10.1016/S0065-2881(01)40003-4.
12. Keenan, K., Davie, P., Mann, D. (1998). 'A revision of the genus Scylla de Haan, 1833 (Crustacea: Decapoda; Brachyura: Portunidae).' The Raffles Bulletin of Zoology. 46 (1): Pp. 1-29.

13. Krishnamurthy, P., Jyothi-prakash, P.A. et al. (2014). 'Role of root hydrophobic barriers in salt exclusion of a mangrove plant Avicennia officinalis.' Plant, Cell & Environment. 37(7): Pp. 1656-1671. https://doi.org/10.1111/pce.12272.
14. Mangubhai, S., Fox, M., & Nand, Y. (2017). 'Value chain analysis of the wild caught mud crab fishery in Fiji. Suva, Fiji: Wildlife Conservation Society.' https://doi.org/10.13140/RG.2.2.25234.76485.
15. Manson, R.A., Loneragan, N.R., Skilleter, G.A., Phinn, S.R. (2005). 'An evaluation of the evidence for linkages between mangroves and fisheries: a synthesis of the literature and identification of research directions.' Oceanography and Marine Biology: An Annual Review 43: Pp. 483-513.
16. Nandi, N.C., Pramanik, S.K. and Dev Roy, M.K. (2016). 'Mud Crab Culture: Relevance of Species Identity in Production Economics with Reference to Sundarban Coast.' Journal of Fisheries Sciences.com. Nandi et al., 10(4): 084-089 (2016). www.isheriessciences.com.
17. Overton, J. L., Macintosh, D. J. (1997). 'Mud crab culture: prospects for the small-scale Asian farmer.' Info. Fish. mt., 5: Pp. 26-32.
18. Patel, V., and R. Rajagopalan. (2009). 'Fishing community issues in the Sundarban Tiger Reserve (STR): Report.' International Collective in Support of Fishworkers (ICSF), Amsterdam, Netherlands and Chennai, India. https://www.icsf.net/wp-content/uploads/2009/09/930.ICSF025.pdf
19. Piatek, M.A. (1981). 'Mangrove crab, Scylla serrata and its utilization with particular reference to Mozambique.' FAO, Rome. 100.
20. Pripanapong, S., and Tongdee. N.A. (1998). 'Review of the mud crab (Scylla sp.) fisheries and culture in Thailand. Newsletter of Danish-SE Asian Collaboration in Tropical Coastal Ecosystems Research and Training Project.' Denmark, Thailand and Malaysia, 2(2): Pp. 7-10.
21. Rouf, M.A., Shahriar, S.I.M., Antu, A-H. and Siddiqui, M.N. (2021). 'Population parameters of the orange mud crab Scylla olivacea (Herbst, 1796) from the Sundarban mangrove forest in Bangladesh'. https://doi.org/10.1016/j.heliyon.2021.e06223.
22. Roy, M., Dey, A., and Chatterjee, D. (2021). 'Mud crabs farming: An alternative sustainable livelihood approach in Sundarban, West Bengal, India.' The Pharma Innovation Journal. SP-10(11): Pp. 932-937. http://www.thepharmajournal.com.
23. Sandilyan, S., Kathiresan, K. (2015). 'Mangroves as bio shield: An undisputable fact. Ocean and Coastal Management.' 103: Pp. 94-96. DOI: 10.1016/J.OCECOAMAN.2014.11.011
24. Sara, L. (2010). 'Study on the size structure and population parameters of mud crab Scylla serrata in Lawele Bay, Southeast Sulawesi, Indonesia.' J. Coast Dev. 13 (2), Pp. 133–147.
25. Sen, A and Pattanaik, S. (2017). 'How can traditional livelihoods find a place in contemporary conservation politics debates in India? Understanding community perspectives in Sundarban, West Bengal.' Journal of political ecology. 24(1):861. DOI: 10.2458/v24i1.20971.
26. Viswanathan, C., Raffi S.M. (2015). 'The natural diet of the mud crab Scylla olivacea (Herbst, 1896) in Pichavaram mangroves, India'. Saudi Journal of Biological Sciences. 22(6): Pp. 698-705.