TRADITIONAL KNOWLEDGE IN

MARINE FISHERIES OF KERALA

Indian Council of Agricultural Research
New Delhi

ICAR- Central Institute of Fisheries Technology
Kochi

Vijnana Bharati
New Delhi

Traditional Knowledge in Marine Fisheries of Kerala

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Foreword

The project on *Indigenous Traditional Knowledge (ITKs) in marine fisheries sector of Kerala: Documentation and Analysis* was a collaborative work of ICAR-Central Institute of Fisheries Technology, Cochin and Vijnana Bharati, New Delhi. The project funded by ESSO-Indian National Centre for Ocean Information Services (INCOIS), Ministry of Earth Sciences, Government of India, was taken up with the objective to document at length and in detail the ITKs prevalent in the marine fishing sector of the state of Kerala. Traditional knowledge is increasingly being recognised the world over, as an important link that connects humanity to systems, that teach us sustainable ways of exploitation of our resources. It shows us means and ways of harmonious existence with nature.

That these knowledge systems persisted for so long and has continued to be transferred from generation to generation is proof enough of its robustness. How valid it is in current times needs to be tested and if there are pointers that can be used for furthering modern science that needs to be explored.

Fishermen and women have used their acquired knowledge to engage in their livelihood activities for long. The traditional knowledge that is embedded in the psyche of these communities is slowly being lost as there are changes taking place that are affecting the fisheries sector as well. Mechanization and introduction of electronic aids has made the effort more efficient. However, even now the acumen of the fishers in various situations is what helps them survive in the open seas. Various processing methods have also survived the test of time and continued to be used to this day.

This book compiles information collected through the project and will be useful read to the lay reader as well as to individuals wanting to work in this very interesting area of enquiry.

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Preface

A project exploring indigenous knowledge of any community is bound to be a learning experience of a different kind. From reading and researching, getting to know what the community had in store for centuries and what is being lost at a pace that is directly proportional to the 'development' taking place, has been a worthwhile experience. It has once again reinforced the necessity to know and record the past, to now the history as well as the growth of a community's knowledge base that can be of great use to future generations, though they may seem not immediately relevant.

This book is a compilation of the Traditional Knowledge on selected topics that were collected from the coastal fisherfolk of the state of Kerala. An attempt was made to record as far as possible what they had to say about the topics that were of direct relevance to their life and livelihoods. The focus of the project was mainly on how the fishers knew where and when to fish; on how they knew the way the seas behaved; and their knowledge on winds and currents. To complete the picture, the team also documented the crafts and gear they used; the methods used for processing; and some of their sayings and beliefs.

The book also attempts to analyse the science behind some of the traditional knowledge documented. It is not complete by any means and there is scope for further work in this area. This is also necessary as what is there is the hearts and minds of the very senior fishermen and women are slowly being lost as they pass on into the annals of time.

The team is grateful to ESSO-INCOIS for funding this work and to Director, ICAR-Central Institute of Fisheries Technology and Secretary General, Vijnana Bharati for supporting the work. Sincere thanks to all the fishermen and women who shared their life experiences with the project team.

Dr. Nikita Gopal
Principal Investigator,
On behalf of the Project Team

Contents

Introduction

When an elder dies, a library burns to the ground

African saying

The Convention on Biological Diversity that was the result of the Rio Earth Summit says:

"Traditional knowledge (TK) refers to the knowledge, innovations and practices of indigenous and local communities around the world. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklores, proverbs, cultural values, beliefs, rituals, community laws, local languages, and agricultural practices, including the development of plant species and animal breeds. Sometimes it is referred to as an oral traditional for it is practiced, sung, danced, painted, carved, chanted and performed down through millennia. Traditional knowledge is mainly of a practical nature, particularly in such fields as agriculture, fisheries, health, horticulture, forestry and environmental management in general."[1]

Traditional knowledge can thus be understood as knowledge that is gained through generations, that are passed down mostly orally or through 'seeing and learning' from elders of the community and that which cannot be directly explained by what is in general parlance understood as 'science'. Traditional knowledge, indigenous knowledge and local knowledge are sometimes interchangeably used though some authors draw clear lines on what constitutes what[2]. There is no single universally recognized definition of traditional knowledge, but broadly agreed upon concepts on what constitutes traditional knowledge[3].

However, all of this is related to indigenous peoples and communities and the knowledge systems that have evolved in them and that has been passing along generations. This is usually closely associated with the environments and ecosystems that these communities live in close association with and there is the link with sustainable development as these knowledge systems have survived for so long[4]. WIPO (World Intellectual Property Organisation) recognises the strong 'practical component' in TKs "since it is often developed in part as an intellectual response to the necessities of life".

Therefore there is increasing awareness that traditional knowledge can actually further the advancement of science as this is knowledge that is gained and refined through experiences of indigenous peoples and communities. This has helped them survive and thrive over centuries in their pursuit of livelihood, whether it is agriculture or fisheries or animal husbandry. They have treated their ailments, cooked their food and lived their lives with this vast wealth of knowledge.

Fishing communities are also one of the oldest communities the world over, that have lived along the coasts for centuries. Their lives intertwined forever with the seas, which provided them with almost all their daily and long-term requirements. The fishing communities have thrived along coastal areas as well as along various other water bodies like lakes and rivers. In fact, all great civilizations have risen along great river systems and the sea routes were an important maritime trade link in ancient India[5]. The sea has been an important source of livelihood for fishing communities along the Indian coast. The communities lived in close proximity to the sea so that it is easily accessible for their daily needs. They berthed their boats and they landed their catch on the beach. The fisherwomen took over the sorting and marketing of fish. They processed the excess fish by salting and drying. The sea met most of their needs. Protein rich fish formed the main part of the diet. The income from fishing provided their other needs.

The fisher folk of Kerala are a community also enriched with ancient wisdom of their seas and fishery resources. They have used their knowledge of fish and fisheries for guiding their fishing operations, for understanding possible dangers when at sea that are caused by changes in weather conditions, resource management and conservation, and post-harvesting. This knowledge is an indispensable aspect of their lives and livelihoods. These are time tested and have evolved from the close relationship that the traditional fisher community had with their natural environment.

With advancements in science and technology, changes are visible in the fisheries sector also. In recent times information through use of satellite and remote sensing technology, for example Ocean State Forecast (OSF) and Potential Fishing Zone (PFZ) information has been made available to fishermen[6]. The advancements have helped fishers go farther and fish deeper and has played a significant role in increasing fish production[7,8].

However not all impacts have been positive. The fishing effort has increased drastically, the degradation of the resources and resource environments is obvious and resource depletion observed, with several regions in the world being overfished and stocks fished at biologically unsustainable levels[9].

Can we actually learn something from the knowledge that the fishing community possessed which made them capable enough to carry out the activities for so long while maintaining the harmony with their natural environment? Will it help in ensuring sustainability of the resources?

As is being increasingly felt, the traditional knowledge has its own value in the larger scheme of things. While not all of it may be immediately explainable, several of them have stood the test of time and have been efficient and effective. However, this information and knowledge is slowly being lost in the sands of time, as the older generations are passing away. The technological advancements in communication have encroached on the dependence that people had on oral traditions. The younger generation is learning more through technology rather than from the experiences of the older members of their communities.

Documentation of this knowledge is essential for understanding the evolution of the coastal community's dependence on the marine resources. This is also essential as the innate adaptive capabilities of the community in preserving the long tradition of fishing can give pointers to the possible strategies that can be adopted to maintain the exploitation at sustainable yet economically beneficial levels[10].

This study was an attempt to systematically document some important aspects of traditional knowledge in the field of marine fisheries sector of Kerala. Further attempts were made to understand the science behind what is believed and practiced. This study funded by ESSO-Indian National Centre for Ocean Information Services (INCOIS), Ministry of Earth Sciences, Government of India, was titled "Indigenous Traditional Knowledge (ITKs) in marine fisheries sector of Kerala: Documentation and Analysis" with the following objectives:

- Documentation of ITKs in marine fisheries sector of Kerala
- Exploring the scientific basis of selected ITKs
- Developing suitable output to disseminate the ITKs in the society
- To demonstrate a model for study of ITKs in other sectors of the state

The study covered nine coastal districts of Kerala viz., Kasaragod, Kannur, Kozhikode, Malappuram, Thrissur, Ernakulam, Alappuzha, Kollam and Thiruvananthapuram. For convenience, the state was divided into Northern Kerala (Kasaragod, Kannur and Kozhikode); Central Kerala (Malappuram, Thrissur and Ernakulam) and Southern Kerala (Alappuzha, Kollam and Thiruvananthapuram).

The data were collected through various methods like personal interviews, in depth surveys, focus group discussion and several field level and institute level workshops.

A project initiation workshop (details given in Annexure 1) was held to launch the project as well as get expert opinion to finalize the broad areas and methodologies for the collection of information and data that was being planned under the project.

A pilot survey was first carried out in Munambam and Cherai fishing villages of Ernakulam district. Ten fishermen in the age group 48-76 years were interviewed during the preliminary survey. The interviews conducted during this phase were non-directive and respondents were asked to describe their experiences and knowledge about fishing and fisheries. The respondents were allowed to talk on their experiences and knowledge about fish and fishing which built the base line to draft a survey instrument. With the knowledge gathered from the non-directive interviews conducted with fishermen during pilot survey, a structured questionnaire was prepared. The questionnaire was open ended and indicative and was used in later field surveys.

Simultaneously in the initial phase of the project, fishing villages were identified and personal contacts established with older members of the community who were willing to share information for the study. Snowballing technique was used for identifying the informants from the population. Though initially the stress was to identify older members of the community, it was realized that there were younger fishers who had the same passion for fishing and who were knowledgeable on various aspects of fishing that the project was attempting to address. To the extent possible traditional fishermen were selected for the study (details of fishing villages and age group of respondents given in Table 1).

Table 1: Details of field surveys undertaken

S. No.	District	Names of fishing villages covered	Age group (years)
1.	Kasaragod	BengaraManjeswar, Hosabattor, Shiriya, Kumbala, Kasaba, Kizhoor, Pallikkara, Kootikulam, Bekel, Kanjangadu, Ajanoor, Kappil, Poonjavikadapuram, Thrikaripur, Valiyaparamba, Padanakadapuram, Thikadappuram, Kadangodu	46-88
2.	Kannur	Mahi, Gopalapeta, Edakaad, Thaiyil, Thalaserry, Makudan, Kawai,Payyannur	36-79
3.	Kozhikode	Kappad, Koyilandy, Beypore, Vadakara, Kolavi, Azheethala, Elathur, Kadalur, Kannankadavu, Thikkoti, Puthiyappa, Vellayil	45-70

4.	Malappuram	Palapetty, Veliyancodu, Puduponnani,Ponnani harbor,Thekkekadappuram, Mukkadi, Marakkadavu, Meentheruvu, Pallivalappu, Purathur, Koottayi, Paravanna, Thevarakadappuram, Puthiyakadappuram, Cheerankadappuram, Ossankadappuram, Pandakadappuram, Edakkadappuram, Koramankadappuram, Elarankadappuram, Parappanagadi, Alangadi, Aryankadappuram, Ariyalloor Beach, Kadalundy Beach	35-73
5.	Thrissur	Azheekode, Munakkal, Kara, Vembelloor, Peeyembelloor (Tsunami colony), Eriyad, Chavakkad, Thottapp, Nattika, Vadanapilly, Puthiya Road (Kara), Perinjanam, Mathilakam, Moonnupeedika, Vanjipura, Valappaudu, Edathuruthu, Chettuva, Chettuvaazhi, Valappadu Harbour, Edakkazhiyoor, Thiruvithara, Puthenkadappuram, Koolimuttam, Poclayi, Karukachapally	28-80
6.	Ernakulam	Munambam, Vypin, Perumalpadi, Elankunnapuzha, Malippuram, Kuzhuppilly, Cherai	42-81
7.	Alappuzha	Pallithodu North, PunnackkalPurayidam, Pallithodu Church Road,Pallithodu South, Ottamasheri North, Ottamasheri South, Chappakadavu, Azheekkal , Oorappu colony, Arthungal, Thaikkal , Cheannaveli,Chethy, Pollathai, Korthusheri, Kaattoor, Mararikulam	27-76
8.	Kollam	Neendakkara, Chavara, Karunagappally, Shakthikulangara, Vaadi, Thankassery, Cheriyazheekkal, Valiyazheekkal, Pandarathuruthu, Eravipuram, Kakkathoppu, Mukampozhy, Mayanad, Kottiyam, Tannipalam, Paravoor Beach, Perumpuzha, Vadikadapuram, Ozhukuthodu, Puthanthura and Azheekal	45-97
9.	Thiruvananthapuram	Mariyanad, perumanthura, Anjuthengu, Varkala, Gloria beach, Shankumugham, Puthukurichi	48-67

In all the number of respondents covered in all the nine districts were 469. Besides interviewing individual respondents, Focus Group Discussions (FGDs) were conducted in different districts in which about 180 respondents participated in the discussions. Special workshops in the field (seven in all in Ernakulam, Thrissur, Alappuzha and Kollam districts) as well as the Institute (two) were also organised as part of validating information collected during the course of the field work.

The information was collected after *prior informed consent* of the respondents was obtained. Detailed information was provided to the members of the community, who cooperated with the team, on the intentions of the research study. The respondents were informed that the study was primarily meant to document the information on how the fishers in the coastal districts of Kerala carried out their fishing activity traditionally before the advent of technology; how they processed fish; and some information on their beliefs mainly related to fishing and fishes.

There were similarities in the information documented on certain aspects of the study. For instance, the physical parameters that affect fishing like wind; waves; stars and constellations. However, several other practices varied.

Observations have been recorded and cross checked through responses across section of respondents in the same places. Malayalam words and names have been used to represent the local usage and wherever possible the English equivalent has been provided. The fishermen refer the months during with respect to the Malayalam era calendar [also called Kollavarsham or Kollam era[11], which also has twelve months, each of which roughly beginning towards the middle of a month in the Gregorian calendar (for example the month of *Makaram* begins in the middle of January).

Validation of ITKs recorded was done by expert consultation and review of published work and referencing from other electronic sources, including grey literature. Expert consultations were through direct interaction of fishermen and experts from various fields like oceanography, fishing technology, fish processing and biochemistry (Annexure 2), as well as through information sought on selected ITKs through a personal mailed open-ended questionnaire. The authors would like to state that further work needs to be carried out on the assessments and they need to be further validated rigorously.

Documenting on film was outsourced to a professional documentary film-maker and three films (each in three languages – Malayalam, English and Hindi) on the experiences of fishers in North, Central and South Kerala have been produced titled 'Beyond the waves'. The script for the films as well as the actual filming was carried out jointly, with the crew accompanying the project team during the fieldwork.

In this book, we present the information in various chapters on the fishing craft and gear used; on the knowledge fishers had on natural phenomenon like wind, currents, stars and constellations, lunar cycles, weather prediction; fisher's knowledge on fish and fish shoal identification; fish processing and nutrition related usages; and some interesting beliefs in relation to the sea.

The knowledge of the traditional fishers is invaluable and its conservation and better understanding of this cumulative knowledge is important as society advances.

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Fishers and fishing:
Boats and nets used for fishing

Chapter 1
FISHING CRAFT AND GEAR

Introduction

The most important assets a fisherman owns are those directly related to his livelihood viz; boat (fishing craft) and net (fishing gear). Though significant advancements have taken place in boat building materials, designs of boats and nets and in the ways of fishing, traditional knowledge on how fishing was pursued in earlier times has been documented in this study.

The traditional fishing crafts and other fishing accessories were fabricated through trial and error, experiments and through the knowledge of prowess fishermen. The shape of crafts, materials used for its construction, and its method of construction vary within the coastal state. For instance, dugout canoes were prevalent in northern and central Kerala whereas catamarans dominated in the southern tip according to the rough nature of the sea. The boats were generally made of wood and the species that were commonly available in the locality which could withstand the rigours of the sea were selected for the purpose. Boats were crafted by local artisans. Nets were made of cotton fibre and were fabricated by the fishers themselves. The fisherwomen also contributed to the effort and were experts in net mending as well. The distances and depths of fishing were determined by the type of fish being targeted and the boat and net used, besides the skill of the fishermen.

Fishing methods

Distance from the shore and depth in the sea often determined fishing locations for particular fish species. For measuring the distance and depth, fishermen used different methods and had specific terminologies in different districts of the state of Kerala. Most of these methods and terminologies are still used by the fishers.

Terminology *maaru* is used to measure distance as well as depth in sea. This usage continues to this day, even though it can be linked to nautical miles and other standard measures of distances. This is used most commonly and is understood all along the coast of Kerala. One *maaru* roughly equals 1.5m.

Krishnan (63), Vemballoor, Thrissur
Jalaludheen (41), Chavakkadu, Thrissur

Paakam is used to denote depth of fishing. One *paakam* equals 1.8 m which corresponds to one fathom.

Krishnan (63), Vemballoor, Thrissur

Depths were measured using a measuring tool which had a twine with an iron block tied at its one end. This was called *muduth* in some places [Jerome (72), Vaadi, Kollam] and *murdh* in others [Prakashan (35), Kasaba, Kasaragod]. Usually the length of the twine is around 30 m [Jalaludheen (41), Chavakkadu, Thrissur].

Fishing crafts

Types of fishing crafts and craft materials

As mentioned earlier, traditional fishing crafts were mainly made of locally available, durable tree species. The mode of propulsion was rowing with oars which is locally termed as *Thanduvalikkuka.*

Boat construction was done very carefully in order reduce accidental damages and ensure safety. A wooden structure called *manikkal* was fitted in the bow (forward portion) of the boat to increase the safety and reduce the risk arising out of collisions at sea.'

Plank built canoe (Ottakori)

The different parts and accessories of a fishing canoe are *chukkan* (rudder), *thuzha* (oar), *komb* (stem), *palam* (thwart). Canoes were also classified as *odam* (small canoe) and *thoni* (plank built canoe).

Suresh (41), Koottayi, Malappuram

The oar used in wooden canoes are called as *pangayam*. The size of the canoes depended on the number of persons onboard which varied from five to even 16. There were two types of canoes, ie, plank built and dug out. Each could take onboard 4-12 people.

Purushothaman (58), Neerkadavu, Kannur.

Dugout canoes, made of a single log, are locally termed as *ottathadivallam* and *catamaram* (catamaran) made of two or more logs of wood which are still in use in Thriuvananthapuram district [John (60), Sanghumukham, Thiruvananthapuram]. A small boat known as *Karamatti* is also used other than *catamarams* [Yosep (48), Munakkal, Ernakulam].

Catamaran

The canoes made of wood of *cheeni* (*Tetrameles nudiflora*) that could take onboard up to five persons, were most commonly used for fishing. Fishermen physically navigated using oars.

Suku (65), Kuzhuppilly, Ernakulam

Michael (77), Kattoor, Alappuzha, said that he went onboard plank built canoes, having capacity of 16 people, and it was propelled using 12 wooden oars made up of *aini/anjili* (*Artocarpus hirsutus*-Wild jack fruit tree). Plank built canoes also called *odam* made of locally available *punna* (*Calophyllum inophyllum*- Alexandrian laurel ball tree) or *aini* or mango (*Mangifera indica*) that could board around five people were employed in Kasaragod [Moidheenkunju (50), Manjeswaram, Kasaragod; Prakashan (35), Kasaba, Kasaragod].

Dugout canoes made of *panjimaram* (kapok tree) that could take onboard five fishermen, were used earlier in Alappuzha district.

Thomas (61), Punnapra, Alappuzha

Punna was also used in these districts for boat construction

[Arumukhan (72), Kara, Thrissur; Jaffar (31), Edakazhiyur, Thrissur;
Sivadasan (80), Perumpilly, Ernakulam;
Dinesh D. Udyapuram (68), Kanwatheertha, Kasaragod;
Purushothaman (58), Neerkadavu, Kannur;
Veeru (73), Puthuponnani, Malappuram;
Asinaar (62), Puthuponnani, Malappuram;
Rafeeka (67), Perumanthura, Thiruvananthapuram;
Jalaludheen (41), Chavakkadu, Thrissur;
Jerom (72), Vaadi, Kollam).

In Malappuram, earlier canoes known as *ottakori* made of jack wood (*plavu, Artocarpus heterophyllus*) which could carry 15-20 fishermen was used for fishing [Asinaar (62), Puthuponnani, Malappuram] and *odam* made of *punna* and *cheeni* used for fishing before days of *ottakori* [Muhammed (68), Marakkadavu, Malappuram].

People use *pontha* also known as *dingi* which is made of thermocol in some parts of Alappuzha. Only one person can go on a *pontha* and they can go only up to about five *maaru* (1maaru = 1.5m) for fishing safely.

Dennis (58), Chaappakadavu, Alappuzha

Plank built canoe (Mooduvetti)

Fishing craft maintenance

During off season or lean fishing season, the fishermen spent time in repair and maintenance of their fishing crafts. Sardine oil, which was the most commonly used raw material for maintenance of crafts.
During dry season sardine oil (*chala nei*) and cashew kernel oil (*kashuandi nei*) were coated on the wooden crafts and left to dry out completely for about one week. This would improve the durability of the craft. During rainy season such practice is not carried out as the craft needs to be dried for carrying out this.

Sivadasan (80), Perumpilly, Ernakulam

Sardine oil mixed with ash and *maida* powder was applied to the hull and keel of the canoe every year for greater durability.

Michael (77), Kattoor, Alappuzha

The bigger crafts were treated with sardine oil and the smaller ones with cashew kernel oil for increased durability. The degradation of wooden planks and the attack from fouling organisms also could be minimized through this. After fishing, the crafts were sun dried every day in order to avoid fouling of the hull by various organisms.

Jerom (72), Vaadi, Kollam
Lonan Pilla (70), Valanjoli, Alappuzha
Purushothaman (58), Neerkadavu, Kannur
Preman (52), Vellayil, Kozhikode
Suku (65), Kuzhuppilly, Ernakulam
Asinaar (62), Puthuponnani, Malappuram
Prakashan (35), Kasaba, Kasaragod
Shanmukhan (65), Karukachalppally, Thissur
Arumukhan (72), Kara, Thrissur
Rafeeka (67), Perumanthura, Thiruvananthapuram

For the increased durability, neem oil was applied on the canoes.

Karthikeyan (56), Cherai, Ernakulam

Newly built boats are treated with cashew kernel oil on which powdered rice bran is spread. This safeguard the skin of fishermen from burns caused by the cashew kernel oil.

Lonan Pilla (70), Valanjoli, Alappuzha

In order to remove the marine fouling organisms and fungi from the hull of the canoes, the hull is scrubbed using coir.

Devadas (46), Kasaba, Kasaragod

Kottu nei (oil extracted from the bird little heron) was applied on canoes for strength.

Choyi (87) Kottikulam, Kasaragod

In some areas for increased strength and durability of canoe, shark oil were applied [Moidheen Kunju (50), Manjeswaram, Kasaragod] and ray fish oil or sardine oil are used to strengthen the wooden crafts [Basheer (49), Puthukurichi, Malappuram].

Punnakkai enna (oil from the nuts of the *Punna* tree - *Calophyllum inophyllum*) used for fishing craft treatment.

Muhammed (68), Marakkadavu, Malappuram

Of late, to increase the durability of the boats, fibre coating is done annually, especially for FRP canoes [Muhammed Rafi (30), Edakazhiyur, Thrissur]. For wooden crafts also a coating of FRP is given for increasing durability [Thomas (61), Punnapra, Alappuzha].

Navigation of fishing crafts using sails

Fishing operations start around 3.00 am and before starting, they wait for the period when after every 7 to 9 waves, the sea flattens for a while. Fishermen prefer this period to get their canoes into the sea in order to safeguard their lives as well as canoes [Francis Antony (76), Munambam, Ernakulam]. The still wave period is called *klaal* [Jalaludheen (41), Chavakkadu, Thrissur].

Iron weight for depth measurement

The mode of propulsion was rowing with oars [Preman (52), Vellayil, Kozhikode] and the oars were made of either *punna* (*Calophyllum inophyllum*) wood or bamboo [Jalaludheen (41), Chavakkadu, Thrissur].

But when winds and currents prevail, sails made of thick cotton clothes, treated with boiled aqueous solution of seeds of Malabar ebony (*Diospyros malabarica*) or boiled aqueous solution of the powdered tamarind seeds (*Tamarindus indica*) was used. The treatment is believed to stiffen the cloth and increase its durability [Preman (52), Vellayil, Kozhikode; Purushothaman (58), Neerkadavu, Kannur].

Wooden gauge

Sail is used for easy navigation of the country craft and it is tied according to direction of the wind [Suku (65), Kuzhuppilly, Ernakulam] especially when depth of fishing operation is more [Arumukhan (72), Kara, Thrissur; Vijayan (59), Perinjanam, Thrissur]. Sails of 10 to 15 feet height on bamboo sticks were often used [Muhammed (68), Marakkadavu, Malappuram]. In order to decrease the efforts in manual propulsion, sometimes, empty sacks are tied in front of the canoes just like a sail on a bamboo stick. This reduces stress of rowing [Michael (77), Kattoor, Alappuzha].

While going for fishing to far off places, the fishermen tie up coir mats up to a height of 12 feet to function like a sail.

Sivadasan (80), Perumpilly, Ernakulam

Fishing gear

Fishing gear materials

Earlier days, nets were made of mainly cotton twine

Suku (65), Kuzhuppilly, Ernakulam; Michael (77), Kattoor, Alappuzha
Prakashan (35), Kasaba, Kasaragod
Dinesh D. Udyapuram (68), Kanwatheertha, Kasaragod.
Basheer (49), Puthukurichi, Malappuram
John (60), Sanghumukham, Thiruvananthapuram
Jalaludeen (41), Chavakkad, Thrissur
Arumukhan (72), Kara, Thrissur

Each twine, used for making fishing gear consisted of five cotton threads twisted together.

Govindan (71), Nattika, Thrissur

The nets were fabricated manually using gauge and needle locally known as *padi* and *elapp* respectively.

Napoleon (70), Neerkunnam, Alappuzha

Needles (locally known as *elapp*) used for gear making were made using coconut wood and gauge (locally known as *padi*) was made of wood of any tree.

Kuttan (60), Valappad, Thrissur

Hook and line fishing was carried out mainly for bigger fishes like sharks. In hook and line method, the main baits used are sardine, mackerel, crab and some local fishes called *erana*, *etta* and *varaal* (snake head). Small sardine pieces are used to lure the sharks and the sharks get attracted to their odour and the catch become easier. Floats (*ponthu*) used are empty cans and thermocol and sinkers (*kallu*) are stones and rocks. The depth of operation was around 77m and the length of line was around 154m. Usually 12 hooks are used in a line. The lines were also made of cotton twine. Cotton twine was treated by boiling it with the dye (*kara*) extracted from wild mangosteen seed.

Preman (52), Vellayil, Kozhikode

The **shark fishery** was a specialized fishery and there were many experts in this. Hook and line was used for catching sharks and the preferred time was the evenings. Fishers leave for fishing around 4.30pm. The lines were laid and the hauling takes place the next morning. The common baits used are *kudutha* (*Auxis thazard)* and *varaal* (snake head, *Channa sp*.). The local names of various species of sharks we used to get are "Thekkan sraavu", "Kallan sraavu", "pachakannan", "chadayan", "pilla sraavu", "pittha sraavu" etc.

Hariharan (51), Chettuva Azhi, Thrissur

Fishing gear maintenance

The fishing gear materials and the gear itself were subject to several locally evolved treatments to increase the strength and durability. As cotton is a biodegradable material and its constant contact with seawater makes the degradation faster.

Prior to net fabrication, the twines made of five cotton yarn are kept in *kanjivellam* (rice water – solution of starch obtained by draining boiled rice) [Napoleon (70), Neerkunnam, Alappuzha]. Boiled solution of a plant locally known as *adambuvalli* (*Ipomoea pes-caprae* : Goat's foot creeper) and cow dung is used to treat the cotton twine for increased durability and strength [Basheer (49), Puthukurichi, Malappuram].

To make the cotton twine strong, it is kept in water for some days [Arumukhan (72), Kara, Thrissur] or treated with *Kavipodi* (red ochre powder) and these twines are kept in water for some days [Mahesh (32), Kasaba, Kasaragod].

In order to increase the strength of the net, treatments used included immersing the nets in water boiled with dried nuts of *kadukka* (*Terminalia chebula* - Black myrobalan) [Suku (65), Kuzhuppilly, Ernakulam; Aboobakar (61), Puthuponnani, Malappuram; Jalaludeen (41), Chavakkad, Thrissur]. They were also immersed once a week in water boiled with the bark of a tree locally called as *kalasham* (*Lannea coromandelica* - Indian ash tree) [Jalaludeen (41), Chavakkad, Thrissur; Purushothaman (58), Neerkadavu, Kannur].

Wooden needle

The leaves of local plant *munja* (*Premna mollissima*) is ground and mixed in water and boiled before immersing the nets and this in turn improves the strength of nets.

Sivadasan (80), Perumppilly, Ernakulam

To give strength to the net and to increase the catch *munja* (*Premna mollissima*) leaves are boiled in water and cotton nets are dipped into it. The nets first turn brown and are kept in the solution till the brown colour disappears.

Michael (77), Kattoor, Alappuzha

Panji kaya (*Ceiba pentandra* - Kapok tree) is sliced and rubbed on to the gear for strengthening.

Dinesh D. Udyapuram (68), Kanwatheertha, Kasaragod.

Iron anchor

The twine of hand line fishing targeting *kombanmeen* (rays) was treated with *panachikka* (*Diospyros malabarica* – Malabar ebony). Crushed juice of *panachikka* used for keeping the twine and it gives strength to the twine.

Kunjuvava (64), OssanKadappuram, Malappuram

Fishing nets used to be treated in water boiled with bark of *karamaram* (*Elaeocarpus serratus* - wild olive tree) and *Kadukka* (*Terminalia chebula* - Black myrobalan) nuts, in which it used to be immersed for 12 hours.

Suresh (41), Koottayi, Malappuram

For the strengthening of gears, it is immersed in cow dung mixed with water and dried in sunlight.

Rafeeka (67), Perumanthura, Thiruvananthapuram
Benedict (65), Ervaipuram, Kollam

Gear damage and protection

Sea cow used to damage the nets of fisherman and in order to shoo them away fishermen produced sound by tapping on the sides of the boat.

Sivadasan (80), Perumppilly, Ernakulam

The aquatic organisms that destruct the fishing nets are dolphins and *kadal makri* (puffer fish) [Karthikeyan (56), Cherai, Ernakulam; Arumukhan (72), Kara, Thrissur; Vijayan (59), Perinjanam, Thrissur; Suku (65), Vypin, Ernakulam].

Cotton nets were washed daily in fresh water to protect against microbial attack and net degradation [Hamsakoya (55), Puthuponnani, Malappuram] or nets were washed in aqueous solution of a *munja* to remove the foul smell of the net [Sebastin (71), Pallithode, Alappuzha].

Types of fishing gears

Based on the mode of operation, gear materials used and major fish species targeted, different fishing gears are locally called as *koru vala, chaala kollivala* and *etta kollivala* (bag net) *vatta vala* (boatseine) etc.

Sivadasan (80), Perumppilly, Ernakulam

In Alappuzha district, some other terminologies viz; "thangu vala", "chooda vala" and "nona vala" (different types of seine nets) were used for indicating different types of fishing gears. *Nona vala* was used by fishermen during earlier days. The fishing nets resembled the nets worn by British women on their heads and hence the name. Using these nets, fishing is done upto 16 fathom depth.

Justin (79), Pallithode, Alappuzha

Gillnet

A list of different types of fishing gears and their vernacular names used in different parts of Kerala are presented in Table 2.

Thaanguvala (ring seine) is one of the major fishing gears used nowadays [Joseph (61), Ottamaserry, Alappuzha; Kuttan (60), Valappad, Thrissur] and ring seining using two boats were employed for fishing. The mother boat is locally called *vala vanji* and the skiff boat is locally called *cheru vanji* [Suku (65), Kuzhuppilly, Ernakulam]. This is operated within a distance of 14 *maaru* [Shaji (26), Thiruvithara, Thrissur].

Table 2: Fishing gears and their vernacular names

Name of the fisherman expert	*Vernacular Name of the gear*	*Name of the gear*	*Fish species and mesh size (mm)*
Stephan (60), Fort Kochi, Ernakulam	*Chavittu vala*	Seine net	Shrimp and other small fishes (8-10)
Mahesh (32), Kasaba, Kasaragod	*Rani vala*	Boat seine	Shrimp, sardine and fishes (18)
	Nathalu vala	Anchovy gillnet	Anchovy (5-8)
	Kolli vala	Boat seine	Shrimp and other small fishes (10-12)
Moidheen Kunju (50), Manjeswaram, Kasaragod	*Odam vala*	Boat seine	Sardine, (5-8)
	Edakettu vala	Gillnet	White fish (30-35)
	Chala vala	Sardine gillnet	Sardine (3)
	Thathuvala	Bottom set gillnet	(140)
	Vakku vala	Hemp gillnet	Marine catfish
Benedict (65), Ervaipuram, Kollam	*Roll vala (otherwise called as "silk vala" was introduced after 1980) Neettu vala: Gillnets*	Monofilament gillnet	Used for different species (20-120)
	Kamba vala	Boat seine	Carangids, Clupeids, Engraulids and Leiognathids (6)
	Aila vala	Mackerel gillnet	Mackerel (40-60)
	Chaala vala	Sardine gillnet	Sardine (30-40)
	Paachu vala	Gillnet	(25)
	Kaccha vala	Scoop net	3 (6-40)
Basheer (49), Puthukurichi, Malappuram	*Noolu vala*	Drift gillnet	(60-100)
	Thangu vala	Medium sized ring seine	Small fishes like anchovy (8-10)
	Choodan vala	Small sized ring seine	Anchovy, white baits and sardine (10-14)
	Netholi vala	Anchovy gillnet	Anchovy (14)
Sivadasan (80), Perumppilly, Ernakulam	*Thirandi vala*	Bottom set gillnet	Ray (260)
Valsan Pillai (82), Pallithode, Alappuzha	Drags an iron chain through the water (may be touching the bottom, could not be verified) so that the shrimps jumped out of water caught in the nets	Dragging of iron chain (practiced before introduction of bottom trawlers)	Shrimps

When the fishing is done within a distance of eight *maaru*, the gear locally named *choodavala* is used.

Shaji (26), Thiruvithara, Thrissur

Shore seine

During rough season they do not go for fishing with nets instead they move to estuaries for fishing using scoop nets.

Sivadasan (80), Perumppilly, Ernakulam

Beach seines of mesh size 28 mm, 33 mm and 70 mm was another major gear used for fishing.

Karthikeyan (56), Cherai, Ernakulam

Old aluminum cans locally known as *paatta* is used as floats and heavy stones were used for anchorage.

Sivadasan (80), Perumppilly, Ernakulam

Assessing the Scientific Rationale of fishing craft and gear

Fishing crafts

The fishes move away in low frequency sounds since it is an indication of approaching predator[1,2]. *This validates the statement while ring seine operations are on, in order to spread the fish shoal and thus to ensure the catch, the fishers strike the paddle on the side of boats.*

Ocean depth is one of the critical factors which varies with physical parameters. Navigation at sea and fishing are required to know the depth. The technique used from ancient time is depth sounding or depth measurement using a lead weight with twine[3]. A similar measuring tool was prevalent in Kerala coast and it is vernacularly called as *muduth or murdh.* Jerome, Prakashan, Jalaludheen the fishers from Kollam, Kasaragod and Thrissur district and others made this observation. Depth is measured in fathom (*paakam or maaru*) and one fathom is 1.8 m.

Cultural evolution and the ancient human life on the banks of rivers and water bodies taught men, the art of sea faring and navigation which led to exchange of goods between many cultural systems in the world. Several authors have described on the fishing and related activities, boat building and maritime trade between Indian subcontinent and the rest of the world[4,5.] In 1937 Hornell[5] who embarked on a journey along the maritime states of India to study the cultural drift in the east and west coast, had observed that the fishing crafts prevalent in India was the same as a hundred years ago (the period thus roughly coinciding with the early nineteenth century). The fishing crafts of Malabar were simple and built using single log namely dugout canoe and plank built canoe and catamarans along the south most end (from Quilon – now Kollam-onwards). This may be due to the ecological fact that the south west coast of India is bountiful in its fishery resources than north-west coast and has near shore fishing grounds. It corroborates the information given by the fishers from the different coastal districts of the state.

Mini trawl net

The fishing crafts of Kerala are classified into three types based on its construction methods such as dugout canoe, plank built canoe and raft catamaran. Based on the length range of the craft there are *odam* (11-13 m) *thoni* (8-9 m) and *beppu thoni* (6-7 m). The *odam* with crew capacity 10 - l5 fishermen, *thonies* carry 5 – 8 fishermen and the *bepputhoni* only 1 - 2 fishermen. The technique in the making of plank built canoe is as the name

indicates made of planks which are stitched and glued. The catamarans are the fishing craft form in which logs tied together for sea faring or fishing[7,8].

'Catamarans' locally called 'kattumaram' are the dominant craft along southern coast[9]. Based on the size range two types of catamarans, a small one with a crew size of one or two used mainly for hook and line fishing and gill net operations targeting prawn, sardine and anchovy. The large catamaran with a crew size of 3 to 4 persons is used for the operation of boat seine or *thattamadi*[10]. The operation of boat seine by surrounding the fish shoal with the help of two catamarans was also reported[11]. The dugout canoe is made by scooping out from a single log, using jungle jack or mango otherwise called *ottathadi vallam*. The plank built canoe is made mainly using jungle jack planks seamed with the help of coir rope are of two types small and large according to length overall. The larger one is used for fishing by a group of 10 to 12 fishers whereas smaller one by one or two fishers[11,12].

Wood selection for fishing craft building is subject to several factors. Timber logs of heart wood and straight grains with good quality and without any natural defects are usually considered. Since the fishing crafts are operated in sea water, wood which can withstand constant immersion in sea-water and weathering, rain and wind are selected. The prevalent wood species in fishing craft building along the Kerala coast are given in Table 3.

Table 3: Wood used for fishing craft construction

Local name	Vernacular name	Scientific name
Mango tree	Mavu	*Mangifera indica*
Wild jack fruit tree	*Aini /Aanjili*	*Artocarpus hirsutus*
False Hemp Tree	*Cheeni*	*Tetrameles nudiflora*
Alexandrian laurel/ Borneo mahogany	*Punna*	*Calophyllum inophyllum*
Kapok tree	*Panji maram*	*Ceiba pentandra*
Aruna or Arjun tree	*Marudh*	*Terminalia arjuna*
Jack fruit tree	*Plavu*	*Artocarpus heterophyllus*

(Source: References 7,13)

Timber logs should be free as much as possible from any natural defects and blemishes. Timber, which are able to withstand the constant immersion in sea-water and constant exposure to the weathering action of sun, rain and wind are preferred for craft making. The local techniques for extending the life of craft were carried out periodically using cashew kernel oil, sardine oil, shark oil, neem oil etc. and the basic mechanism is the biocidal activity of these oils on borers and foulers[14,15,16,17].

Periodic maintenance of fishing crafts with cashew nut shell liquid was prominent technique in India[13,18]. Cashew nut shell liquid (CNSL), a by-product of cashew industry, which is composed of naturally produced phenolic compounds such as about 90% Anacardic acid and 10% Cardol[19]. The long chain unsaturated hydrocarbon of cardanol, a decarboxylated product of anacardic acid[20] is highly active against termites and has water repellency[21]. The prominence of cashew resins over the synthetic resins has also been studied[22]. Azadirachtin a major component in neem oil acts as insect repellent, feeding inhibitors, egg laying deterrents, growth retardants, sterilants[19].

Lonan Pilla (70), a fisher from Valanjoli, Alappuzha reported that rice bran used to be spread over the CNSL treated craft to safeguard the fishers from getting burned in contact with CNSL, since it is extremely caustic[23]. It has however been reported that though the CNSL is effective in wood preservation, such protection is only temporary[24]. Hence the incorporation of other chemical compounds along with plant products has been found to be effective[24,25].

In addition to that Muhammed Rafi (30), from Edakazhiyur, Thrissur and Thomas (61), from Punnapra, Alappuzha opined that a new mitigation measure adopted recently is the coating of wooden hull with FRP material. FRP coating is effective in terms of increasing durability, reducing corrosiveness and water absorption and preventing attack by borers and foulers on the wooden hulls of fishing crafts[13,26].

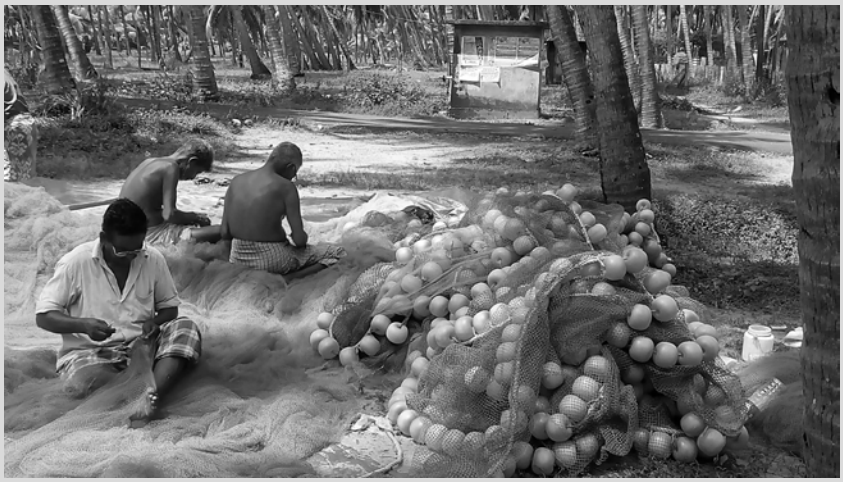
The sails of Malabar-Travancore coast were adopted from Arab designs[27,28]. Motorization was suggested as a measure to supplement the sails in the unfavourable wind conditions[29].

Fishing gear

Cotton twines were the prevalent fishing gear material until the introduction of synthetic ones[5]. Hemp was also used for making a few specific fishing gears like *etta vala*[30]. Later a variety of fishing gear materials were introduced that were more durable[31,32].

Different types of fishing gears in the commercial marine fisheries sector of Kerala with a list of vernacular name have been documented[8]. The ring seines mainly intended to catch the pelagic shoaling fishes are categorized according to mesh size as *Chooda vala*, *Chemmeen vala* etc. which are specific to anchovy and shrimp respectively[33]. Species specific gill nets and other gear are also prevalent today[34,35].

Fishing gear treatment and maintenance was carried out using locally available plant resins and other by products includes *Ipomea carnea*[36]. Another important issue in gear maintenance was gear damage due to dolphin attack[30]. Marine mammals are capable of detecting sound waves and it can be used as mitigation measure in the fisheries sector to repel them from the fishing systems[37].



Ring seine

Conclusion

Several of the methods of construction of fishing craft and gear are still practiced and they have stood the test of time. Wood continues to be a popular boat building material and some of the TKs can be effectively utilized in construction and maintenance of the same. With increasing stress of sustainability and on reducing environmental degradation due to the use of material that are non-degradable, there is need to take re-look at possible ways to increase the use of natural materials and the potential information that already exists in the fishing community can be a base for the same.

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Fishers and natural phenomenon: Traditional Knowledge on winds, currents, stars and constellations, lunar cycles, weather

Chapter 2
WINDS & THEIR INFLUENCE ON FISHING ACTIVITY

Introduction

Fishermen have always depended on the forces of nature to aid them in fishing. Natural weather phenomenon like winds and monsoons are inter-related, and in turn has a relation with the seasons. Livelihood activities like fishing is deeply influenced by the seasons and the weather conditions. Winds have been used basically for navigation from time immemorial. The rhythmic seasonal weather pattern in Arabian sea called monsoon system derived from the Arabic word mawsim, meaning a fixed time of year. It has been recorded that the people of Indus Valley civilization were already using monsoon winds and currents for maritime trade and navigation in 2500 BC[1]. Many studies have described about the influence of monsoon winds on trade[2,3,4]. Knowledge on winds and other phenomenon like ocean currents and stars (which will be discussed in later chapters) were used by early traders as well who sailed to the coast of Kerala for its black gold, pepper, and other spices[5,6,7].

The direction and the strength of the winds determined the decision on when and how to navigate. This has also been used by fishermen to determine when and where to go fishing. Studies have shown that winds also influence the fish availability[8,9]. Thus fishers attune their fishing activities to the winds in their local fishing grounds.

Indigenous Knowledge on Winds & Fishing

As fishing involves navigating through the sea and when reaches the fishing ground hunting the fishes from water, the word fishing basically accompanies the navigation at sea. As hunting of terrestrial animals the hunting of aquatic animals also started time immemorial and the major physical parameter that have prominent importance in navigation is winds and currents. Hence here it tries to analyse the traditional knowledge on these meteorological parameters in fishing and how these perceptions relate with the advanced scientific knowledge. The shift from fishing using traditional sails to mechanization occurred in the 19th century. Major advancements in the fishing system in terms of mechanization was happened in the past 150 years[10]. The traditional crafts of Kerala were motorized through the Indo-Norwegian project, in 1955[11,12,13].

Fishermen generally identify the winds with the direction they blow and and the names were given in such a way which gives some indication on the direction. There are differences in the names given in different districts of

the state of Kerala, however largely it has to do with the directions or the characteristic feature of the phenomenon. As mentioned earlier, the fishermen refer the months during which these winds occur with respect to the Malayalam era[14]. The physical reference point is generally the sea and the shore.

"…blows form the sea to land, from south to north….."

Fishermen also categorised and identified winds based on their feel or temperature.

"……wind from the sea is warm……."

"*The easterly winds are cool in nature whereas westerly winds are warm*"
Simon. P. O (48), Chethy, Alappuzha

The old-timers also associated winds with odours, but this is now rarely cited. Ninety four year old Solomon from Chellanam in Ernakulam district, said that "…..*the Easterly wind has an odour like that of burning fire*……". He used to fish onboard a small traditional canoe.

The information on winds documented from the fishermen is broadly presented with reference to the names and directions, the seasons and the relation with fishing activity.

Local Names & Direction of winds

"Fishermen have also always depended on the direction of the wind to determine the direction of sailing. During the day the wind blows from East to West and at night times from West to East"
Kamaal (60), Edakkazhiyur, Thrissur

The easterly wind is locally known as *karakkaattu* and the westerly wind is known as *kadalkkaattu* [Antony Kurisingal (38), Andhakaranazhi, Alappuzha].

In a similar vein, 64 year old Pathrose from Chaappakkadavu, Alappuzha says

"*Which ever the directions the wind may come from, the waves are always directed towards the east."*

Muhammed (64), from Perumanthura, Thiruvananthapuram goes fishing in a catamaram or a canoe. He listed the local names of winds.

'karakattu' (shore wind)- blowing from East to West
'ullekattu'- blowing from West to East
'vaadakattu' – blowing from south to north
'kachaankattu' - blowing from north to south.

Local names vary from place to place. Abdullah (56) from Parappanangadi, Malappuram who is a traditional fisherman and goes fishing on wooden canoes, has the following to add on the names:

'Thengarakattu' – wind blowing from the East
'Vadakara/Vadarakattu' – wind blowing from the North
'Thembrayikattu' – wind blowing from the South West
'Vadumelkattu' – wind blowing from the North West
'Poramkattu' – wind blowing from the West

Suresh (41) from Koottayi, Malappuram, lists '*Kara kattu*', '*Kachamkattu*' and '*Thekkankattu*'. *'Thulavaada'* is a local name given to the wind blows from South to North [KochuVelayi (79), Azheekkode, Thrissur] or *kollukaattu* [Moidheenkunju (50), Manjeswaram, Kasaragod].

The westerly wind is also referred as *mekkaatt* [Antony Kurisingal (38), Andhakaranazhi, Alappuzha] or *puramkaattu* [Soman (58), Azheekkode, Thrissur] or *purakattu* [Moidheenkunju (50), Manjeswaram, Kasaragod].

The only reference to a cyclonic wind was made by 70 year old Alikunju from Chaavakkad in Thrissur who goes for fishing on a small *vallam* (canoe), who spoke about the *Pishashukattu* (*Pishashu* – devil)/*Chuzhalikattu* (cyclone) which comes from south and was violent and strong enough to capsize boats and cause fatalities.

Winds & Seasons

The fishermen are well versed with the typical winds during different months of the Malayalam calendar and these roughly coincide with the different seasons. It is also associated with the degree of difficulty in carrying out fishing activity and sometimes to the availability of fish. Some seasonal winds are typically named with reference to the months they blow.

The eastern winds are prominent during Chingam to Thulam (mid-August to mid-November). On the 10th of *Kanni* (which falls in late September*)*, if there are strong western winds, fishing should not be done. Also during monsoon, western winds are stronger [Choyi (87), Kottikulam, Kasaragod].

The wind named *thulavaada* has its origin from the name of the month *Thulam* (mid-October to mid-November) and it blows around this time of the year from South to North and the *kannimundan* blows in *Kanni* (mid-September to mid-October) [KochuVelayi (79), Azheekkode, Thrissur]. This is also referred to as *Vaadakattu* by fishermen in Thiruvananthapuram [Muhammed (64), Perumanthura, Thiruvananthapuram]

Kachaankattu is the name given to the wind that blows from north to south in the Malayalam months of *Meenam, Medam* and *Edavam* (mid-March to mid-May). It is stronger in *Medam* (mid-April to mid-May). Fish availability will be less when these winds blow [MoidheenKunju (50), Manjeswaram, Kasaragod]. In Malappuram district this wind is called as *Vadakarakattu* or *Vadarakattu* [Abdulla(56), Chappapadi, Malappuram]

Vadakachaan (or) *Kumbhakachaan* is a wind from north west blowing towards the South, in the Malayalam month of *Kumbam* (mid-February to mid-March). This wind is strong and it results in strong wave action that makes difficulty in fishing. The phenomenon of sea erosion is also associated with this type of wind.

"*The wind takes away the soil layer by layer. It is called 'pollamaanthi'* .
Karthikeyan. P. K (70), Azheekkode, Thrissur

However, fishermen from Kozhikode district believe that the adverse tidal action is sometimes favourable for fishing and they call it *Vadokkattu* or *Vadaporathekattu* [MoidhinKutty (80), Puthiyappa, Kozhikode].

Vaadakondal blows in south to west direction and occurs in lean and rough season. It is strong and cool and blows after the *Karakattu. Karakattu is* also called *Koda* when it blows during the month of *Vrishchikam* (mid-November to mid-December) and sometimes extends upto *Makaram* (mid-January to mid-February) also. Normally, it blows from straight from east, but sometimes the origin may slightly incline to northeast or southeast [Benjamin (73), Thangassery, Kollam]

Thekkankattu blows from the south. This wind is severe in Malayalam months *Edavam-Midhunam* (mid-May to mid-July) and it sometimes makes the sea violent during which the currents are strong.

"*Aayiram vadakkanu oru thekkan*"
[one south (wind) is equal to thousand north (wind)]
Padmanabhan (75), Kasaragod

Vrishchikakattu, an easterly wind, starts to blow after *Vrishchikam* 18 (falls somewhere in early December). Fish availability is low from Vrishchikam 1

to *Makaram* 15 (mid-November to mid-February) due to the strong winds during this period and sometimes severity of the wind may start to decrease by *Makaram* 5 onwards [Appu (65), Azheekkode, Thrissur].

Padinjarankattu blows from sea to shore in the months of *Karkidakam* (mid-July to mid-August) and *Chingam* (mid-August to mid-September). This wind will be strong during rains and fishermen do not venture for fishing when the seas turn rough [Dineesh.D. Udhyapuram (62), Kanwatheertha, Kasaragod]

Mukundan (65) from Neerkadavu, Kannur, observed that during the monsoon there is no easterly wind. And soon after the monsoon, the easterly wind blows in the morning and it is a 'cool' wind. The westerly wind during monsoon is very strong unlike the westerly winds during other seasons.

Thembrayilkattu blows in south-west direction. During this wind period, water rises in the seas and there is increased water current which result in rough sea [MoidhinKutty (80), Puthiyappa, Kozhikode]. *Thangam* is a slowly moving wind and it is an indication of rough sea [Balakrishnan (60), Malipuram, Ernakulam]. *Cholaakarakattu* blows in summer season from North to East. And *cholarkondal* blows in rough season at north-west direction [Antony Patrick (55), Vaadi, Kollam].

The *karakkaattu, wind from east* is more during the month of November-December [Soman (58), Azheekkode, Thrissur]

Winds & Fish Availability

Different kinds of winds and seasons in which they blow have been associated with fish availability and fishermen have used the direction of the winds for deciding whether to fish on a particular day or not. When certain winds blew they were certain that fish would be available in plenty and other times they would net no catch

"If the westerly wind prevails, the water level increase and the fishes are plenty and can be easily detected by the fisherman."

Karthikeyan. P. K (70), Azheekkode, Thrissur

Adding to this, Simon. P. O (48), Chethy, Alappuzha said that the fishes are clearly visible on the water surface when the wind blows from the west, so the catches are good. He also pointed out that when the winds from east prevail, most of the fishes tend to migrate vertically downwards and the shoals of sardine tend to move through the layer of water just below the surface, which results in formation of bubbles on the water surface

When winds from south blow, the water current is from South to North, and the water flow is more and fishing activity becomes difficult [KochuVelayi (79), Azheekkode, Thrissur].

"*Kachamkattu*' that blows in the North to East direction in the months of November – December brings with it good catches" [John (61), Koottayi, Malappuram]. Dinesh D. Udhyapuram (68), Kanwathertha, Kasaragod has a similar opinion regarding *Kachaankattu*. Fishes are plenty during this wind due to cool and muddy water. Fishes cannot migrate to bottom. However, MoidheenKunju (50), Manjeswaram, Kasaragod said that it is difficult to do fishing when very strong "*kachaankattu*" prevails.

The availability of fish during southern wind would be less [Joppan (60), Munambam, Ernakulam] and fishes travel from west to east in *kizhakkankattu*" [Muhammed (68), Marakkadavu, Malappuram].

Assessing the Scientific Rationale behind observations and beliefs of fishers: winds and its impacts on fishing

The geophysical characteristics of Arabian Sea is different for different maritime states and also the semi-annually reversing monsoon system along west coast results in differences in wind patterns and water circulation. There are patterns that fishermen identify and know these differences during different seasons[15]. Since it is associated with convective, radiative, and sensible heat sources and sinks, with convective latent heating playing the most important role.

Monsoon season along the coast have significant influence in the fish availability along the coast, the sea conditions changes by the onset of the summer monsoon (June-September), at the time of south-westerly winds along the west coast, the colder, nutrient-rich and oxygen depleted waters from the subsurface replaces the surface water from the coast. This leads to growth of phytoplankton mostly diatoms and dinoflagellates which in turn results in increased productivity[16]. *This can validate the statement that during westerly winds, which are prominent during monsoon, the fish availability is high.*

Experts opined that during the transition period from South-West monsoon to North-East monsoon the winds (land-sea breezes) will be much lighter and will /may occur for a short period of time[17,18]. *This validates the statements made by fishermen that there are periods when there is no wind blowing either from the East or from the West.*

Studies have indicated that March-April and October are transition months with weak winds[19,20,21]. The low fish availability during March to May in

addition to the strong wind effects may be due to very low primary production (14 to 21 m mol C m-2 d-1) and chlorophyll (45 m mol C m-2 d-1) availability in Arabian sea at that period[16]. *This corroborates the view held by the fishermen that winds are strong in the Malayalam month of Medam (mid-April to mid-May)*.

According to the semi-annually reversing monsoon system, the surface circulation of the basin undergoes seasonal change. The wind speed which was ~7m/s in January, gradually reduced to 5m/s in March-April. Starting from May it increase rapidly peaking to 13 m/s in July and then decrease to 6m/s in October-November. Again in December wind speed will be 7m/s. Whereas it is believed that the cooling and sinking of upper layer waters in the absence of strong winds in the month of December, resulting in a drop of productivity[22,23]. *This is thus a validation of the ITK where the fishermen consider that fish availability is low from mid-November to mid-February the reason being strong winds in this period*.

Another ITK related to fish availability is that during *"Kachamkattu' that blows from North in the months of November – December brings with it good catches"*. This coincides with the low Sea Surface Temperature (SST) prevailing during these months, as a result of which fish migrate to the bottom[17]. Though this observation by fishermen is not directly related to wind patterns, they have made this deduction based purely on their experience.

According to the expert opinion the fish availability is found to be higher during this wind only in the northern Arabian Sea[24]. During the months of November- December, the origin of the wind is more likely to be from the North Eastern direction[17]. While the direction mentioned by fishermen is north.

During westerly winds, fish shoals tend to move shoreward and when the sea is rough, fish shoals move down into deeper water[25]. This is why during westerly winds, traditional fishermen who operate in near shore waters are able to net higher catches and so the observation that the fish availability is high during westerly winds. Panipilla (2015)[26] has observed that when the '*kondal*' wind blowing from the darkened western horizon becomes stronger, then fishermen's boats start to rise and fall on the waves. '*Kondal*' wind helps the fishermen to navigate in the ocean. Another observation by the same author is during the time of '*koda*' wind fishermen will sail only in the north western direction. With the help of wind power, a *kattumaram* navigates by using two bamboo poles locally known as '*paaimula*' and '*challimula'*. When the '*paaimula*' snaps mid-sea fishermen used to paddle back to shore.

Westerly wind towards Kerala coast may cause to piling up of water which may lead to increase in water level temporarily as explained[17] which further support the observation of fishermen that at the time of westerly wind, water level increase. Fish availability observed as high may be due to the increased plankton growth[27]. *Hence the statement of fishermen that if the westerly wind prevails, the water level increase and the fishes are plenty and can be easily detected by the fisherman is validated*.

Clarity of the water depends upon suspended and dissolved material. Wind energy creates more mixing and part of this energy will have impact on the shallow water quality by disturbing bottom sediment[18]. It may also depend on the intensity of wind. If wind is severe, high waves may develop which in turn support turbid water conditions in shallow water areas[17].

Conclusion

The dynamics of the wind plays a dominant role in navigation at sea. This despite rapid technological advances in the field of electronics that has developed several support systems for navigation making sea safety much more reliable than in earlier times. Fishermen have, however, been using the innate knowledge on various natural phenomenon like winds, acquired through their experience at sea. This is crucial to their survival as much as it is for their livelihood pursuits. The risks associated with the seas is related to the natural phenomenon and this knowledge is essential to keep them afloat as well as to engage in fishing. The relation between fish availability and the patterns of wind (and other factors) are also keenly observed and recorded for future use. With the advent of the GPS and Echo-sounder today it is much easier for finding the directions and also in identifying if fish shoals are present or not. However, even today traditional fishermen have the keen acumen to see which side the wind is blowing and tell if there will be a good catch on the day.

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Chapter 3
WATER CURRENTS, SEA SURFACE TEMPERATURE, WATER TURBIDITY & ITS INFLUENCE ON FISHING ACTIVITY

Introduction

Oceanic currents are the movement of water from one location to another and the wind pattern, tidal forces, season etc. affect it. The deep knowledge on these factors is crucial for fishing. Years of experiences at sea helps the fishers to distinguish favourable and hostile conditions of sea for casting their nets. Seasonal variation in flow patterns and other physical parameters have significant role in predicting the fish availability. It is common observation that the older fishers knew about the physical characteristics of the sea like its temperature and turbidity which they expertly used to identify fishing grounds and predict fish availability. The current generation of fishers are increasingly relying on modern tools for the purpose. Fish availability in particular area and season is greatly related to the physical conditions in the water body in which the fish live, these includes sea surface temperature, turbidity etc. Moreover, the sea surface temperature measurement is an important parameter to assess the climate variability.

Sea surface temperature refers to the mean temperature of the ocean in the upper few meters or defined as the skin temperature of the ocean surface water[1,2]. The exact meaning of surface varies according to the measurement method used, but it is between 1 millimetre (0.04 in) and 20 metres (70 ft) below the sea surface[3].

Current[4] is a horizontal movement of water and are classified as tidal and non-tidal. Tidal currents are caused by gravitational interactions between the sun, moon, and earth and are a part of the same general movement of the sea that is manifested in the vertical rise and fall, called TIDE. Tidal currents are periodic with a net velocity of zero over the tidal cycle. Non-tidal currents include the permanent currents in the general circulatory systems of the sea as well as temporary currents arising from more pronounced meteorological variability. The SET of a current is the direction toward which it flows; the DRIFT is its speed.

Turbidity[5] is the thickness or opaqueness of water caused by the suspension of matter. The turbidity of rivers and lakes increases after a rainfall.

There is a need for collection, archiving, synthesis and dissemination of these knowledge systems so that they can be suitably integrated into modern methods of fish identification, wherever possible. Even if they are not

immediately usable, there is need to record such information for posterity, before they are lost completely. This chapter presents information collected on sea and ocean related parameters like water currents, sea surface temperature and turbidity.

Indigenous Knowledge on Water currents and the effects on fishing activities

Native Nomenclature of water currents & Direction of currents

As seen in the case of winds that guide and determine fishing activity, fishermen also have specific indigenous names for the water currents which represent the direction of the flow. The flow of water is called *"neerozhukku"* (literally flow of water).

> *"Neerozhukku* will be sometimes strong and other times calm. The water also will be turbid at times or will be very clear."
>
> Thankachan (58), Munambam, Ernakulam

The local terms to denote waves in the sea are *moori*, *neeru valichil*, *muzha* etc. [Kuttan (60), Valappad, Thrissur].

Other names are *thekkan neeru, vadakkan neeru*, p*ura neeru* (sea to shore) and *kara neeru* (from shore to sea) [Beeranunni (64), Ponnani, Malappuram] or *thengara neeru* and *Vadakara neeru* [Abdulla (56), Parappanangadi, Malappuram].

Different names of the currents often refer to the direction of the flow. There are slight variations in the names given to similar currents across districts based on the dialects in use in these districts (Table 4).

The flow of water from north to south is also called *vadaneeru* [Thankachan (58), Munambam, Ernakulam] and from west to east and it is locally known as "*moori ottam*" [Francis Antony (76), Munambam, Ernakulum].

When the direction is not very clear in the open seas, the fishermen depended on the direction of water current, *aayippu* which always flow from West-East [Karthikeyan (56), Cherai, Ernakulam].

When the water currents are from South to North, the atmosphere becomes cool and sometimes very cold. There could also be rainfall and winds during this [Soman (58), Azheekkode, Thrissur]. When the water current originating from the North-East direction prevails, rain clouds are seen. However, these clouds are generally blown away by the wind [Purushan (73), Azheekkode, Thrissur]. If the movement of the clouds are towards the South-East

direction, the water level decreases and the water current is towards North-West direction [Aranmula (63), Azheekkode, Thrissur].

"When the water current is from South-East (*thengara neeru)*, there will be churning and the mud from seafloor comes to the surface and this can also get accumulated along the seashore."

Aranmula (63), Azheekkode, Thrissur

Table 4: Vernacular names for Currents

Direction of flow	Kochu Velayi (79), Azheekkode, Thrissur	Francis Antony (76), Munambam, Ernakulum
North-East to South-West	*Vadakara Neeru*	
South to North	*Thekkan Neeru*	*Thekkan Neeru*
East to West	*Kezhakkan Neeru*	*Karaneeru*
West to East	*Pora Neeru (or) Kaattu* (wind)	*Poraneeru*
North-West to South-East	*Vadakku Padinjaaran Neeru*	*Vadaporathu Neeru* also known as *Kalangiyaneeru* (Turbid Waters)
South-West to North-East	*Themborathu Neeru*	*Themburathu Neeru* also known as *Meneeru*
North to South	*Vadakkan Neeru*	
South- East to North-West	*Thengara Neeru*	*Thengara Neeru*

When the currents are prominent, during the months of April-May, some areas of sea are seen to be yellowish in colour which is locally called as *pola* [Stephan (60), Fort Kochi, Ernakulam]. The currents originating from the South-East is more during the months of August to November [Subrahmanyam (75), Azheekkode, Thrissur].

Another feature which has relevance to fishing is the *Chakara* or mud bank formation which is unique in Kerala coast. Fish availability is very high especially during rainy season and during the months of Malayalam calendar *Chingam* and *Kanni* [Sivadasan (80), Perumpilly, Ernakulam; Arumukhan (60), Kara, Ernakulam]. The water in the mud bank area is calm and have no wave action around 5-6 km diameter, the manoeuvering of the craft is easier, and the fishing activity continues for nearly 4-5 months [Thomas (61), Punnapra,

Alappuzha]. During the occurrence of mud bank, the area smells as that of a cracker [Devadas (46), Kasaba, Kasaragod].

Water currents & Fish Availability

Direction of water currents over a fishing ground can give hints to the fishermen about the possibility of finding fish in a particular area. Through long years of experience and by observing the water currents closely and they can accurately predict the availability of fishes in particular water currents.

Neeru maarumbol meen maarum
When the current changes, the fish also change (*direction*).
Thankachan (58), Munambam, Ernakulam

Fishermen have observed that when the water currents are strong, the fish availability is also less [Antony P.J. (48), Chethy, Alappuzha]. The clarity of water also affects fish availability. The waters are turbid at times and at other times, it is crystal clear. The turbid water means fishes will be available in plenty and in clear water current usually fish availability is less [Pradeepan (69), Neerkadavu, Kannur]. During *kara neeru* (shore to sea) fish availability very less [Beeranunni (64), Ponnani, Malappuram]. According to Abdulla (56), Parappanangadi, Malappuram, fish is less during water currents from east to west *(roughly coinciding with Beeranunni's statement above of 'kara neeru' and low fish availability)* and currents from west to east brings good fish catch.

During *thekkan neeru,* water current is from the North and the fish is less [Bineesh (36), Koottayi, Malappuram].

Fishermen are also able to predict fish species in relation to the water currents.

- Currents from South to North, water is clear locally called '*thelinja vellam*' and sardine and mackerel are abundant.
- Currents from North-East to South-West, rich in sardine and mackerel with the waters being clear.
- Currents from North-West to South-East (also known as *kalangiyaneeru,* mentioned earlier), fish availability is high, corroborating the view that in turbid waters fish availability is high.
- Currents from South-West to North-East also known as *"meneeru"* indicates less fish availability

Indigenous Knowledge on Sea Surface Temperature (SST) and turbidity

Fishermen referred to the temperature of water as cold or warm. This depended on the season (or month).

The sea water will be warm roughly from December to May (there were different opinions on this, and this has been compiled from what Josy (55), Fort Kochi, Ernakulam; Stephan (60), also Fort Kochi, Ernakulam; Subrahmanyam (75), Azheekkode, Thrissur had to say). Towards peak temperatures fish availability is also less.

Subrahmanyam (75), Azheekkode, Thrissur also added that the westerly winds are more in this period.

During the time of peak temperature, the fishes tend to move vertically downwards and as the temperature decreases, fishes come to the water surface.

Padmanabhan (70), Neerkadavu, Kannur

According to Solomon (94), Chellanam, Ernakulam and Thankachan (58), Munambam, Ernakulam when the wave action is rough, the turbidity of sea water is high and the fish availability is also high in these turbid waters. Generally turbid waters are observed from May through July (roughly coinciding with the monsoon). Endorsed by Antony P.J (48), Chethy, Alappuzha who noted that turbid water is an indication of fish availability and clear water often contains no fishes. The most turbid waters are observed during monsoon season. Solomon (94) added that the fishes are comparatively very less during March to May as the sea surface temperature (SST) increases.

Crabs and fishes are plenty in turbid waters.

Stephan (60), Fort Kochi, Ernakulam

The changes in underwater current pattern cause the turbidity of the water. In turbid water, the fish is abundant.

Viswambaran (76), Azheekkode, Thrissur

Assessing the scientific rationale of the relation between water currents, SST, turbidity and fishing and fish availability

Water currents

Biological and ecological characteristics of marine ecosystems are affected by water currents. At the time of pre-monsoon period, northerly current disappear and southerly flow will be restricted to a narrow belt. When the currents are low, there is a possibility of few fishes that prefer low current areas to congregate in shoals and hence, there is an increased chance of good

fishery in these areas[6]. This can be related to the fishers' knowledge that when strong water currents are prevailing, the fish availability is less. The type of current and flow characteristics varies according to season and geographical area[7].

The currents flow from the northern direction is an indication of less fish availability and when it is from the southern direction more fish catch is possible because in the northern direction when temperature is cool, warm heated air moves up and is replaced by cold wind from the north. Low temperature on the surface waters induces the fishes that live in deeper waters to come to the surface, which in turn leads to good fishery[8]. This validates the statement '*when water current is from north, the fish is less*'.

The saying *"neeru maarumbol meen maarum"* could be related to the behaviour of fish that it may move along with the water current[9]. Experts opine that though there is no direct connection between water currents with the movement of clouds, if we consider wind direction and consequent current flow along with the tidal currents, then the possibility of lowering water level can be possible[9]. During SW monsoon period upwelling may bring denser water to surface which again supports this possibility. This validates the statement that '*.....if the movement of the clouds is towards the South-East direction, the water level decreases and the water current are towards North-West direction....'.*

The phyto-planktons the basic producers in the food web pyramids are capable of controlling many ecological processes including the impacts of global climate variation through the absorption of solar radiation[10]. The pattern of water current and phytoplankton are interdependent, hence the variation in the current pattern and its significance are assessed from the plankton productivity[11] or otherwise phytoplankton analyses are employed as a indicators of water quality change in the system[12]. There also exists relationship between phytoplankton production to different physico-chemical factors and plankton composition is affected by different environmental factors such as pH, light and temperature[13,14,15,16].

The pale yellow colour of seawater during monsoon as reported by the fishers can be validated by the fact that sea water colour changes turns pale yellow, red, brown, due to the algal bloom during monsoon[17,9]. Other possibilities as explained are that high amount of suspended particles and primary production also cause the discolouration in the water[18]. The Algal bloom may also adversely affect the fish stock in that area.

During monsoon the southerly current spreads and the phenomenon of upwelling is observed due to various factors like the surface currents running parallel to the coast at high velocity during this period[19]. They are distinct patches of calm, turbid water with high load of suspended sediment,

appearing with a clay substratum during the rough monsoon season[20,21,22]. During upwelling nutrient-rich sub-surface water replaces the cold surface waters[23] and this occurs during the south west monsoon period[24,25,26]. Mud banks or *chakara,* as it is locally referred to, along the coast and is rich in fish and prawns. The reason for abundance of fish and prawns may be[27] the vigorous stirring up of mud due to the wave action, which results in the upward movement of fishes and prawns. The artisanal fishermen look ahead for a good mud bank season during which he can operate his canoe from the calm waters of the mud bank and often land heavy catches of shoals which enter the area[28]. It has been observed that during upwellings the surface zooplankton biomass is the greatest and as such the increased availability of fish is because of they can feed in relatively calmer waters which is abundant in food[29].

Fish is abundant in water current from west to east due to the coastal upwelling, which brings high productivity in the epipelagic layer[9] and hence the observation of fishermen that the water currents from west to east brings good fish catch can be validated. Mud in this area is soft like butter due to accumulation of mineral oil, mineral salts, organic matter and plankton, which invites shoals of oil sardine, mackerel, prawns and soles[30]. In Kerala, mud banks arise with the onset of south-west monsoon and withdraw during August[31]. Several studies[32] have compared the catch statistics from mud bank and non-mudbank areas and a special study of the prawns landed at the mud bank region during 1972 to 1976 has also been made. One of the reasons for the occurrence of mud banks[33] was that the subterranean flow along with activated trending faults and originate from the adjacent watershed (Vembanad Lake) separated from the sea by a narrow strip of land where submerged porous lime shell beds are present may be the reason.

Mud bank formation in terms of meteorological aspect was analysed and also the other factors like increase in coastal upwelling and chlorophyll concentration were analysed in detail[28,34].

Sea Surface Temperature

One of the critical physical factor, which affect coastal ecological system, is Sea surface temperature (SST). Water temperature directly affects process rates, water column stability, and the species of plants (such as algae, seagrasses, marsh plants, and mangroves) and animals (microscopic animals, larger invertebrates, fish, and mammals) that live in a particular region. Change in SST in the decadal or centurial scale may results in cascaded effects in the ocean ecology due to the decreased primary production to decline in fish production. Moreover, it alters the long-term cycles in the ocean circulation[35,36,37] and there may be discernible change in surface temperature of oceans all over the world.

According to the expert opinion, during high temperature the fishes tend to move vertically downwards due to the low primary production and food scarcity in the surface water. As the temperature decreases, increased plankton growth in the surface layer attracts the fishes to the surface water[38]. This observation endorses the fishers' ITK that '*During the time of peak temperature, the fishes tend to move vertically downwards and as the temperature decrease, fishes come to the water surface*.'

Oceans have important role in global climate change and one among the most important geo-physical parameter in determining this change is sea surface temperature[39]. WARM ocean surface is the one of the reason for tropical cyclogenisis[40]. The rise in SST along Indian coast through satellite derived information has been reported[41]. At high temperature the fishes tend to move vertically downwards due to non-upwelling situations prevailing and Oxygen is sufficient in the middle column of sea water. As temperature decreases fishes come to the water surface because during the monsoon period, as a result of upwelling process the surface water is replaced with the cooler deep water. Since the deep water is Oxygen deficient, fishes move to upper layers. The temperature is less during monsoon, so this can be related to the given observation[17].

During the period of high temperature, certain fish species cannot tolerate the variations in temperature so they migrate to deeper water and vice versa when the temperature decreases[9].

Recent hydrographic surveys in the southeast Arabian sea shows that during October– November, the SST reaches 28.5°C and during December– January, SST dips to 28°C. During January, SSTs ranges between 28–29°C in various parts of the southeast Arabian sea. From mid-February to March, the southeast Arabian sea warms significantly and SST ranges from 29–30°C during March and the region where temperature exceeds 29°C during February–May is called the Arabian Sea Mini Warm Pool[42,43]. These statements also validate the observation by the fishermen that the temperatures of the waters are high in the Arabian sea during December to May.

Turbidity

The fish abundance in turbid waters may be linked to reduced predation pressure and also the high food supply[6,44]. From studies it is evident that zooplankton abundance is strongly correlated with turbidity of the water[45]. This can be related to the high fish availability observed in turbid waters.

Conclusion

Natural phenomenon like winds, currents, temperature etc. are inter-related and have a direct bearing on the fishery resources. This is thus reflected in the knowledge that fishermen have gleaned over generations which have guided their fishing activity. Their keen observation of these phenomenon and linking the same with fish availability has helped them harvest the seas effectively. The fishermen have learnt to relate the direction of wind and water currents to the movement and abundance of fish. This has also been associated with water temperatures and to different seasons. They are aware of the seasonality of fish abundance. This innate knowledge, if documented, can be useful for future reference and use, even with the current advances in technology related to fishing and in the science of understanding and prediction of weather phenomenon.

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Chapter 4
LUNAR CYCLE, STARS AND CONSTELLATION & RELATED FISHING PRACTICES

Introduction

The astronomical phenomena like lunar phases influence fishing and fisheries. The availability of fish has long been predicted with relation with moon light. Lunar cycles are also related to tidal action[1]. While some species of fish tend to aggregate towards light sources, some others move away[2]. While the lunar phases have a direct relation to fishing, other phenomenon like stars and constellations have mostly been used for navigation rather than for fishing per se[3]. Keen observations have evolved into knowledge systems and have served the fishing community for ages. Generally, trips began very early in the mornings and there was hardly any other light source acting as beacons except for the stars[3,4] and the positions of different known and popular and easily identifiable constellations. About 88 constellations are visible to naked eye, have been authorized by International Astronomical Union (AIU)[5].

Indigenous Knowledge on Lunar cycle, star and constellation and Fishing

Lunar Cycle

Fish availability is predicted according to the appearance (or phase) of the moon and it is locally called '*pakkam*'.

Valsan Pillai (82), Pallithode, Alappuzha

According to Thankachan (58) from Munambam, Ernakulam, fish is abundant on new moon day and fish availability is very low on full moon day (the local term denote this scarcity is *vaavaruthy*). Moonlight towards the west side brings in more catch [also endorsed by Mukundan (68), Kasaba, Kasaragod]. For two to three days before both full moon and new moon days, the fish catch is high. Maxson (48), Fort Kochi, Ernakulam, has a similar opinion about the fish availability on full moon day and new moon days.

On full moon nights, the fishes are believed to migrate to shallow waters and as the moon light fades out, they come back to sea.

Preman (52), Vellayil, Kozhikode

Fishermen also used days (with vernacular names) for their fishing practices like 'on *Ashtami*, the eighth day ahead of the new moon, the fish availability is high and on new moon day there is no catch'.

Maxson (48), Fort Kochi, Ernakulam

The tenth day after new moon (*Amavasya*) is called *Dashami*. On *Dashami*, the availability of fish, prawns and crabs are high. Fishes locally known as *Karichala* (*Clupeid* spp.) and *Mural* (*Hemiramhid* spp.) are found on *Pournami* (full moon). However, because of the bright moonlight fish availability is restricted to a few species. The 11th day of lunar cycle of each of the two lunar phases is called *Ekadasi*. On *Ekadashi* the water level increases and fishermen have to fish at depths of upto 10-12 feet to catch fish and crustaceans. On *Ashtami* the water level decreases after 7.30 am and the fishes are found to be abundant during this time.

Josy (55), Fort Kochi, Ernakulam

During high tide, which occurs when the moon is rising, fish do not move in schools. The interval between the high and low tides (which occurs towards the time the moon sets) of about two hours also results in no catch.

Mukundan (68), Kasaba, Kasaragod

During 'high tide' water from upper layer flows towards west and lower layer of water towards south.

Savithri (61), Perumpilly, Ernakulam

Fishermen related intensity of tides to various commonly observed religious days like 'high tide is maximum during *sivarathri* (a religious observance which usually falls in February) and *naga panchami* (a religious observance which usually falls in August).

Dinesh D Udyapuram (68), Kanwartheertha, Kasaragod

During high tide, the Chinese dip nets also get abundant catch as fish availability is more during these times and during low tides fish catches will be less.

Thomas (60), Munakkal, Thrissur

During low tides if the *bombili* worm is seen on the water surface it is considered an indication of high fish availability in that particular area.

Thankachan (58), Munambam, Ernakulam.

Stars and Constellations

The traditional fishers of the Kerala have relied on stars and constellations to determine time, to navigate, to fish and to locate offshore reefs. Early seafaring people explored their way by trial and error and their knowledge about celestial bodies helped them to navigate and other purposes[6].

Ninety four years old Solomon from Chellanam, Ernakulam reminiscences that fishermen relied on stars to determine direction and time when out at sea. He names them *Perumalayan, Kondotti, Muzhakkol* etc. seen during the

months of January and February. The star *Perumalayan* is generally observed at 4.00 am, about the time when they start their preparations for their fishing trips.

Stars and constellations generally indicated the direction and have been used for navigation. When there is no sense of direction in the sea, when they did not have any modern equipment or even a rudimentary compass, the fishermen of earlier times relied entirely on their knowledge of natural phenomenon for navigation. The best bet in such cases was these celestial objects.

The *Perumeen* is used by the fishermen to determine the direction back to shore as this is observed towards the east after 3.00 am and by the time it is 7.00 pm it travels to the west. By observing this star, fishermen know where direction to head in to reach the shore.

John (82), Thaikkal, Alappuzha and A.Y.Antony (68), Chappakkadavu, Alappuzha

Other stars/ constellations that were used in navigation were *Naazhika Mani* (pendulum), *Muzho kol* (scale or ruler) and *Kontha* (rosary).

John (82), Thaikkal, Alappuzha

They also used the names *Koottu Nakshathram* (could not be validated), *Kurisu Velli* (southern crux), *Trimoorthikal* (the holy trinity), *saptarshikal* (Pleiades) etc.

Mukundan (68), Kasaba, Kasaragod

The *Kurish Nakshathram* is a constellation of four stars that appears in a shape of cross (*kurish*). If this appears along the east west direction, the fishermen do not take their boat into the sea (as it is considered a very bad omen), but if it lies in north south direction, then fishing is undertaken [Anthrose Vasthin (74), Chaappakkadavu, Alappuzha]. Another belief associated with this according to Yosep (48), Munakkal, Thrissur is that if this constellation is seen in the east-west direction and then changes its position every two hours, the fishermen start to return (they believe, it is a sign of danger and God is giving them a warning.

Kavundam, three stars appearing in a line seen during December – June months.

Hamsakoya (55), Alangadi, Malappuram

A star locally known as *kottu* is followed which is very bright, visible in the eastern direction from 8.00pm to 2.00am. It is believed that the fish is plentiful in the direction towards which the light is directed.

Viswanathan (55), Perinjanam, Thrissur and Manoharan (52), Chettuva, Thrissur

Mukundan (68), Kasaba, Kasaragod referred to a star by the same name *Kottu*, which rose by 5.00 am, and *Malakottu* which sets by 4.00 pm.

Kootameen, a constellation of 10 to 15 starts seen in north west direction after 11.00 pm, is also used for navigational purpose.

Abdulla (56), Parappanangadi – Chappapadi, Malappuram
Hamsakoya (55), Alangadi, Malappuram

Palli nakshathram (*palli* –place of worship can be a mosque or church, *nakshatram* – star) and *Kodipamaram* - a blinking star [Muhammed (68), Marakkadavu, Malappuram] and constellation of nine stars (three starts each in three rows) rises after sunset is called *onpathu vilakku velliyari* [Rafeeka (67), Perumanthura, Thiruvananthapuram].

Stars are also used to determine time. *Muzhakol velli* is a stellar constellation usually rises at 8.00pm. It is group of three stars. Another constellation of six stars rises at 10.00 pm locally known as *aarami*.

Muhammed (64), Perumanthura, Thiruvananthapuram

The star, which appears after 9 o'clock in the night, is referred to as *'Mulakkameen Nakshathram'* (Rising Star).

Yosep (48), Munakkal, Thrissur

If a *vaal nakshatram* (comet) called "*velli chaamam*" is seen setting at 9.00 pm in the West direction, fish availability is high.

Marcose (60), Vaadi, Kollam

A star locally known as "*vadikottu*" rises at 4.00 am as well as 2.00 am. Another star called "*veliunda kottu*" rises at on 9.00 pm.

Moidheen Kunju (50), Manjeswaram, Kasaragod

A constellation "*panjorkalla*" rises early morning on 5.00 am. This is used for navigation. Another star usually rises towards the evening on the west side, known as "*koota kotti*".

Dinesh D. Udhyapuram, (68), Kanwathertha, Udyaavar, Kasaragod

Assessing the Scientific Rationale of astronomical phenomenon on fishing

Fish behaviour is affected by various natural phenomenon have an influence on fishing also. Most fish species move according to the light, and the general observation has been that fish moves to face east when the moon rises and towards west when the moon sets[7]. This supports the commonly held belief by fishers that that *on full moon nights, the fishes are believed to migrate to shallow waters and as the moon light fades out, they come back to sea*.

Lunar eclipses involve the reaction of gravitational forces between earth, moon and sun and these forces results in the changes in the oceanic conditions and it was noted that a few days ahead of new moon and full moon, there exists strong water currents and hence the fish catch is less[8]. It is during the 4th day (Chaturthi) to 8th day (Ashtami) of lunar cycle[9]. The new moon phase is helpful in spotting the fish shoals and they are caught in the fishing gears easily, whereas, peak intense luminescence is considered unfavourable for fishing because the intensity of light enables fish to see and avoid predators and fishing gear[10,11]. So during 12th day to 3rd day of lunar cycle, i. e. between Dwadashi to Tritiya of lunar month the fish catch is more but during the 9th day (Navami) to 11th day (Ekadashi) of lunar cycle the fish catch is moderate because of faster currents resulting in more filtration[13,14,15,16,17]. This corroborates the statements of the fishers regarding fish availability or lack of it close to full and new moon.

Often fishermen are able to locate schools of small fishes by the glow of phosphorescent plankton in seawater. In lagoons and estuaries, primary and secondary maxima of fish catch rates have been observed on new moon and full moon days respectively which has been strengthened with the findings of several researchers[18,19,20,21,22]. Catches of certain species have been reported to be higher and more numerous during full moon than during the darker phase of the lunar cycle. It has been reported that shrimps, when fished at night can be caught in greatest quantities at new moon[23,24,25,26,27]. Generally, shrimps are nocturnal in behaviour and have a burrowing nature in sediment to avoid predators. Because of this, in the relative darkness of the new moon, when they are actively feeding above the substrate, they are more likely to be caught by trawl nets[28]. They assumed that the effect of lunar phases on catchability can impact vertical migrations of primary food source (bait species) of these fishes and modify the accessibility of the fish to the fishing gear.

Fishers also showed great sophistication with regard to navigational skills and used their knowledge of winds and currents (as seen in previous chapters) and also of celestial bodies, which helped them carry out fishing safely. The stars are identified by their position, time of appearance and number in constellation etc. even though the same stars/constellations may be named differently in different places. Historically also people have used instruments which aided in the observation of celestial bodies for various purposes such as navigation, direction finding, determine time etc.[29]

The fact that fishermen's experience of stars influence the fishing can be validated from the findings of Benson, 2012 who points out that the fishes comes close to the shore during the evening rising time of Pleiades in November and helical rising time in June along Peru coast. Other studies have also reported that the *Aarameen* and *Kurishu nakshathram*, the stars

which help in finding direction and determining time are the Pleiades and Southern Crux[30].

The observations, myths and omens in relation to the rising and setting stars are also seen in several indigenous communities[31]. Constellations are generally looked up by the fishermen to identify the navigational routes. Observations from Thoothoor village in Tamil Nadu recorded *Kurusu velli*, *Kappal velli*, *Dhruva nakshatra*, *Vidia velli*, *Malaimeen velli* etc. that are followed by the fishers[32].

Conclusion

Lunar cycles have an influence on fishing. The waxing and waning of the moon influences tidal action and this in turn has an impact on the movement of the fish. And the movement of fish and fish shoals is what ultimately determines the fishing activity. Stars and constellations have generally been used or navigational purposes and when in open seas there was little else to depend on except these.

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Chapter 5
WEATHER PREDICTION & FISHING

Introduction

Marine fishing is always associated with high risks and uncertainties. Any change in weather can affect the physical parameters of the sea and the sudden occurrence of storm surge and other natural disasters many times poses life risk for fishers. In older days, fishers had derived a vast treasure of knowledge from their experiences to cope up with risks.

As the fishing activities mainly depends on the forces of nature and there are high chances of occupational fatality in the sector, accurate weather prediction and its dissemination are very essential. Scientific advancements have made weather forecasting reasonably accurate. The Earth System Science Organisation - Indian National Centre for Ocean Information Services (ESSO-INCOIS) integrated INDian Ocean FOrecasting System (INDOFOS), established via Ocean Forecasting System is capable of predicting the surface and subsurface features of the Indian Ocean reasonably well in advance[1,2,3,4,5,6,7].

The weather prediction in earlier times was done from the practical/experiential knowledge which was passed on through generations. Even though there are sophisticated weather forecasting systems available now, the traditional wisdom continues to be important. This can be particularly useful in situations where precarious weather conditions can be forecasted by combining traditional knowledge and information generated through modern technologies.

The fishing communities in India have developed coping strategies to adverse weather conditions by making observations on speed and direction of wind and current, water mass movement and subsequent predictions of fishing grounds. This helps them to switch their fishing activities in favour of their fish catch and gaining an insight into this ITKs of fishermen will help in evolving coping mechanisms[8]. Even though fishermen communities depend on ITKs for fish scouting it has a luck factor attached to it and so the services of PFZ and OSF for welfare of fishers have been initiated by INCOIS which considerably reduces the time and fuel for identification of fishing grounds for catching fish[9].

This chapter presents information on how the fishers interpreted the observations of cloud formations in relationship to adverse weather conditions. Observations on the behavior of aquatic animals were also used to anticipate the occurrence of natural disasters. Such information can be useful in disaster preparedness or warning systems.

Indigenous Knowledge of fishers on weather predictions

An experienced fisherman can predict a rough sea
by observing the way the wind blows.
Thankachan (58), Munambam, Ernakulam

When clouds appear in North West direction there is possibility of heavy rain. A natural disaster is imminent when the odour of the seawater is similar to that of a burning fire. In the sea bed there is eruption of silt locally referred to as *Chella villuga* which is an indication of disasters like storms (even tsunamis).

Sivadasan (80), Perumpilly, Ernakulam

Thekkanpaada (thekku-south; *paada*-skim), a dark grey coloured cloud in north-west direction, results in heavy rainfall. If "*thekkanpaada*" prevails, the fishermen do not prefer to go for fishing.

Francis Antony (76), Munambam, Ernakulam

The presence of dark clouds in any one portion of sky is a fore teller of heavy rain and storm [Joppan (60), Munambam, Ernakulam] and if the cloud appears in west side, it is an indication of arrival of rain [Suku (65), Kuzhuppilly, Ernakulam].

Appearance of layers of clouds and heavy clouds in west side that do not move away with the wind, are sign of occurrence of rain; as well as clouds in south and south-west direction indicate chances of heavy rain and rough weather conditions.

Muhammed (68), Marakkadavu, Malappuram
Abdulla (56), Parappanangadi, Malappuram
Joseph (57), Shangumugham, Thiruvananthapuram
Pradeepan (59), Neerkadavu, Kannur

Observation on large bubbles coming on to the water surface and the sighting of sea snakes related to natural hazards has been recorded in many districts.

Large bubbles on the water surface indicate the
disturbances in sea bottom and can result in rough sea conditions.
Coiled sea snakes above the water surface, black coloured worm
on shores are also indications of rough weather.
Dinesh D Udyapuram (68), Kanwartheertha, Kasaragod

Big bubbles coming up in the sea are the first indication of unfavourable conditions.

Muhammed (68), Marakkadavu, Malappuram

When the seafloor is disturbed, sea snakes coil into a bunch resembling a ball and rise to the surface. Each bunch has more than two snakes.

Solomon (94), Chellanam, Ernakulam

Sudden appearance of sea snake and bottom dwelling worms is an indication of any disturbance at sea bottom. The snakes are locally called *Thuni paambu* and worms are *Bombili puzhu*.

Antony (58), Munambam, Ernakulam

The observation on sea snakes and rough seas was also made by Ismail (50), Manjeswaram, Kasaragod.

During summer, the muddy sea bottom cracks and releases slightly bigger bubbles which may be an indication of a bad sea weather condition.

Antony P.J (48), Chethy, Alappuzha

Chettarly (red snake) seen in the bottom of sea coming to the water surface as well as *muda* (large bubbles) coming to the surface are indications of unfavourable weather condition

Abdulla (56), Parappanangadi, Malappuram

Assessing the scientific rationale behind the observations on weather conditions of fishers

As can be observed from the statements recorded from the fishers, there is strong association between weather (climatic) conditions and fishing. Fishing, biodiversity and climate are also linked and one affects the other[10,11]. Wind is a major factor, as winds generate local wind waves and long ocean-swells and therefore the wind is considered as the driving force of weather at sea[12,13]. This can thus be corroboration of fishers' statement that the weather can be predicted based on the direction of wind.

Cloud movements, type of clouds and cloud cover are also observed by the fishers to predict weather and other climatic conditions. Rainy conditions are identified by dark cloud cover and type of clouds. Wind direction and strength also has an effect on cloud movement[14,15,16].

Bubbles in the ocean floor have been observed and a number of reasons are attributed for the same, including movements along fault line or formation and release of hydrocarbon bubbles[17,18]. Bubbles have recorded as being been important in sea gas transfers[19] and in 'elevating dissolved gas concentrations during storm'[20] and studies have recorded observations of storms with bubbles[21,22] (but not necessarily bubbles from the sea bottom). The fishers have also not explicitly mentioned that the bubbles were from

the sea bottom, but it appeared as if it was from there. It could be other bubbles as observed in studies.

The coiling of snakes has not been found recorded in literature. However, predictions based on the observation of behavior of other animals were documented. It has been observed that animals can sense impending natural disasters such as storms and earthquakes[23,24,25]. Local weather forecasting have been associated with empirical observation and closely connected to behavior patterns of birds and animals[26,27]. Aquatic animals and sea birds have peculiar and typical behavior patterns when they sense impending storms[28].

This behavior in sea snakes can be due to the presence of larger sensilla than land snakes potentially making them more likely to be able to sense vibrations from all directions[29]. The sensors, known as scale sensilla, are sensitive organs that protrude from scales on a snake's head. Also the possibility that worm like organisms are bottom-dwelling in nature and so may be more sensitive to seismic shifts.

When there are sudden fissures in the sea bottom and generation of whirlpools the sea snake coils around itself like a ball and comes to the water surface. Crustaceans like crabs unable to bear the disturbance in sea floor throw themselves out from deeper waters to surface.

Conclusion

Livelihood activities that are weather dependent require knowledge of different parameters indicating adverse weather conditions. This can be widely seen in farming activities and also is the case in fishing. Since the fishing activities are carried out in open seas, the knowledge on the behavior of the weather is essential for personal safety and for the safety of fishing implements. The possibility of bad weather could be identified by observing the clouds, winds and and the behavior of certain marine fauna. Such traditional knowledge act as an informal insurance mechanism for the life of fishers and their fishing equipment.

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Fisheries and Fish:
Knowledge on fish and fish shoal identification and seasons

Chapter 6
KNOWLEDGE ON FISH SPECIES AND FISH AVAILABILITY

Introduction

The knowledge of fishes and fishing are intrinsically linked. As already discussed in chapter 8, fishers identified fish shoals from afar, based on several characteristics including colour. Traditional fishers in earlier times did not venture too far into the seas and their area of operation was generally near-shore and the species targeted were pelagic shoals. While sardine and mackerel were the main catch, they also caught anchovies, shrimp, sharks and a variety of other fishes. Though hook and line fishing Fishermen had knowledge about the different types of fishes and their behavior that aided them in fishing.

Some of the information documented regarding the fish behavior and fish availability is presented in this chapter.

Indigenous Knowledge on fish and fish availability

While hauling the net itself, the fishermen can predict whether the catch is high or low. This is known as *naadipidikkuka* (in other parlance a medical term indicating the traditional medicine man checking of the pulse).

Sharafudheen (41), Chavakkad, Thrissur.

Fish were available in plenty in near shore waters up to a depth of 15 *paakam* (but nowadays, fishermen have to go further for a reasonable catch) [Nandanan (60), Kara, Thrissur] and the availability of smaller fishes will be high within a distance of 8 *maaru* (1 *maaru* = one fathom= 1.8 m) [Shaji (26), Thiruvithara, Thrissur].

Generally, fish availability was higher during monsoon season. The sardines and mackerels migrate to shore during monsoon for spawning [workshop respondents; Maxson (48), Fort Kochi, Ernakulam; Thankachan (58), Munambam, Ernakulam]. *Chala* (Sardine), *aila* (mackerel), *chemeen* (*shrimp*), *Poovalan* (*Metapenaeus dobsoni*), *Karikkadi (Parapenaeopsis stylifera/ Kiddi shrimp). Manthal (flat fish), korakutty (Scienids), Kari mathi* (*Sardinella fimbriata/* Fringe scale sardine) dominate in the catch composition [Vijayan (59), Perinjnam, Thrissur; Mukundan (68), Kasaba, Kasaragod; Krishnan (63), Vemballoor, Thrissur].

In rainy seasons, the fishes migrate towards the shore and thus the traditional fishermen get more catch. Especially when there is *Kadalellakam* (the stirring of the sea), shrimp catch is more.

Nandanan (60), Kara, Thrissur

Following the Malayalam calendar, fishermen a seasonal calendar was prepared by the fishermen indicating the availability of fish (Table 5).

Table 5: Seasonal availability of fish

Species	***June-Sept***	***Sept-Oct***	***Oct-Nov***	***Nov-Dec***	***Dec-Jan***	***Jan- Feb***	***Mar-May***
Malayalam month/s	*Edavam; Midhunam; Karkidakam; Chingam*	*Kanni*	*Thulam*	*Vrischikam*	*Dhanu*	*Makaram*	*Kumbham; Meenam; Medam*
Mathi *(Sardinella longiceps)*	***H***	***H***	***H***	***M***	***L***	***L***	
Aila *(Rastrelliger kanagurta)*	***H***	***L***	***H***	***H***	***H***	***`L***	
Karikkadi *(Parapenaeopsis stylifera)*	***H***	***H***		***L***	***L***	***L***	***L***
Poovalan *(Metapenaeus dobsoni)*	***H***	***H***		***L***	***L***	***L***	***L***
Naran *(Fenneropenaeus indicus)*	***H***	***H***					
Thiriyan *(Megalaspis cordyla)*	***H***	***H***					
Natthal *(Stolephorus indicus)*	***H***	***H***					***M***
Etta *Ariidae family*						***H***	***H***

(Compiled from the workshops conducted at ICAR-CIFT with fishermen from Alappuzha and Thrissur and information collected from fishermen in other districts during field surveys)

Choyi (87), Kottikulam, Kasaragod who went fishing on a canoe using gill nets and cast nets said that fish availability was high during *Karkidakam*, *Chingam*, *Meenam* and *Medam* and fish is abundant in muddy water

Nazar (58), Varkala, Thiruvananthapuram, also said that fish availability was more in Malayalam month *Thulam* with the saying

Patthu jaathi vallathil patthu jaathi meen

(ten different crafts get ten different species of fish)

Fish catches are more during June to August and less during November to February [Gero Mart (57), Shangumugham, Thiruvanathapuram; Solomon (94), Chellanam, Ernakulam].

The fish availability is high during the months of July to August for those who gleaned for fish in shallow waters along beaches. The fishes abundant during this season are sole fishes, catfishes and crabs. Gleaners catch fishes and crustaceans with bare hands with ease during 5 am -10 am of the morning hours. Cat fishes are available more during night whereas crabs during early morning hours.

Maxson (48), Fort Kochi, Ernakulam.

'*Chakara'* mud bank formation is unique in Kerala coast. Fish availability is very high especially during Rainy season and during the months of Malayalam calendar *Chingam* and *Kanni*.

Sivadasan (80), Perumpilly, Ernakulam

The phenomenon of Chakara at Challi beach observed during the project period– Alappuzha District

During summer, sardine and mackeral are caught abundantly and in rainy season fishes known as *pallimeen* (Lesser tiger toothed croaker), *kuttan* (Croaker), *parava* (White fish) are caught more [Sivadasan (80), Perumppilly, Ernakulam who fished using a traditional canoe and operated gill nets and cast nets] *karichaala* (Lesser sardine) and *neyychaala* (Sardine), mackerel, anchovy and trevallies [Marcose (60), Vaadi, Kollam]. In the monsoon period, mackerel, give local name *Naranchemmen* (*Indian white shrimp*), *Poovalan* (Kadal shrimp) dominated the catch [Mukundan (68), Kasaba, Kasaragod, has used *kambavala* (type of boat seine), *kollivala* (Boat seine); Vijayan (59), Perinjanam, Thrissur who fished using *chalavala* (sardine net), *ailavala* (mackeral net), *choodavala (a*nchovy net- ring seine) and vatta vala (scoop net).

In summer season, generally the catches were very less. Fishermen have to move upto 16 fathoms in order get fish. The reason was that fishes migrated to deeper waters where the traditional fishermen cannot operate their

canoes. The highest catches are observed during the months of May-September which comprised of the *kuttan* (Croaker), *palli* (Lesser tiger toothed croaker), *parava* (White fish), *kozhuva* (Anchovy) and *chemmeen* (shrimps). During the period of South-West monsoon, the fishes are found to be abundant in shallow waters upto 7 fathoms.

Sivadasan (80), Perumppilly, Vypin, Ernakulam

During August to November, fish availability is more and the same is less in April.

Dinesh D. Udhyapuram (68), Kanwathertha, Kasaragod

Fishers also had knowledge of the fish they harvested. They are named differently in different districts and an attempt was made to capture this and to identify the species.

Mackerel in a traditional landing centre

The majority of the catch was composed of *chala*, *aila*, *thodi*, *mullan*, *kera*, *sravu*, *etta*, *chemeen, vatta*para, *thovara, kuttan, pallini, nangu*, *nathooli, vattachaala* etc.

John (82), Thaikkal, Alappuzha
Justin (79), Pallithode, Alappuzha

Josephin (70), Kakkathopp, Kollam identifies a shark locally called as "mayyansraavu" as very dark black in colour and Simi Mandiram (68), Kakkathopp, Kollam said that the shark locally known as "*madayansraavu*" has bigger pectoral fins.

The shrimp locally called as "*vettuvaalkonch*" is identified by its characteristic of jumping out of the seawater very often [Joseph C (69),

Kakkathopp, Kollam]. Sea cow was occasionally sighted and was called *edi*alongMalappuram coast of Kerala [Muhammed (68), Marakkadavu, Malappuram].

Eighty two year old John from Thakkal, Alappuzha said that the majority of the catch was composed of sardine, mackerel [also mentioned by Suku (65), Vypin, Ernakulam], *thodi* (Gizzard shad), *mullan* (Silverbellies), *kera* (Yellow fin tuna), shark, *etta* (cat fish), shrimp etc. Sivadasan (80) from Perumppilly, Ernakulam also mentioned *Pallimeen* (Lesser tiger toothed croaker), *Kuttan* (croaker), *Mandhal* (Flat fish) etc. that were netted in *Vatta vala* (a type of seine net). Justin [Appachan] (79) of Pallithode, Alappuzha added *vattapara* (Shrimp scad, *Alepes djedaba*), *kuttan* (croaker), *pallimeen* (Lesser tiger toothed croaker), *nangu* (Flat fish), *natholi* (anchovy), *vattachaala* (*Sardinella albella*/ Short body sardine), *aila* (mackerel), *chaala* (sardine) and shrimp were some of the fishes caught. The names of major shark species caught in Kollam area were *madayan sraavu, mayyan sraavu, karattu sraavu* etc. [Marcose (60), Vaadi, Kollam who went fishing in a dug out canoes and *kattamaram*]. Sardine, mackeral, shrimps and cat fishes were the major catch of *pontha* (local craft made using thermocol) [Anthrose Vasthin (74), Chaappakkadavu, Alappuzha]. *Arracka* (*s*eerfish) was a priced fish and bigger squids caught were not preferred and usually discarded and squids locally called *tubekanava* (Squid) were the most preferred [Justin [Appachan] (79), Pallithode, Alappuzha]. Earlier give local name Kara chemmen (*Penaeus monodon)*, *naranchemmen* (*Fenneropenaeus indicus*) fetched very low prices in the market, but these are now highly valued [Sivadasan (80), Perumppilly, Ernakulam].

Sardine landings

Species earlier abundantly available in that area but are netted very less these days are *vatta* (Torpedo scad, *Megalopsis cordyla*), *kanniaila* (Indian scad, *Decapterus russelli*), *kudukka* (tuna), …

[Pathrose (64), Chaappakkadavu, Alappuzha]

…as also *thalayan* (Ribbon fish), *vattamathi* (Short body sardine) and *paravuchala* (Flying fish)

[Nazar (58), Varkala, Thiruvanathapuram].

Olaan (Sail fish), *therandi* (rays), *kottakomban sraavu* (Pointed saw fish), *valli sravu* (thresher shark) were plentiful earlier but now are landed in very meager volumes and sometimes not seen at all [Yosep (48), Munakkal, Thrissur]. Others also had a list of species that they observe are now difficult to find or are being caught in lesser volumes than earlier (Table 6).

Table 6: List of species now rarely seen or seen in lesser volumes_Fishermens' perception

Species	Respondent
Kera (yellow fin tuna), *etta* (cat fish), *thodi* (gizzard shad)	John (82), Thaikkal, Alappuzha
Choragh (shark), *mullan* (silver bellies), *kurumanagh* (*Thryssa malabarica/* Malabar anchovy),	Justin [Appachan] (79), Pallithode, Alappuzha
Vetta koori (cat fish), M*ullan* (silver bellies), *kurumu nangu* (Thryssa), *therandi* (Ray)	Sebastin (71), Pallithode, Alappuzha Shanmugan (65), Karukachalppally, Thrissur Vijayan (59), Perinjanam , Thrissur
Valli sraavu (thresher shark), *paalaan* (mullet)	Suku (65), Vypin, Ernakulam
Oratthal (flat head)	Joseph (61), Ottamassery, Alappuzha
Udumbu sravu (ridge back cat shark/ *Chiloscyllium indicum*), A fish with very rough back and red and black in colour. It also is not seen much nowadays.	Joseph (61), Ottamassery, Alappuzha
Mullan (silver bellies), *thodi* (gizzard shad), *karichala* (lesser sardine), *manangu* (Thryssa)	Kuttan (60), Valappad, Thrissur
Sheelaavu (Barracuda)	Nazar (58), Varkala, Thiruvanathapuram
Karumanang (Malabar anchovy), *mullan* (silver bellies), *sraavu* (shark), *etta* (cat fish), *choora* (skip jack tuna), *kera* (yellow fin tuna), *Kora* (croaker), *aavoli* (pomfret), *maachaan* (black pomfret), *parava* (white fish), *shankan therandi* (ray), *thodi* (gizzard shad), *kathiran* (silver whiting), *maalaan* (Speiglers grey mullet), *kanambu* (mullet), *veloori* (white sardine, *Esculosa thoracata*), *vella choodan* (anchovy),	Nepolian (70), Neerkunnam, Alappuzha

(As identified during workshops using pictorial species charts. Vernacular names of the fishes in the coastal districts is given in Annexure 4. Some of the local names have been sourced from the publication Marine Fisheries Information Service, No. 134, CMFRI, Cochin, November, 1994, pp. 12-17.)

Assessing the Scientific Rationale behind observations and beliefs of fishers: seasonal availability of fishes

The state Kerala possess 3700 sq. km of continental shelf which is about half of the shelf area of south west coast. Moreover the `shelf area of of the state is adjacent to the coast which enable near shore fishing. The potential yield from a depth range of 200 m in the state was estimated at about 8 lakh tonnes[1,2]. This validates the statements of several fishers that *fish were available in plenty in near shore waters up to a depth of 15 paakam.*

The results of FAO/UNDP Pelagic Fisheries Project (PFP)[3] shows that spawning of sardine occurs in shallow waters, particularly in near shore waters between latitudes 11⁰30' N and 15°30' N during the peak of monsoon[4,5]. This validates the belief of fishers that the sardine migrate to shallow water during monsoon and contribute to the shore-based fishery. The shoreward migration of the spawners and juveniles is mainly for feeding purpose[6]. However, from the detailed studies of food and feeding habits of juveniles, adult, spawners and spent, it is evident that, the spawners always show an empty stomach indicating the cessation of feeding during spawning period. The migration of the spawners is, therefore, confirmed to be for spawning only[7].

A similar statement about mackerel's spawning for migration to the near-shore waters during monsoon however seems contradictory. Studies show that the spawning grounds of mackerel are believed to be farther away from usual traditional fishing grounds or away from the in-shore waters as they "advance in maturity condition"[8]. Observations of PFP and other studies state that the mackerel spawn during most of the year, mainly from April to October and the peak spawning was observed during April-May[9,10,11]. The spawning behaviour is also related to food abundance for the larvae which coincides with the plankton growth[12,13]. Similarly evidence suggests that the depth at which other species are available and their relative abundance varies with seasons[14,15].

Conclusion

The deep knowledge of fishers on fish species, its abundance, its spawning and feeding behavior was evident from the information gathered during the study. Fishers used this knowledge to guide their fishing related livelihood activities. Fishing activity has been intrinsically linked to seasons, especially the monsoon. Fishing seasons pass through lean and peak phases, and this awareness was important for resource conservation and sustainability as well as ensuring sustained employment and incomes.

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Chapter 7
IDENTIFICATION OF FISH SHOALS

Indigenous Knowledge on identification of fish shoals

As seen in previous chapters, the fishermen had deep insights into the natural phenomenon that played a role as they went about in their pursuit of their livelihoods, ie, fishing. Their knowledge on the living resources also is equally important. They have long used this acquired knowledge on fish and fish behavior, associated these with natural phenomenon like currents and temperature and this has aided in making fishing effective. Fishermen have used colour, movements in the water, presence of other animals and birds etc. to identify fish shoals.

Fish shoal identification based on colour

The major species targeted by traditional fishermen were sardine, mackerels, anchovies, shrimp, pomfret etc. which the fishermen identify with changes in colour of the waters.

Several fishermen identified sardine shoals with the waters turning muddy, brown, grey, black, blue-black in colour.

Justin (79), Pallithode, Alappuzha
Padmanabhan (70), Nerkadavu, Kannur
Suku (65), Kuzhuppilly, Ernakulam
Beeranunni (64), Puthuponnani, Malappuram
Muhammed (64), Perumanthura, Thiruvananthapuram
Joppan (60), Munambam, Ernakulam
Josy (55), Fort kochi, Ernakulam
Purushothaman (52), Koottikulam, Kasaragod.
Preman (52), Vellayil, Kozhikode
Mahesh (32), Kasaba, Kasaragod

Mackerel shoals appear red/ shaded red [Justin (79), Pallithode, Alappuzha; Purushothaman (52), Koottikulam, Kasaragod; Preman (52), Vellayil, Kozhikode] or light green [Beeranunni (64), Puthuponnani, Malappuram].

Prawns appear in red or copper in colour

Beeranunni (64), Puthuponnani, Malappuram
Preman (52), Vellayil, Kozhikode
Purushothaman (52), Koottikulam, Kasaragod

Machan (Black pomfret) shoals are locally paraphrased as locally by

Machan vellayam vach warum

…since its shoal seen on the surface of water appears white in colour.

Muhammed (56), Marakkadavu, Malappuram
Preman (52), Vellayil, Kozhikode
Padmanabhan (70), Nerkadavu, Kannur

Anchovies are detected by the brown/ reddish brown colour they render to the waters.

Preman (52), Vellayil, Kozhikode
Muhammed (64), Perumanthura, Thiruvananthapuram

Other characteristics used in identification of fish shoals

The appearance of fish shoal during night times on new moon days is locally called *Kavaru*. The fish shoal of sardine appears like a thin line and that of mackerel appears like a well.

Valsanpilla (79), Pallithode, Alappuzha

Kamaru (*Kavauru* in Alappuzha) denotes the abundance of fish appearing like a 'bright light of a torch' on the water surface.

Thankachan(58), Munambam, Ernakulam

During night when the sardine shoal arrives it resembles the luminescence of a torch light. Sometimes, sardines jump out of the shoal and it will be visible even from the shore. When mackerel shoal arrives the area remains isolated and resembles a 'well' like formation.

Savithri (61), Perumpilly, Ernakulam

The sardine shoals are characterised by the bubbles seen on the water surface [Joppan (60), Munambam, Ernakulam; Sharafudheen (41), Chavakkad, Thrissur; Kuttan (60), Valappad, Thrissur; Mahesh (32), Kasaba, Kasaragod; Mukundan (68), Kasaba, Kasaragod; Preman (52), Vellayil, Kozhikode; Padmanabhan (70), Nerkadavu, Kannur]. However, Kuttan also adds that in summers the bubbles may be due to other reasons and can be mistaken for sardine. Abdulla (56) from Parappanangadi, Malappuram, also adds that bubbles are seen for both *mathi* (sardine) and *natthal* (anchovy).

If the water surface is seen without any wave actions and resembles a layer of oil, it indicates the presence of sardine shoal.

Pradeepan (59), Neerkadavu, Kannur.

The thick mackerel shoals can be seen on the water surface and this is locally called as *pelapp* (as a layer).

Mukundan (68), Kasaba, Kasaragod
Sharafudheen (41), Chavakkad, Thrissur

If it is the shoal of mackerel or *kudutha* (tuna) it appears like hump.

Suku (65), Kuzhuppilly, Ernakulam

The presence of king fish is an indication of the presence of mackerel as they are predator and prey [Preman (52), Vellayil, Kozhikode] and also the presence of sea birds is an indication of good catch on that particular area [Muhammed

(64), Perumanthura, Thiruvananthapuram]. Seagulls fly, dive, and capture fish from sardine shoals [Dinesh D. udhyapuram (68), Kanwathertha, Kasaragod] and a sea bird called *meen chulli* (most likely cormorant) have an ability to dive very deep for fishes. These birds are an indication of the availability of fish.

Fish availability and light have been associated as was seen from the chapter on lunar cycles and fishing. *Karippan* is a term used to denote that period of the day just before sunrise or sunset when the light is very low when fishers expect to get more catch [Krishnan (63), Vemballoor, Thrissur; Yosep (48), Munakkal, Thrissur].

If the sea gets rough during fishing, the net is taken on board as fast as possible and the fishers head in the eastern direction.

Joseph (61), Ottamassery, Alapppuzha

While ring seine operations are on, in order to spread the fish shoal and thus to ensure the catch, the fishers strike the paddle on the side of boats.

Kuttan (60), Valappad, Thrissur

Assessing the Scientific Rationale of fish shoal identification

Fishers have been depending on the bioluminescent mechanisms in marine organisms since the very primitive stage to attract and capture other species and also to detect and assess the large shoals of fish[1]. Bioluminescent dinoflagellates and other planktonic organisms on the water surface helps in detecting fish shoals, crustaceans or squids which feed or attracted to the bioluminescent organisms. This can be one validation for the ITKs of fishermen that at night times fishes are identified along with luminescent patches. Fishers also depended on luminescence of fish itself (locally called *kavaru*) during night times, particularly during the dark phases of moon, to spot the sardine shoals[2]. A shoal, during such times, appears as a patch of light (demarcated by the length and size of the shoal) moving on the water surface. A similar feature is also noted in the case of Indian mackerel[3] also. Intense luminescence also enables the fishes to see and avoid predators and fishing gear.

In a study conducted by ICAR-Central Institute of Marine Fisheries Research Institute on feeding habits of kingfish, it was observed that the gut content of the fish was mainly composed of mackerel, whitebaits etc[4]. It is an evidence for kingfish feeding on mackerel and it can be considered as a validation for the statement of fishermen that the presence of king fish is an indication of the presence of mackerels.

Bubble producing bottom feeding shoals have been identified. This can validate the statement that sardine shoals are characterized by bubbles on

the water surface[5]. Studies have also found that the flipping and splashing noise of fish shoals is also taken into consideration while identification of shoals which further supported by the fact escapement of fishes from predators causes splashing of water on the sea surface[6].

Some studies suggest that the bubbles are produced by bottom shoals of sardine. Though these shoals are not seen on water surface, their presence can be detected by the tiny bubbles come out of water[8]. A possible explanation regarding this characteristic is that these bubbles are released from the air-bladder of the sardine through the external opening behind the anal aperture. While the air-bubbles are released from the air-bladder, it enables the fish to sink towards sea bottom.

The muddy water is an indication of abundance of fishes like sardine and mackerel. This is again related to the feeding habits of the shoals[8].

The statement that the presence of birds like seagull is an indication of fish shoals can be validated by the feeding habits of the gull which is mainly on marine fishes, marine and fresh water invertebrates etc. The presence of gulls is an indication of fish availability[9].

The sardine shoals appear in black or dark blue colour. Some fishermen also reported red coloured shoals of sardine. It has been reported that the blue/black colour effect could be caused by the effect of sunlight on the shoal, especially for compact shoals during peak fishery seasons (October to March). The red / pinkish tinged colour is caused when the shoal disturbs the bottom mud which consequently spreads out in the area[10,11].

Conclusion

The deep knowledge of fishers on fish species, its abundance, its spawning and feeding behavior was evident from the information gathered during the study. Fishers used this knowledge to guide their fishing related livelihood activities. Fishing activity has been intrinsically linked to seasons, especially the monsoon. Fishing seasons pass through lean and peak phases, and this awareness was important for resource conservation and sustainability as well as ensuring sustained employment and incomes.

Each fish species has its own peculiar shoaling behavior and appear in typical pattern, textures and colours over the water surface. Fishers have used the knowledge of this manifestations of the shoaling behaviour to target their catch. Fishes that appear in unique colours and patterns, can be identified based on the same and it is still widely used in the traditional fisheries sector of the state of Kerala, especially the ring seine fishery that targets pelagic shoals like sardine, mackerel and anchovies. Features like

water bubbles are also used to identify exactly the type of fish that can be netted. Also different species are spotted in connection with the prey – predator relationship which is another indication for the fishermen.

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Fish in the socio-cultural fabric of the fishing community: Traditional knowledge on fish processing and nutrition & some beliefs

Chapter 8
FISH PROCESSING AND PRESERVATION

Introduction

The fish processing industry in India comprise of two distinct phases; the first phase was characterized by age old traditional curing upto about 1953 followed by application of modern preservation methods and export of frozen and canned fishery products to neighbouring countries during second phase[1]. The fish curing industry has been thriving through ages and has continued to thrive alongside modern fish preservation and processing techniques[2]. Excess catch has always been preserved and processed, especially when the catches exceeded local demand. Preserving fishes is an age old practice in India and have been traditionally practiced by the fisher community. The fish processing is linked with culture, employment and protection of food[3]. In most developing economies with fishing as the major economic activity sun-drying, smoke-drying, frying and salting are identified as indigenous methods of fish processing and preservation[4]. A large quantity of small fishes in the state is preserved traditionally by various drying, salting and curing methods. Women in the fishing families actively participate in the fish processing and preservation on a small scale through the implementation of the time tested and transmitted ITKs.

The traditional fish preservation techniques being practiced in Kerala can be broadly classified as sun drying, dry salting and wet salting. Apart from these, pit curing and Colombo curing methods were also practiced along Malabar and southern Kerala respectively and these type of traditional methods are not practiced nowadays[5,6]. However, in some parts of Thiruvananthapuram district, the pit curing is practiced in very small scale, especially practiced by the women who are engaged in small scale marketing of fishes.

The ITK about various curing methods practiced is a crucial prerequisite for developing improved technologies. In this chapter, various traditional preservation methods and traditional knowledge regarding fish processing and preservation are discussed.

Indigenous Knowledge on Fish preservation and Processing

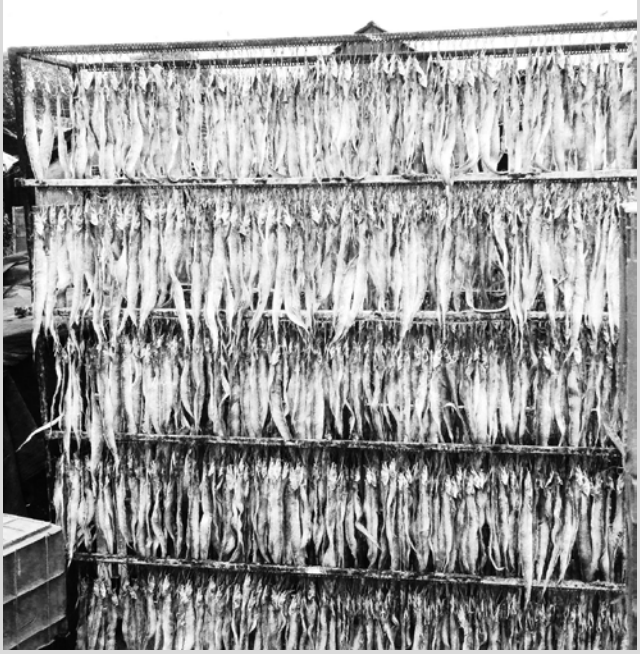
Preservation of fishes

The fishes were sun dried in mats. Before the introduction of ice, massive sun drying of fishes could be seen on the beaches as all excess fish was sundried. Fishes were also preserved in salt in tanks locally called *chaappa*

and were used for human consumption [Arumukhan (72), Kara, Thrissur]. Lizard fishes (*arana meen*) and a fish locally known as *palava* are gutted, cut open, salted then sun dried [Subhashini (71), Perumpilly, Ernakulam].

If the atmosphere is humid, the fish catch was spread over the canoe, so that the fishes will not be spoiled.
[Vijayan (59), Perinjanam, Thrissur]

In order to avoid spoilage of fish while transportation, the fish is mixed with sand and wrapped in the leaves of coconut tree.
[Anthrose Vasthin (74), Chaappakkadavu, Alappuzha]



Rack drying of ribbon fish

The oil sardine was boiled and oil was extracted and the fish waste was used for poultry feed. The sardines other than oil sardine are sun dried.

Sebastin (71), Pallithode, Alappuzha

'*Aila mudukuthuka'* refers to the process of cutting the fish into two halves and sun drying on a special mat made with raw coconut leaves.

Eliyamma (75), Pallithode, Alappuzha

The mackerel catch was kept along with sand in order to preserve it for short time. This practice was prevailing before the invention of ice. To remove the sand from the fish dried on shore, the fish is scrubbed with coconut shell.

Josphin (70), Kakkathoppu, Kollam

Puthiyappa in Kozhikode District is a well-known area for commercial sun drying of fishes. The major fishes sundried in the locality are anchovies, ribbon fish, sole fish, lizard fishes etc. Lizard fishes (*Saurida* spp.) are mainly exported to Tamil Nadu while anchovies were exported to almost all the domestic markets in and out the state. The fishes are dried with or without

salt. The small fishes like anchovies were, mostly sun dried without salt. Excess fishes are stored in the *chappa* where fishes were immersed in salt even upto a period of 6 months without any spoilage.

Gopi (60), Puthiyappa, Kozhikode
Jaffar (31), Edakkazhiyur, Thrissur

Before the introduction of ice, the fishes were kept with salt in *chappas*.

Purushothaman (58), Neerkadavu, Kannur

Coir mats locally called as *kayattu paya* are used for drying prawn [Aboobakar (61), Puthuponnani, Malappuram] and also *mathi*, *veloori*, *nathali* and *arinjili* [Muhammed (68), Marakkadavu, Malappuram].

Fish oil was separated in traditional way by storing the fish with a low level of salt in tanks. This is covered with coconut palm leaves or jute (*chanam*) sacks and a heavy weight kept upon this. Fish oil is collected from outlets situated at the base of the tank. This process can continue for weeks or even months.

Muhammed (68), Marakkadavu, Malappuram

Fish stored in brine in traditional chapa

Salt was used for fish preservation. Fishes were kept in salt during the evenings and washed the next morning then dried.

Joseph (57), Shanughumukham, Thiruvananthapuram

The bigger fishes like shark, tuna, mackerel are cut opened and salted then sun dried on the mats made of coir locally known as *padam* which have 5 to 6 m length [Purushothaman (52), Koottikulam, Kasaragod; Hariharan (51), Chettuva Azhi, Thrissur]

In earlier days, for the safe transportation of fishes, the baskets made of coconut palm leaves locally named as *thadukku* is used. The shrimps were boiled and sun dried and exported [Ramu (80), Thottappu, Thrissur].

Traditional chapa

The small sardine are sun dried on the beaches itself and are utilised as manure. The bigger fishes like shark, tuna, mackerel are gutted, salted and sun dried on the mats made of coir locally known as *padam*. The sun dried fishes are transported in a structure made of coconut leaves locally known *valla*.
[Savithri (60), Nattika, Thrissur]

Chemeen paripu was a local dish and delicacy of Nattika, Trissur. Whenever heavy catch of shrimp was there, the entire shrimp catch was put in a huge bronze vessel locally known as *chembu* and boiled with salt and water. The water is drained out later and shrimps are sun dried. Later these dried shrimps are filled in jute sacks and threshed with wooden sticks. The head and tail separates out. Later on these are winnowed using sieves called *morram*. The waste is used as manure and the edible portion is the *Chemeen parippu* which was earlier packed and exported to South East Asian countries.

Mani (65), Nattika, Thrissur

Fish being sun-dried on the beach

Assessing the Scientific Rationale of fish preservation Techniques used by Traditional fishermen

Fish is a highly perishable food material but is also highly nutritious because of high protein content. However, it is a media for bacterial multiplication. Spoilage starts within 12 hours in the high ambient temperature of the tropics[7,8]. In raw fish the spoilage is attributed to three reasons namely enzymatic action, microbial action and chemical action[9]. The degradation of fish species occur as a result of digestive enzymes and lipases, microbial spoilage from surface bacteria and oxidation[10]. Its Intensity is varied, in the fatty and lean species in which former is characterized by high lipid content, free fat content and proportion of triglycerides, while the latter have a low lipid content, chiefly in the form of phospho lipids and lipoprotein immediately associated with muscle proteins[11]. Sun drying is one of the cheapest method for preventing growth of microorganisms. During sun drying water from fish cells are removed it leads to lowering their moisture content[12,13]. During sun drying the microorganisms cannot grow and multiply to spoil the fish as the water activity is considerably reduced[14]. Most spoilage causing microorganisms are sensitive to saline conditions. On salting, osmosis process takes place. Water moves out from fish cell into the outside solution. A little quantity of salt moves into the fish cell due to the variation in concentration gradients. As a result, water content of the fish is reduced. It prevents various biochemical and enzymatic reactions and microbial growth. After salting, sun drying is practiced, it

removes moisture due to the heat of the sun and air movement. Fish preservation on wet sand collected from beach has no scientific reason. In fact, it may lead to further spoilage due to contaminants in the sand[15,16].

The moisture content and water activity in fishes is reduced during drying, which in turn, retard the growth of microorganisms that causes spoilage[17,18,19]. The reduction in water content also affects the chemical and enzymatic reaction in the fish[20]. This validates the statements of fishermen that the sundrying of fishes is a preservation technique used by the fishers.

Conclusion

The availability of fish depended on the seasons and as discussed in earlier chapters, fish is abundant in some seasons and scarce in others. In season of abundance, not all fish could be consumed or marketed and this led to the evolution of the culture of processing and preservation. This process is as old as civilization itself as evidences from history point out to the fact that fish was dried and stored for consumption later. During the course of the project several recipes were collected from fisher households in the coastal districts of the state have also been compiled[21].

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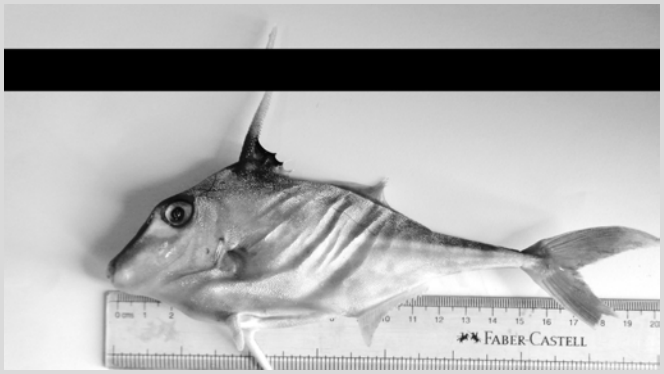
Chapter 9
NUTRITION AND FISH IN FISHER HOUSEHOLDS

Introduction

Fish is a unique source of essential nutrients, including long-chain omega-3 fatty acids, iodine, vitamin D, calcium and a source of proteins and healthy fats[1]. The omega-3 fatty acids and polyunsaturated fatty acids presents in the fish are helpful for the development of the brain and retina and also for protection against some chronic diseases[2]. Apart from this fish is a good source of trace elements that are essential for normal tissue metabolism and for maintenance of health[3]. The fisher community also had distinct beliefs regarding nutritional and medicinal uses of different fishes. This must have evolved along with the ethnic culinary traditions of the community and the linkages they assigned to causes and effects, which gets passed on by learning, by observing and following the ways of their forefathers[4]. The authenticity of several beliefs related to nutrition has been proven by scientific studies.

Indigenous Knowledge on Nutritional Aspects

Some of the fishes were used by fisher households for curing common ailments. The most commonly observed was the use of *chuma kurichi* (*Triacanthus biaculeatus*) in persons having breathing related issues like asthma and coughs [Sebastin (71), Pallithode, Alappuzha; Nandanan (60), Kara, Thrissur; Pavithran (55), Purakkadu, Alappuzha].



Triacanthus biaculeatus (Mutheri)

Sivadasan (80), Perumppilly, Ernakulam mentioned the method of use as….
'for Asthma, the fish *chuma kurichi* is sun dried, powdered and consumed by mixing with honey'

Nazar (58), Varkala, Thiruvananthapuram had this to say…….
'for curing asthma and cough *clathi* (also known as *mutheri* or *chuma kurichi)* is roasted and consumed.'
There were other solutions for breathing related issues.

Sun dried seahorse is powdered and consumed with honey for curing cough. The dried seahorse is deskinned and roasted and consumed.

Pavithran (55),Purakkadu, Alappuzha

The dried and powdered seahorse mixed with honey is used to cure asthma and other breathing troubles.

Vijayan (59), Perinjanam, Thrissur

*Muth*al (*Triacanthus biaculeatus*) boiled turmeric powder, pepper and salt was used for curing breathing problems.

Abdulla (56), Parappanangadi – Chappapadi, Malappuram

For assuaging breathing problems several other fish were also recommended by the fishers like:

Sravu (shark) and *veloori* (Anchovies)

[Beeranunni (64), Puthu Ponnani Azhimukham, Malapuram]

Kada poocha (Rough flathead/*Grammoplites scaber*)

[Kunjuvava (64), Ossan kadappuram, Malapuram

Women in fishing households, especially pregnant women and lactating mothers are fed diets rich in certain fishes as they are believed to be highly nutritious. Some of the fish that are given to the women are:

Maanthal (Sole fish)*, orathal* (Bartailed flathead) and *kathiran* (Indian whiting)

[Maxson (35), St.john's Pattam, Fortkochi, Ernakulam]

Ray fish

[Geromart (57), Shangumugham, Thiruvanathapuram],

Thalayan (Largehead hairtail/*Trichiurus lepturus*), *mullan* (Silver belly) and *mathi*(Sardine)

[Baby (58),Puthiyaappa, Kozhikode]

After childbirth women eat shark curry made with Malabar tamarind and chilly.

Hariharan (51), Chettuva Azhi, Thrissur

Lactating mothers are fed with anchovies, catla and pomfrets.

Mukundan (68), Kasaba, Kasaragod

Some fish were rich in Calcium and are good for teeth and bones like:

Nandan (*Chanda nama*)

[Baby (58), Puthiyaappa, Kozhikkode; Mukundan (65), Neerkadavu, Kannur]

Thalayan (*Trichiurus lepturus)*and dried *natholi* (anchovy)

[Kunjuvava (64), Ossan kadappuram, Malapuram].

Silver belly is very nutritious.

Shanmugan (65), Karukachalppally, Thrissur

Lonan Pilla (70), Valanjoli, Alappuzha

Dried and powdered shark and shark oil are also good for health [Muhammed (68), Marakkadavu, Malapuram] and believed to cure cardiac diseases [Joseph C (69), Kakkathoppu, Kollam].

Sharks were also given as a cure for fever as well as shark oil is used as medicine for rheumatism [Mukundan (65), Neerkadavu, Kannur] and for quick healing of wounds [Maxson (35), St.john's Pattam, Fortkochi, Ernakulam].

Sardine oil prevent heart diseases [Pavithran (55), Purakkadu, Alappuzha] and heals the cracks on heel [Pradeepan (59), Neerkadavu, Kannur].

The consumption of sole fish helps in proper digestion.

Pavithran (55), Purakkadu, Alappuzha

Fishers also kept away from certain fish and knew about the ill effects also.

Consumption of puffer fish is not preferred as the skin of puffer fish is believed to be poisonous.

Baby (58), Puthiyaappa, Kozhikode

The over consumption of the resources like mackerel, pomfret, crab and shrimp can cause cholesterol.

Shanmugan (65), Karukachalppally, Thrissur

Assessing the scientific rationale of nutritional benefits from sea foods

Seahorses comes under Syngnathidae species and have been used in China and Caribbean coast of Mexico as traditional medicine for asthma, infections of the throat, insomnia, and abdominal pain[5,6]. This can validate the statement of fishermen that the sea horses are used to cure asthma.

The presence of Chondroitin and Glucosamine present in Shark Cartilage is useful in curing osteoarthritis[7,8,9]. Hence, the ITK, Juvenile shark oil is used as medicine for rheumatism can be validated. Besides this the researches undertaken by ICAR-CIFT shows that fish oils are rich in Poly Unsaturated Fatty Acids (PUFA). This can be related to the healing powers of sharks which have high therapeutic values including healing internal wounds, good for pregnant women, curing fever etc[10]. Alkylglycerol-rich bone marrow soup is a home remedy for colds and fever in Chinese cuisine[11]. Proteoglycans (PGs) from deep sea shark cartilage and their anti-proliferative activity fight against MCF-7 human breast cancer cells have been studied[12].

The reason behind the heel cracks may include lack of moisture, diabetes etc. which can be cured by applying sardine which is highly rich in omega 3 fatty acids[13]. Thus the ITK that sardine oil is applied for healing heel cracks can be validated.

Presence of histamine content in *scombroid* fishes such as mackerel is responsible for allergy[14,15,16]. This could be the reason why fishermen state that the children are not fed with mackerel as it is hot for their body and also result in allergies. Besides this, the fishers also believe that mackerel, catfishes, squids, crabs and prawns should not be consumed if there are any wounds on the body as healing gets delayed. However it has been observed that the crabs and prawns are rich in arginine which should help boost the healing phase during injuries as arginine assists in immune function and collagen growth[17].

The leiognathids are rich in Calcium, phosphorous and high quality protein[18] which is a validation for the ITK that the silver bellies (*mullan*) is given to lactating mothers for increased milk production.

Conclusion

From experience of dealing with fish over centuries, the fishing community has evolved their own understanding of the nutritional aspects of fish as well. Several of these continue to this day and are passed on as family and community traditions. However, external influences will sooner or later alter atleast some of these. While the body of work on nutrition and fish is expanding, a look at the traditionally held views can also be attempted to explore the science behind them.

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Chapter 10
BELIEFS AND SAYINGS

"Belief"
An acceptance that something exists or is true, especially one without proof. Trust, faith, or confidence in (someone or something).

Fishermen always worship the sea before going fishing. The sea is considered as mother, *kadalamma*(*kadal*-sea; *amma*- mother).

Karthikeyan (60), Cherai, Ernakulam
Mukundan (68), Kasaba, Kasaragod
Nazar (58), Varkala, Thiruvananthapuram

The fishes in the sea are believed to be tastier than the fishes in estuaries as the estuaries have less wave actions compared to seas.

Stephan (60), Fort Kochi, Ernakulam

Netting of a *komban sraavu* (Hammerhead shark) is a bad omen for the family.

Thakachan (58), Munambam, Ernakulam

Seeing the clarity of water fishermen take boat into sea. After that all pray together before proceeding.

John (82), Thaikkal, Alappuzha

Before going to sea there is a ritual performed known as '*Kazhcha veppu'* in the church and they touch the seawater and make a cross on forehead. They should go to fishing only after taking a bath and seeing a broom while going for the same is considered as a bad omen.

Eliyamma (75), Pallithode, Alappuzha

Paravaykku era thikayilla netholi
The fish *parava* (False trevally) will continue to feed on *netholi* (anchovies), even if it has fed enough.

Joseph C (69), Kakkathoppu, Kollam

If a cat crosses our path on the way to the beach before fishing, it is considered as a bad omen and we believe that the sea will be rough on that day.

Joseph C (69), Kakkathoppu, Kollam

Carpenters carry out the ritual '*muttarukka*l' before commencing work on a new craft.

Muhammed (68), Marakkadavu, Malappuram

During the months of *Karkidakkam* (June – July) traditional fishermen do not go for fishing because of rough sea condition.

Nazar (58), Varkala, Thiruvananthapuram
Rafeeka (67), Perumanthura, Thiruvanathapuram

The sea and the boat and net are treated with great respect. If fishermen come for work drunk, they are neither allowed to enter the crafts nor going for fishing.

Nazar (58), Varkala, Thiruvananthapuram

A wind used to blow from south direction, locally called *pishaashu kaattu*, the demonic wind. Fishermen pray for the wind to be stopped.

Alikunju (70), Chavakkad, Thrissur

Fishermen used to consume rice water (*kanji vellam*) during fishing activities to reduce fatigue.

Ramu (80), Thottappu, Thrissur

When the conditions at sea are unfavourable and fishing is not possible, the priest is called to the sea shore to offer special prayers.

Yosep (48), Munakkal, Thrissur

The fishermen must be clean in body when he steps on to the boat for going fishing in the sea.

Vijayan (59), Perinjanam, Thrissur

Chapter 11
EPILOGUE

This project on documenting traditional knowledge of the fisherfolk of coastal Kerala was an attempt to try and record available TKs before they are completely lost in the rush towards modernization of the fishing systems of the state. Already the traditional fishermen and the contribution of the traditional fishery to the fish production of the state (and the country) is on the decline. A glimpse into the deep insights of the fishermen and women on various aspects of fishing, fish processing and the environment surrounding have been recorded. This work used a mix of methodologies including personal interview, workshops, film-making, expert consultations and literature reviews to study this aspect. However, a lot more can be documented and a lot more work is possible, especially since India has a long coastline and very many different fishing communities along its coast and in inland areas.

Attempt to scientifically understand the importance of what was documented has also been carried out. However, a more robust method of validating this information, if possible through experimentation is necessary so that this knowledge base can be formally included in modern modeling attempts for disaster and extreme weather predictions, fish shoal identification, medicine and other food and nutrition applications.

Sincere thanks to all the fishermen and women who shared their life experiences with the project team

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Annexure 1
Presentations during the project initiation workshop
30th October 2015

Paper presented	Expert
"Mapping the traditional Ecological knowledge on marine fisheries of Kerala/ SLK methodology	Dr. C.R. Rajagopalan, Director, International Centre for Kerala studies, University of Kerala
"Folk, Folklore and Folk Identity: New perspective	Dr. Aju .K. Narayanan, Assistant professor, U.C College,
Significance of Indigenous Technical Knowledge in Traditional Fisheries scenario	Dr. K.S. Purushan, Professor of Eminence, KUFOS
village knowledge register of Thoothoor fishing community". She described the Traditional knowledge prevailing in Thoothoor Fishing village.	Dr. Leela Edwin, Head of Division, , Fishing Technology division ICAR-CIFT
Indigenous Technical Knowledge of Indian Marine fishermen	Dr. P. S. Swathi Lekshmi, Principal Scientist, ICAR-CMFRI
Assimilating Traditional Knowledge as Rules using Data Mining: An application in marine fisheries	Dr. M.N Raghavendra Sreevathsa, Scientist D, NCMRWF, Noida
Protection of Traditional Knowledge: Jural Paradigm	Dr.Anjana Girish, Assistant professor, Inter-university centre for Intellectual Property Right Studies, CUSAT,

Annexure 2
List of experts of the validation workshop

A workshop on Validation and dissemination of ITKs was conducted at the Institute aiming both the scientific validation and dissemination of project deliverables. Experts from CSIR-National Institute of Oceanography, ICAR- Central Institute of Fisheries Technology, ICAR-Central Marine Fisheries Research Institute, Experts from various print and digital media and fishermen from Ernakulam and Alappuzha were participated in the interactive sessions between scientist and stakeholders followed by a session on various methodologies for dissemination of ITKs to the society.

Sl. No.	Name of expert	Designation & Address
1.	Dr. Swathi Lekshmi	Principal Scientist, ICAR-Central Marine Fisheries Research Institute, Cochin
2.	Dr. T. V. Sankar	Director of Research, Kerala University of Fisheries and Ocean Studies, Cochin
3.	Dr. Muraleedharan K. R.	Scientist, National Institute of Oceanography, Cochin
4.	Dr. Asha K. K	Senior Scientist, ICAR-Central Institute of Fisheries Technology, Cochin
5.	Dr. Sajesh V. K.	Scientist, ICAR-Central Institute of Fisheries Technology, Cochin
6.	Mr. Vivekananda Pai	South Zone Organising Secretary, Vijnana Bharati
7.	Dr. Bindu J.	Principal Scientist, ICAR-Central Institute of Fisheries Technology, Cochin
8.	Dr. Saly N. Thomas	Principal Scientist, ICAR-Central Institute of Fisheries Technology, Cochin
9.	Mr. Abilash	Correspondent, Deepika (Malayalam Newspaper)
10.	Mr. Saj Kurian	Managing Director, Southlive Networks pvt. ltd
11.	Mr. Socrates Vallath	Writer/ Script writer
12.	Mr. Maneesh Nararyanan	Film Critic, Journalist
13.	Mr. Unnikrishnan M. N.	Bureau Chief, Deshabhimani
14.	Mr. Simon P. O.	Fisherman, Chethi, Alappuzha
15.	Mr. Wilson T. S.	Fisherman, Chethi, Alappuzha
16.	Mr. Balakrishnan	Fisherman, Maalipuram, Ernakulam
17.	Mr. Asharaf	Fisherman, Malipuram, Ernakulam

Annexure 4

Common fishes and their vernacular names in the coastal districts of Kerala

(This is a compilation based on identification done by fishermen during the field surveys using pictorial charts)

Common name	**Scientific name**	**Local names in different coastal districts**								
		Thiruvanan-thapuram	**Kollam**	**Alappuzha**	**Ernakulam**	**Thrissur**	**Malappu-ram**	**Kozhikode**	**Kannur**	**Kasaragod**
CRABS										
Flower crab	*Portunus pelagicus*	Njandu	Neela njandu	Kaalan njandu	Kavaali njandu	Kavaali njandu	Pulli njandu	Neelakaala n njandu	Pulli njandu/ Neelakaalan	Kadal njandu/ nada njandu
Blood spotted crab	*Portunus sanguinolentus*	Njandu	Mukkann an	Pulli njandu	Mukkannan	Moonu pulli njandu	Moonu pulli	Naadan njandu	Kannan njandu	Kuru njandu
Banded - leg swimming crab	*Charybdis annulata*	Kayal njandu	Kappal kadiyan	Pulli njandu	Pulli njandu	Vennjandu	Pacha pulli	Pulli njandu	Pulli njandu	Nada njandu
Crucifix crab	*Charybdis feriatus*	Njandu	Penjandu	Kurishu njandu	Kurishu njandu	Kurishu njandu	Kallumel njandu/ Para njandu	Polayan njandu	Kurishu njandu	Bannatha njandu
Crenate swimming crab	*Thalamita crenata*	Kayal njandu	Kora njandu	Kalan kammatti	Karikkachi njandu	Karikkaach i njandu	Paara njandu	Kallan njandu	Pacha nanjdu	Kallu nanjdu
PRAWNS/ SHRIMPS										
Indian white prawn	*Fenneropenaeus indicus*	Konju	Naaran	Poovalan	Naaran	Naaran	Naaran	Karikkadi/ naaran	Vella chemeen	Vellati
Giant tiger prawn	*Penaeus monodon*	Chemeen	Kara/ onchi	Vettan	Vettan	Kara	Kara	Kara	Kara	Kara/ Verangitti
Kuruma prawn	*Marsupenaeus japonicus*	Chemeen	Tiger	Kara	Kara chemeen	Pookara	Kariyalan chemeen	Hovi/ Kara	Varayan choodan	Mandetti
Witch prawn	*Melicertus canaliculatus*	Chemeen	Zebra	Pullan	Pullan	Kara	Kara	Hovi/ kara	Kayanthan	Verngitti
Greasy back shrimp	*Metapenaeus ensis*	Naran Chemeen	Konchu	Kazhanthan	Kazhanthan	Choodan	Naran	Poovalan/ Kazhanthan	Poovalan	Charthitti

Bird shirmp	*Metapenaeus lysianassa*	Naran chemeen	Konchu	Elanaran	Naran	Elanaran	Kazhanjan	Naaran/ Kazhanthan	Vella chemeen	Vella etti
Southern rough shrimp	*Trachysalambria curvirostris*	Naran Chemeen	Motta konchu	Pullan	Pullan	Pullan chemeen	Kashanjan	Koonan chemeen/ Pullan chemeen	Kayanthan	Manda etti
Ridge back shrimp	*Solenocera choprai*	Naran Chemeen	Katti thodan konchu	Pullan	Pullan	Kombu	Kashanjan	Hovi chemeen/ Thakkali pullan	Pullan	Charthetti
Coastal mud shrimp	*Solenocera crassicornis*	Vetraalu	Motta konchu	Chelli	Konju/ Chemmeen	Chemeen	Chemeen	Pullan chemmeen	Karikkadi	Mandetti
LOBSTERS										
Scalloped spiny lobster	*Panulirus homarus*	Raalu	Raal	Raalu	Adippan	Konchu	Umarubiyan / Kallumel chemeen	Chitta chemeen	Chitta	Kallitti
Mud bug lobster	*Thenus indicus*	Raalu	Chatti konchu	Adippan	Adippan	Konchu	Umarubiyan / Kallumel chemeen	Chellu	Chitta	Eatta
ELASMOBRANCHS										
Black tip shark	*Carcharhinus limbatus*	Sravu	Sravu	Kutti sravu	Kutti sravu	Thumbaan sravu	Kavilan sravu	Kaata / Kalla sravu/ Pooi sravu	Malaankutty	Velle chiraav
Pondicherry shark	*Carcharhinus hemiodon*	Sravu	Mayyan sravu	Pachakannan	Pachakannan	Pachakannan	Chundan sravu	Velan sravu	Malaankutty	Karimandi
Bull shark	*Carcharhinus leucas*	Sravu	Mayyan sravu	Sravu	Pulli udumb	Pulli sravu	Sravu	Pulli udumbu	Kallan	Mandi
Spade-nose shark	*Scoliodon laticaudus*	Sravu	Uliyan sravu	Valli sravu	Kutti sravu	Valli sravu	Chadayan	Kavala sravu	Vellem kutty	Chiraav
Milk shark	*Rhizoprionodon acutus*	Sravu	Paal / madayan sravu	Paal sravu	Kai kutty sravu	Kadiyan sravu	Udumbu	Chadayan	Vellem kutty	Chiraav

Grey bamboosha rk	*Chiloscyllium griseum*	Udumbu	Udumba n sravu	Varuthala sravu	Varuthala sravu	Udumbu sravu	Udumbu	Udumbu	Udumban/ Wills	Gumma chiraav
Scalloped hammer-head shark	*Sphyrna lewini*	Komban sravu/ Chattithalayan sravu	Madayan sravu	Chadayan sravu	Bramaav	Chadayan sravu	Komban sravu	Chaata sravu/ Komban sravu	Komban	Komban chiraav/ Kathal chiraav
Whale shark	*Rhincodon typus*	Pulli sravu	Pulli sravu	Pulli sravu	Pulli sravu	Mullan sravu	Kallumel sravu/ Pulli sravu	Pulli sravu	Kalludumbu	Chemberi
Annandale' s guitarfish	*Rhinobatos annandalei*	Parambutholu	Painthi	Kurien sravu	Orathal	Varuthala	Koithala	Varuthala /Makaran	Manakuttan	Pochanaran gi/ Kochuchiraa v
TELEOSTS										
Devis' anchovy	*Encrasicholina devisi*	Netholi	Natholi	Vella chooda	Vella kozhuva	Vella natholi	Nethal	Mulla nethal/ Arana chooda	Nathal	Nathal
Shorthead anchovy	*Encrasicholina heteroloba*	Neytholi	Natholi	Kozhuva/ Natholi/ Vellavar	Karutha natholi	Karinatholi	Karinathal	Karinathal	Nathal	Nathal
Buccaneer anchovy	*Encrasicholina punctifer*	Chaala	Kutaal	Natholi/ Karutha vara	Nedumeen	Manangu	Mullu manangu	Arana chooda	Cheru manangu	Manangu
Malabar thryssa	*Thryssa malabarica*	Noozhi	Thaada	Challa, Ammayi chella	Vatta chaala	Challa	Karichaala	Manangu/ Ambatta	Ambatta	Manangu
Moustache d thryssa	*Thryssa mystax*	Parava	Nonnavu	Manangu	Thaada	Challa	Ambata	Manangu	Charu	Kavery chola
White sardine	*Escualosa thoracata*	Nooli	Vella natholi	Veloori	Veloori	Veloori	Kathichooda	Chooda	Veloori	Veloori
Tardoore	*Opisthopterus tardoore*	Chaala	Nonnavu / Kuttal	Thaada	Manangu	Thaada	Nedu manangu	Manangu	Ambatta	Yeppal
Rainbow sardine	*Dussumieria acuta*	Parava	Mathi	Kokkala mathi	Karalan chaala	Kokkan chaala	Parappan mathi	Kannan mathi	Charu	Vatti chaala/ Kari tholiya

Goldstripe sardinella	*Sardinella gibbosa*	Chaala	Keeri chaala	Vattamathi	Nalla chaala	Kathi chaala	Kari chaala	Chaala mathi	Chaala	Memathi
Indian oil sardine	*Sardinella longiceps*	Kola	Vari chaala	Chaala	Chaala	Chaala	Mathi/ Unda mathi	Chaala mathi	Chaala	Erambayi
Chacunda gizzard shad	*Anodontostoma chacunda*	Parava	Varlu	Thodi	Thodi	Thodi	Thodi mathi	Kondadi	Kundadi	Tholiyan
Golden trevally	*Gnathanodon speciosus*	Kaaral	Paara varayan/ manja	Manja vatta	Manja vatta	Vatta	Manja / Kaduva paara	Manja kaduka	Kaduva paara	Kaduva
African pompano	*Alectis ciliaris*	Kaaral	Vellapaa ra	Kathadi vatta	Kannadi vatta	Vatta	Vellodi	Vella kaduka	Paara	Kaduva
Horse mackerel	*Alepes djedaba*	Ayila	Kottan paara	Vatta	Vatta	Ayila paara	Erachi paara	Ayila paara	Thuli paara	Paara
Imposter trevally	*Carangoides talamparoides*	Paara	Paara	Vatta	Vatta	Vatta	Erachi paara	Vatta Kadukka	Ovu paara	Kaduva
Razorbelly scad	*Alepes kleinii*	Ayila	Kottan paara	Vattapaara	Vattapaara	Kandan paara	Kandan paara	Kadukka	Thuli paara	Kooli paara
Indian scad	*Decapterus russelli*	Ayila	Kannam thiruvida	Thiriyaan	Thiriyaan	Choora kanni/ Kannan ayila	Chembaan	Kadukka	Paara	Karukkan adavu
Bigeye scad	*Selar crumenophthalmus*	Vatta paara	Vatta paara	Kanniayila	Paranna mullan	Kannan ayila	Kannan chembaan	Kaduka	Kannan thirukida	Porakaduva
Torpedo scad	*Megalaspis cordyla*	Vangada	Vangada	Vangada	Vangada	Vangada	Kanameen	Kanniayila	Kannan paara	Kodandha
Needle scaled queenfish	*Scomberoides tol*	Paara	Paara	Njaramban	Pola vatta	Pannal	Yappa	Choora	Eappa	Pala meen
Black pomfret	*Parastromateus niger*	Karutha avoli	Machaan avoli	Maachan	Maachan	Karutha avoli	Karutha avoli	Karutha avoli	Karutha avoli	Karutha manji
Indian pellona	*Pellona ditchela*	Parava	Vellakannan	Kannathi	Vatta chaala	Karalan/vatta chaala	Vella paara	Kumbaadi	Charu	Kuruthari/ mayyakanna
Yellowing flyingfish	*Cypselurus poecilopterus*	Parava Chaala	Para chaala	Parameen	Parameen	Parameen	Parameen	Parameen	Kilimeen	Parameen
Lutke's halfbeak	*Hemiramphus lutkei*	Mural	Mural	Mural	Chundan mural	Kolaan	Koli	Pookoli	Koila	Anjaal

Black-barred halfbeak	*Hemiramphus far*	Mural	Mural	Mural	Mural	Chundan Kolaan	Koli	Koli	Koila	Kondhi
Pickhandle barracuda	*Sphyraena jello*	Nenmeen	Kozhuva	Olakka	Sheelav/ Ulakkameen	Sheelavu	Thinda	Thinda	Thinda	Theanda/ chatta
Hound needlefish	*Tylosurus crocodilus*	Chundan mural	Vaali koluthi	Kolaan	Kandakolaa n	Kolaan	Neelankoli	Kannan chembaan	Koila	Kaanda
Flathead grey mullet	*Mugil cephalus*	Parachil	Paral	Maalaan	Paalav	Thirutha	Maalaan	Maalaan	Maalaan	Potholiya
Narrow – barred Spanish mackerel	*Scomberomorus commerson*	Velavu	Paral	Chamban cheruthu	Kora	Arukki	Fibersootha / Aycura	Choora	Varimeen	Chatta
Indian mackerel	*Rastrelliger kanagurta*	Ayila	Ayila	Ayila	Ayila	Ayila	Ayila	Ayila	Ayila	Ayila
Kawakawa	*Euthynnus affinis*	Choora	Choora	Urulan kudukka	Kudutha	Kudutha	Sootha/ Pettisootha	Vaala	Kethal	Ayilachemba
Skipjack tuna	*Katsuwonus pelamis*	Nenmeen /Choora	Varayan choora	Kera	Kera	Kera	Fiber sootha	Thalaan	Kethal	Kethal
Indo-Pacific king mackerel	*Scomberomorus guttatus*	Choora	Choora	Araykkan chamban	Varayan kudal	Thambaan	Sootha	Neymeen	Ayakura kethal	Chatta
Bullet tuna	*Auxis rochei*	Nenmeen	Pollal	Neelan kudukka	Neymeen/ Araykka	Thambaan	Sootha	Aikura	Varimeen	Valakkamee n
Frigate tuna	*Auxis thazard*	Choora	Choora	Ayila kudukka	Choora	Kudutha	Sootha	Thalaan	Ayakoora	Gothi/ Koila
Striped bonito	*Sarda orientalis*	Choora	Pollal	Ayila kudukka/	Kera	Kudutha	Chonthakor a	Choora	Ayakoora kethal	Kethari/ Kethal
Dussumier' s ponyfish	*Leiognathus dussumieri*	Kaaral	Kaaral	Mullan	Mullan	Kallan mullan	Mullan	Mullan	Modan mullan	Kurichi
Pugnose ponyfish	*Secutor insidiator*	Mulangaral	Thali kaaral	Methakuric hil	Mullan	Nalla mullan	Aana chavity/ Mullan/	Chakkara mullan	Mullan	Kurichi

Indian goatfish	*Parupeneus indicus*	Kilivarand	Thatha meen	Kilimeem	Cheeral	Kiliparanda	Puthiyapla kora	Chemballi	Puthiyapla katila	Chemberi
Moonfish	*Mene maculata*	Kaaral	Naso paara	Mekurichi	Paamullan	Paramullan	Praachi	Aanachavitti/ Vattamullan	Paamullan/ Mangalapuram mullan	Porakurichi
Japanese threadfin bream	*Nemipterus japonicus*	Paal, Kaaral	Chengalava	Kilimeen	Kilimeen	Kilimeen	Keeri kora	Kilimeen	Puyyapla kora/	Kili/ Malumaatti katla
Whipfin silver-biddy	*Gerres filamentosus*	Mullan/ Kaaral	Plaachi	Praanjil	Praanjili	Prayil	Praachi	Praachi	Madali	Payva
Malabar Tonguesole	*Cynoglossus macrostomus*	Ilapaatti	Aelapaata	Nangu	Manamaanthal	Maanthal	Maanthal	Nool manthal	Kallu mantha	Nangu
Jarbua terapon	*Terapon jarbua*	Kili	Kili	Kora	Kalakshi/ Kallan kora	Kallan kora	Keeri kora	Keeri	Keeran	Kallakeera
Pale spotfin croaker	*Johnius glaucus*	Kili	Kora	Kuttan	Thalayapaari	Chengora	Kora	Muttikora	Charu	Kalleri
Lesser tigertooth croaker	*Otolithes cuvieri*	Kora	Neelan kora	Pallimeen	Koori	Pallimeen	Pallikora	Pallikora	Koli	Koranu
Humpback red snapper	*Lutjanus gibbus*	Chemballi/ Chundaykka	Chemballi	Kilimeen	Chemballi	Chemmalli	Chemballi	Chemballi	Chovappan	Chemberi
John's snapper	*Lutjanus johnii*	Chemballi	Andikallan	Kallada	Chemballi	Chepperi	Chemballi	Chemballi	Chemballi	Kovaadi
Green jobfish	*Aprion virescens*	Poola	Aelapaata	Punnarameen	Punnarameen	Eari	Kora	Cheameen	Charu	Kanimeen
Fourfinger threadfin	*Eleutheronema tetradactylum*	Maana	Maana	Vaalumeen	Vaazhumeen	Vaazhumeen	Bhameen	Vaameen	Vaameen	Bhameen
False trevally	*Lactarius lactarius*	Parava	Parava	Parava	Parava	Parava	Adavu	Parava/ Adu	Adavu	Karukkan adavu
Silver pomfret	*Pampus argenteus*	Velutha avoli	Agoli	Avoli	Vella avoli	Vella avoli	Vella maachan	Vella avoli	Vella avoli	Vella manji/Aaval
Spiny cheek grouper	*Epinephelus diacanthus*	Pulli azhuva	Kalava	Kattara	Kattara	Karoop	Kalava	Kalava	Othala/ Amor/ Aiva	Kakka katla

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The fishers of Kerala have been engaging with the seas for ages in their daily struggle to earn a livelihood. They did this using unique insights that they earned and experiences they gained through long and difficult years, fishing in different seasons and varied conditions. Each day a new struggle.... with the wind, the water, the currents...

This book is the result of a very humble attempt to document this traditional wisdom and knowledge through a research project funded by Esso-Indian National Centre of Ocean Information Services (INCOIS), Ministry of Earth Sciences, Govt. of India, that was carried out in nine coastal districts of the state of Kerala, India.

This volume documents Indigenous Traditional Knowledge on various fisheries, fishing and fishing community related aspects such as physical oceanographic parameters, fishing techniques, fish shoal identification, processing, and beliefs. An attempt is made also to explore the scientific rationale behind selected ITKs.

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