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Indigenous technical knowledge of the fisher folk of Kerala (South India)

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Abstract
Globally there is recognition of the valuable role that traditional knowledge held by indigenous communities can play in the contemporary management of natural resources. Indigenous knowledge possessed by fisher folk is characterized by practical skills and wisdom developed at a local scale through earning livelihoods from the sea over successive generations. These can contribute place-based, fine-scale spatial and temporal information, management techniques and institutions. A number of studies have investigated the nature of customary management of small-scale tropical fisheries and the revival of traditional practices. However only very few of them have attempted to explicitly identify and integrate them with modern management systems. In the present study an attempt was made to collect indigenous knowledge possessed by the traditional fisher folk of the state of Kerala (South India). The information was collected by organizing three workshops and by holding focus group discussions (FGD) with the fishermen and people inhabiting coastal regions. The traditional knowledge so collected was analyzed in the light of modern scientific principles and are presented in the present paper.

Keywords: Indigenous knowledge, fisher folk, fisheries, Kerala

1. Introduction
Globally there is recognition of the valuable role that traditional knowledge held by indigenous communities, often termed Indigenous Technical Knowledge (ITK), can play in the contemporary management of natural resources [1]. ITK is characterized by practical skills and wisdom developed at a local scale through earning livelihoods from the environment over successive generations [2]. ITK can be conceptualized as different levels in a nested knowledge-practice-belief complex [3]. Local knowledge is nested within resource management systems, tools, and techniques. In turn, these are embedded within the social institutions, codes and norms required to implement management systems and a world view that shapes environmental perception.

When ITK is integrated with modern science and knowledge of management the resulting epistemological pluralism potentially enhances the resilience of social-ecological systems by providing a diversity of knowledge for problem solving [4-9]. In fisheries management, ITK can complement knowledge of modern science of resource management by providing long-term baselines for stock assessments, local knowledge of species' ecology and behavior, habitat conditions, fish utilization and customary management systems.

Tropical inshore marine fisheries present a particular opportunity for the application of ITK. They are typically small but complex social-ecological systems, involving a wide range of species taken for both subsistence and commercial use primarily by local fishers within diverse property regimes. Conventional centralized, command-and-control governance is often under-resourced and too inflexible to provide the fine-scale management required. In many developing nations there has been a renaissance of customary management in response to this problem. In many cases ITK and knowledge of management based on modern science have combined to create effective hybrid management systems.

Although there have been numerous studies investigating the nature of customary management of small-scale tropical fisheries and the revival of traditional practices, there have been few attempts to explicitly identify and integrate them with modern management systems.

There were some attempts in the past to collect information on the indigenous technical knowledge possessed by the fishermen community in India [10, 11]. However such studies pertain either to wider areas or to areas other than the present study area in which little

attention was received for the coastal belts of Kerala. In the present study an attempt was made to collect indigenous knowledge possessed by the traditional fisher folk of the state of Kerala (South India) by organizing workshops and by conducting focus group discussions (FGD). An attempt was also made to examine the traditional knowledge so collected in the light of modern scientific knowledge.

2. Methodology

In the present study which forms part of a larger integrated study, an attempt was made to collect indigenous knowledge possessed by the traditional fisher folk and coastal communities in three locations in Kerala viz., Ernakulam, Kannur and Kollam and to examine the traditional knowledge so collected in the light of the modern scientific knowledge. The information was collected by organizing three workshops and by conducting focus group discussions (FGD). The first workshop was conducted in Ernakulam (Central Kerala) on 27th December, 2014. The second one was conducted in Kannur (North Kerala) on 14th February, 2015 and the third one was conducted in Kollam (South Kerala) on 5th December, 2015. In all these, traditional fishermen and local inhabitants living in the fishermen village who are acquainted with the lives of fishermen, officials of the State Department of Fisheries and scientists in the field were invited to participate. After brief presentations by the officials and scientists in the field the participants were requested to share their knowledge which was documented.

3. Results and Discussion

Some traditional knowledge possessed by the fishermen and coastal inhabitants collected in the workshops and during the FGDs is discussed below. An attempt is also made to interpret such knowledge in the light of modern scientific principles.

3.1 One should not venture into the sea for fishing when 'Mother Sea' is in her menstrual period

During the initial months of south west monsoon (May- June) large patches of sea becomes blood red in colour, often with very bad odour emanating from that area. The traditional fishermen do not go for fishing in that area during the period. They believe that during those days *Mother Sea* (*Kadalamma*) is in her menstrual period and men should not venture into her.

There is good science behind the traditional knowledge of the fishermen. During May- June period the sea water temperature is relatively high on the West Coast of India. The first few monsoon showers enhance the nutrient content of the coastal waters due to terrestrial drainage. The increased nutrient load coupled with high water temperature leads to blooming of certain species of algae belonging to dinoflagellates like *Gymnodinium*, *Peridinium* etc. in the coastal waters [12]. These blooms are often called 'red tides,' or harmful algal blooms (HABs). Red tide is a phenomenon caused by algal blooms during which algae become so numerous that they discolor coastal waters. The microscopic algae produce toxins that make fish and shellfish dangerous to eat. The bloom of algae often turns the water red. Uncontrolled growth of algae also leads to oxygen depletion in the nearby area which in turn leads to mass mortality of marine organisms leading to off odour. During the period it is advisable not to fish in the areas and nearby and consume fish caught in such waters.

Red tide phenomenon is an event that occurs with varying intensity almost every year in the coastal waters. The timing of the phenomenon is difficult to predict. The waste products and decaying matter along the seashore get washed into the sea especially during rains. These nutrients washed from the coastal areas into the sea water are consumed by the unicellular phytoplanktonic algae, which forms the lower most organisms in the food chain. The right salinity, temperature and nutrients are thought to nourish these organisms. These may proliferate and reach enormous amounts thereby discoloring the water surface; hence this phenomenon is also referred to as 'Dinoflagellate bloom'. Most species produce red pigments and so this phenomenon is referred to as red tide phenomenon. These algae may produce very potent toxins. Usually fishes that dwell in deep waters are affected. Following widespread death of fishes, there may be release of noxious gases. Inhalation of these gases by human beings can cause clinical manifestations such as syncopial attacks, headache, drowsiness, abdominal pain, nausea, vomiting and panic attacks [13]. The algae are also consumed by shell fishes which when consumed by human beings can cause gastrointestinal manifestations. Hence human beings are advised to abstain from consuming shellfishes during the phenomenon. Filter feeding molluscs concentrate these toxins and ingestion of these shellfishes may lead to poisoning.

3.2 Presence of whales indicates abundance of fish

Traditional fishermen all over the state believe that presence of whales in large numbers is an indication of abundance of fish.

Baleen whales eat zooplankton. Their finely fringed baleen is able to strain from the water copepods and other small zooplankton. Krill and copepods are major components of a whale's diet. When there is abundance of plankton in the coastal waters whales are attracted to that area. In the area planktivorous fishes also abounds and generally chances of availability of large quantity of fishes in the area are high.

3.3 Presence of sardine shoals

According to the traditional fishermen, splashing of water on sea surface indicates presence of shoal of sardines. Oil sardine (*Sardinella longiceps*) usually exhibits jumping behavior as the shoals come to the surface of sea. This results in splashing of water. This knowledge is used for encircling of the shoal of oil sardine by traditional fishermen.

Fishermen on the lookout for bottom shoals, watch for the presence of a series of little air bubbles coming from below and bursting on the surface water as a certain method to locate shoals of oil sardine. This gives them an indication of the location of bubbling bottom shoals. These bubbles are believed to be released by the oil sardine while feeding on the muddy bottom. When there is big concentration of sardines, a strong fishy odour emanates from the mucous they discharge and this enables fishermen to spot the shoals and to make larger catches [14].

The oil sardine shoals range from 2-25 m in length and 1 to 20m in breadth [14]. Though the speed of the shoals has not been studied critically, rough estimates put it at 5 km per hour [15].

3.4 A dark patch of water with ripples indicates occurrence of mackerel shoal

The traditional sea going fishermen all along Kerala spot mackerel shoal from a distance during daytime as a dark patch

with ripples. According to Bal and Rao (1990) [14] mackerel shoal moves, in crescentric or arrow head formation, at a speed of 8-10 miles per hour. When the fish are chased by sharks or porpoises they dive deep and a sheet of muddy water appears on the surface because of the churning action of the waters by the fish at bottom.

3.5 Presence of flock of sea birds is an indication of fish shoals

The traditional fishermen take the presence of large flocks of birds as an indication of fish shoals. When large fish shoals approach the water surface near the shore, fish eating birds like *kadal kaakka* (sea gull) fly in large numbers over the waters in attempts to catch the fish. Appearance of sea gull scooping into the water frequently indicates the presence of fish.

3.6 Coconut spikes as fish aggregating device

Migratory fishermen from the southern parts of Tamil Nadu who seasonally reach the Malabar region of Kerala use a special type of fishing method locally called *Kolachal* fishing for catching cuttle fish.

Kolachal fishing involves using the spikes (locally called Kolachal) of coconut tree to form structures with a view to attracting fishes, mainly cuttlefish. The fishermen set out kolachal in large numbers in selected parts of the sea. They return to the spot where Kolachal is set after three to four days and catch cuttle fish aggregated there. Here Kolachal serves as an artificial fish aggregating device (FAD). These FADs acts as breeding and hiding place for cuttle fish. Adult cuttle fish are attracted to the area where they lay their eggs. Kolachal also serves as artificial substrates on which periphyton grows in large numbers. Periphyton are excellent food for cuttle fish and hence Kolachal serves as a feeding place for them. It may be remembered here that catching of cuttlefish by positioning the Kolachal on the seabed may cause depletion of natural stock and hence may not be encouraged.

3.7 *Changala pachil* as a means to catch fish and prawns

This is raft trapping of prawns practiced in the shallow areas of the backwaters and their connected canals in the Central Kerala. Two medium sized wooden boats are connected together by trying bamboo poles across the anterior and posterior extremities. After tying the distance between the boats will be about 1 m. Inside the boats weights like stones and sand bags are kept on the inner sides so that these edges lie very near to the water surface. A long iron chain is connected to the boats, its middle region lying in water touching the ground. This acts as a scare line [16]. The boats are moved forward by punting with poles or rowing with paddles, and when the chain is dragged at the bottom, it scares the prawns which jump out of water and fall into the boats. Inside the boats twigs and leaves and large number of empty fronds of coconut inflorescence are kept which prevent the escape of prawns by jumping back into the water. The operation is in night. In Northern parts of Kerala, a variant of this method is in operation. Here on the outer and anterior sides of the boats, nets are fixed on supports inclined outwards to trap the prawns that jump in the direction. Young ones of *Metapenaeus dobsoni, M. monoceros, Penaeus indicus, Mugil cephalus, Liza parsia, Etroplus suratensis* etc. are caught in moderate quantities in this method. This method of fishing has been discussed in detail by earlier workers [17, 18].

3.8 Baited floats to catch fish

This is a devise used in the shallower areas of Kerala backwaters. In this method the visceral mass of snail is tied to a piece of strong string, and at the opposite end a small float is tied. Several of these are kept in water in a small area where prawns abound. After some time the prawns begin to grab at the bait which is visible by the up and down motion of the floats. The fishermen waiting nearby in small canoes approach and entrap them by *ottal* or cover basket. Methods of fishing similar to the above have been discussed in detail by many workers [19, 20].

3.9 Branches of cashew nut tree as fish aggregating device

In the Malabar regions of Kerala inland fishermen lay branches and twigs of cashew nut trees in rivers and lakes to catch fishes like pearl spot (locally known as *Erumeen*). Twigs of cashew nut trees remain undecomposed for many days together. Periphyton grow profusely on these substratum. Pearl spot and other fishes which feed on the periphyton will be attracted to this area. The area also acts as a breeding and hiding place to a large number of fishes. Fishermen periodically come and catch the fishes by encircling the area with nets.

3.10 Scare lines from tender coconut leaves for catching fish

Scare line made of coir and tender leaves of coconut trees is a common fishing device in Kannur and Kasrgod districts of Kerala. It consists of a coir rope of 30-40 m length. From the coir rope split tender coconut leaves are hung at intervals of 10-15 cm. The resultant scare line is dragged along the water course by two fishermen in a semi –circular / curved fashion. 4-8 fishermen attend the areas in between the two ends wading forward slowly along with the scare line. When scare line is dragged in water it creates a noise and fishes either jump out or hide in the bottom mud according to their behavior. The fishes that jump out are caught by using suitable hand nets. The fishermen who move along with the scare line also go down the water and hand pick the fishes which hide at the bottom. The method is slightly different from the method prevalent in other parts of the state which was described by some earlier workers [21], in that in the latter method the fishes are caught by using drag net or by cast nets.

3.11 Fishing of snake heads (*Channa* spp.) with petromax and sickle

Fishing of snake heads (*Channa* spp.) with petromax and sickle was very common in the northern most parts of the state of Kerala, till recently. This method is practiced during the monsoon months mostly in inundated paddy fields, associated canals and ditches. Fishing is done by groups of 3-4 persons. One member of the team holds the petromax and moves forward. Another member who follows the light bearer has a sack or a bag made of palm leaves or leaves of *Pandanus* plant and carries a hand net with him. Another person carries a sharp sickle. The fish are attracted towards the light from distance. When the fish reaches near the light it gets stupefied by the intense light of the petromax. The fishermen strike at the fish with the sickle or catch it by using the hand net according to the convenience and store in the sack or the bag.

3.12 Use of charcoal from coconut shell to clear the well water

The principal source of drinking water in coastal regions of Kerala is open wells. Wells are mostly very shallow and are very often influenced by surface run off. Well water in the coastal regions often become turbid and turns un-potable, especially during the monsoon periods.

Turbidity of well water is either due to suspended inorganic substances, such as silt and clay or due to planktonic organisms. Turbidity varies greatly with the nature of the bottom, degree of exposure, nature of inflowing run off etc. [22].

Excessive turbidity in drinking water is aesthetically unappealing, and may also represent a health concern. Turbidity can provide food and shelter for pathogens. It may lead to waterborne disease outbreaks, which may result in significant cases of gastroenteritis. The particles of turbidity provide "shelter" for microbes by reducing their exposure to attack by disinfectants. Microbial attachment to particulate material has been considered to aid in microbe survival.

The traditional coastal community has a very simple and effective method to control turbidity in well water. They apply house- made charcoal for the purpose. They make charcoal by burning coconut shells. Coconuts are abundantly available in the coastal regions of Kerala.

Charcoal from coconut has very good adsorbing property. It adsorbs sediments and other substances that impart turbidity to well water and makes it clear.

3.13 Use of tannin for preservation of fishing nets

Traditionally fishing nets are made of natural fibres. Natural fibres used traditionally are cotton, sisal, hemp, manila and coir. Cotton fibre is obtained from the seeds of *Gossypium herbaceum* plant. Sisal is the fibre extracted from the leaves of the plant *Agava rigida sisalana*. Hemp is the fibre extracted from the stem of the plant *Crotalaria juncea*. Manila is the leaf fibre *Musa textilis* plant. Coir is made from the fire of coconut tree, *Cocos nucifera*. Traditionally tannin was in use for the preservation of fishing nets.

In preparing the tannins, the barks are cut to small pieces, crushed well and boiled with water in a metal vessel till a concentrated solution is obtained. The residue is squeezed, liquid is collected and filtered. In nuts, seeds are removed and dried shells crushed to powder and boiled with water to form a concentrated solution. Unripe *Panachikka* fruit is crushed to paste and kept for 2-3 days in earthen pot covered with water to obtain a thick purple coloured sticky liquid. The net is immersed in the solution for a day or two and dried. A second dip is also done if required. To prevent leaching tannins are fixed by dipping them in 1% solution of copper sulphate and ammonia. Such treatment is further strengthened by treating the twines by coal tar or coal tar and kerosene.

3.14 Coconut fronds in prawn filtration fields improve survival and growth of prawns

Traditional prawn farmers in Kerala use coconut leaves/ fronds in filtration fields as a means to improve prawn growth and survival. The practice is more common in central Kerala.

Coconut leaves/ fronds placed in prawn filtration fields act as substrates for the growth of periphyton which serves as very good source of natural food for the prawns. Periphyton is a complex mixture of algae, cyanobacteria, heterotrophic microbes, and detritus that are attached to submerged surfaces (substrates) in most aquatic ecosystems. It serves as an important food source for invertebrates, fishes and many other aquatic animals. The submerged coconut fronds also act as hiding place for the prawns which help them escape from predatory fishes, especially during the periods of moulting. Thus the growth and survival of prawns are improved. In fact the modern substrate based aquaculture practised in many parts of the world today has its origin in such traditional practices of fish farmers and fisher folks [23]

3.15 Singhi (*Heteropneustes fossilis*) for treating anemia in pregnant women and children

The coastal people of Kerala traditionally consider 'singhi' as an excellent food for pregnant women and children to get rid of anemia. There is good amount of science behind the belief. The Asian stinging catfish or fossil cat, *Heteropneustes fossilis*, is a species of air sac catfish found in India, Bangladesh, Pakistan, Nepal, Sri Lanka, Thailand, and Myanmar. It is locally known as *kadu, theyili, moyya or kari* in different parts of Kerala [24]. Kari is known to contain high amount of iron, required for the synthesis of haemoglobin. Deficiency of which causes anemia. Regular consumption of *kari* helps get rid of anemia caused by the deficiency of iron

4. Conclusion

Indigenous technical knowledge of coastal fishing communities in Kerala is rich and varied. Traditional fishing practices have importance in sustainable management of production and utilisation of fish and in the everyday life of the fisher folk. Indigenous technical knowledge can complement knowledge of modern science of resource management by providing long-term baselines for stock assessments, local knowledge of species' ecology and behavior, habitat conditions, fish resource utilization and customary management systems. There is also a possibility for combining the indigenous technical knowledge and knowledge of management based on modern science to create effective hybrid management systems.

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