Chapter 5

SUMMARY AND RECOMMENDATIONS
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India is blessed with abundant water resources in the form of rivers, ponds, lakes, reservoirs, flood plain wetlands and innumerable small water bodies. The inland fish habitat in India harbours 587 fish species in the freshwater systems and 171 fish species in the estuarine waters.

The total inland water spread area in Kerala is about 3,55,000 ha. There are 44 rivers in Kerala with a total catchment area of 37,884 km$^2$. Out of the 44 rivers, 21 rivers (including Mahe river) are located in the three Northern districts of Kerala viz., Kozhikode, Kannur and Kasargod. About 10,096 ha of backwaters and 13,354 ha of brackishwater areas are also available. Two reservoirs, Pazhassi (Kannur) and Kuttiadi (Kozhikode) with a total water spread area of about 1700 ha are located in North Kerala. The rivers and streams in the Western Ghats alone harbour about 170 freshwater fish species of which 66 species belongs to food fish category. Major backwaters in Kerala harbour about 95 species of fish and shellfish.

The fish and fisheries play a crucial role in the Kerala’s economy, particularly among the communities along the coastal belt. Inland fish production in Kerala during 2004-05 has been estimated to be about 76,000 t. Fishery activities in the backwaters of Kerala support about 0.2 million fisher folk and provide full time employment to more than 50,000 fishermen.

Fisheries activities of the inland sector of India are traditional in nature and fishermen generally carry out the fishing operations without any consideration to sustainability of the resources, which is leading to dwindling catches and poor returns. Reduction in landings can be further attributed to habitat degradation, land reclamation, sand mining and aquatic pollution.

The literature available on inland capture fisheries of Kerala is based on the study carried out in and around the Central Kerala. No effort is made in the past to
study and document the design and operation of existing fishing gear in North Kerala, where almost half of the total numbers of rivers in Kerala are located.

In the present study, results of investigations conducted during 2003-2005 on the craft and gears in the inland waters of North Kerala and performance evaluation of collapsible fish trap for riverine waters are presented. The content of the thesis is organized into five chapters.

**Chapter I**

In this chapter, an introduction to the topic of study, highlighting its relevance, objectives of the study and a review on the inland fisheries sector of the World, in general, and India and Kerala, in particular, are presented. Inland aquatic and fishery resources of different categories of water bodies in India and Kerala are presented.

Inland aquatic and fishery resources of the selected districts are listed separately. 54 species of fish and shellfishes constituting the catch from the region were identified. Literatures on the inland fisheries and fishing methods of World, India and Kerala are reviewed and documented.

The objectives of the study were (i) To document major fishery resources and different craft and gear combinations operating in inland water bodies in selected districts of North Kerala. (ii) To identify the existing fishing gears and methods, prepare design drawings and classify the gears based on design, operation, mesh size, target species, etc. (iii) To identify the technical problems and suggest improvements in the existing fishing crafts, gears and methods of operation to increase their efficiency and selectivity. (iv) To design and develop a collapsible, durable and cost-effective fish trap for riverine fishing and evaluate the performance in comparison with the traditional traps.
Chapter II

This chapter deals with the materials and methods used for the conduct of the investigations. Details of study area and all water bodies in the selected districts are described. Figures of 21 rivers in the three districts indicating the location of sampling centers and other water bodies are also given. Methodologies followed for the survey of fishing crafts and gears are described. Methodology followed for the performance evaluation of collapsible fish trap is given separately in the respective chapter.

Chapter III

Chapter III is divided into two sections. The first section deals with the details of inland fishing crafts of the region. Wooden canoes of LOA ranging from 3-6 m are the major fishing craft. Dug-out canoes are almost totally replaced with plank-built canoes. FRP coated canoes are seen in the estuarine areas of a few rivers. Coracles are exclusively operated by the migrant fishermen from Karnataka. Migrant fishermen carry out fishing using two plastic cans tied with a piece of cloth.

Canoe constructed using split bamboo covered with polythene bags and coal tar is an innovative cost effective fishing craft seen at Muthampy, in Kuttiadi river and is reported for the first time from India.

The second part deals with various types fishing gears operated in the inland waters of the region.

Seine net

Seine nets in North Kerala are grouped mainly into 3 categories. They are Koruvala (encircling seine), Chavittuvala-I (seine without wings) and Chavittuvala-II (seine net with wings). Design and operation of these seines and other types of seine nets are discussed. Approximately 10 % of the inland fishermen operate seine net. Net is usually made of PA multifilament of 210Dx1x2 having 10-18 mm mesh size. Polyamide (PA) knotless netting is widely used for seine net fabrication.
Average catch and monthly variation of income of the major category of seines are also discussed.

Average catch per day of a seine net in Anjarakandy river is about 31 kg with a CPUE 7.8 kg/h. Catch is mainly constituted by juveniles and other small fishes and prawns. Closed area and season is recommended for seine nets to conserve the resources.

**Gill net & Trammel net**

Important categories like surface gill nets, bottom gill nets, their design, technical specifications and operational details are discussed. Gill net is the most common gear and more than 95% of the gill nets are made of PA monofilament and most predominant material size is 0.16 mm dia. Mesh size of the gillnet varies from 12 to 300 mm in which the lowest case is for the *Metapenaeus dobsoni* net in Kannur district and highest for the *Catla catla* gill net in Kuttiadi reservoir. Mud crab entangling nets are made of PA monofilament having 0.32 mm dia with 90-160 mm mesh size. *Lates calcarifer* gill nets in Chaliyar river is made of PA 210Dx24x3 with 220 mm mesh size. Trammel nets for fish are operated in Valapatanam river for fish. Economics of gill net unit in Kavvayi river shows that average catch/ day was 5.1 kg and the average daily income was Rs. 251/-. Selectivity studies are required to optimize the mesh size for different species. Resource specific gill nets are recommended to reduce the landings of juveniles. Gill net for *M. dobsoni* is unique and is reported for the first time.

**Traps**

Traps are operated in the rivers and backwaters. No traps are found in reservoirs, except the aerial traps operated in Pazhassi Reservoir. Box trap of about 1.5x0.6 m size having a “D” shape in cross section, made of split bamboo fastened using coir twines are popular in Kannur district. This trap is operated in rocky areas without any bait to catch *Etroplus suratensis* and *Lutjanus argentimaculatus*. Service life of the trap is one year.
Screen barriers made of bamboo splinters prevalent in Kannur and Kozhikode districts are almost completely replaced with HDPE net barriers. The later is cheap; handling is easy and is durable. Plunge basket and filter traps are also found in operation at few places.

*Thottil vala* is the aerial trap operated in Pazhassi reservoir during monsoon to catch big fishes. Trap is lowered from the dam and is set above the water surface, to trap the fishes jumping against the current. Operation of this trap is reported for the first time.

**Lines**

Hand lining is carried out using small wooden canoes of 2.5-3.5 m lengths. Lines with multiple hooks without bait are operated in Pazhassi dam to catch jumping fishes, when the shutters are open. Baited line without hook is operated in backwaters to catch *Scylla serrata*. Multiple baited line without hooks is operated in Kannur district for catching *Scylla serrata*. Vertical line with baited hooks are operated in Kozhikode to catch finfishes. Long lines for fish are seen in several places. In Mahe river, long lines are exclusively operated to catch eels for use as bait in shark long lines.

**Mini-trawls**

Mini-trawls for fish, shrimp and crab with head rope length ranging from 3-6 m are popular in the estuarine areas of Kariangode and Chandragiri rivers in Kasargod. Net is generally made of HDPE netting of 0.5mm dia with 15-40 mm mesh size. A few shrimp trawls are made of PA 210Dx2x3. Wooden, flat rectangular otter boards of 40x20 cm weighing 5.5 kg each are used. The net is operated from non-motorised canoes using rope and anchor to catch bottom dwelling fishes.

Operation of mini-trawls from non-motorised craft in estuarine waters is not reported by any workers in the past.
Hand dredge

Hand-held dredges are operated in the estuarine areas of Kariangode, Valapatanam and Kuppam rivers by men and women to collect clams. Dredge is a curved iron plate with teeth attached in the mouth of a small scoop net fastened to a 10 m long wooden pole. The canoe held perpendicular to the shore hold the pole and press the dredge into the bottom. Man standing in the second canoe drag the dredge against current by pulling the rope tied to the pole to scoop the bottom.

Four-boat lift net

It is operated in the lower reaches of Chaliyar river to catch shoaling fishes. Net is trapezoidal in shape and is made of nylon PA multifilament. Mesh size in the central part is 20 mm and it is 90 mm in the periphery. It is operated from four boats and another two boats leads the fish into the net by dragging a scare line during day time or a petromax during night. Catch is mainly mullets and catfish. This method is also reported for the first time.

Cast net

String less cast net without pocket, stringed cast net without pocket and string less cast net with pocket are the three types of cast nets in operation. They are made of PA multifilament (210Dx1x2 & 210Dx1x3) and a few nets are made of PA monofilament. Group cast netting is practiced in Kozhikode by joining 4-5 canoes and a group of 8-10 fishermen. They drive the shoal to a central place and simultaneously cast the net from all sides. Drifting of cast net in open condition along the water current from a canoe and cast net as drive-in-net are some innovative type of fishing seen in some parts of Kozhikode.

Stake net

Stake nets made of PA multifilament knotted or knotless netting with 8-10 mm mesh size is common. Dimension of square mouthed nets varies from 2.5- 3.2 m. The length of the bag varies 8-16 m. Fore part of the net is usually fabricated
using 3 mm dia. PP twine with 230-250 mm mesh size. Middle part of the net is fabricated using PA multifilament with different mesh and twine size. Last part of the net is fabricated with PA multifilament or knotless netting with 8-10 mm mesh size. Total cost of the net varies from Rs. 10,000 to 30,000. In Kallai river stake net fishermen practice quota system for the net operation because suitable locations are limited.

**Encircling net**

Dragging two rectangular nets against each other and encircling shallow areas temporarily using poles erected to the bottom to harvest the trapped fishes during low tide is an unique and ancient fishing method practiced by the members of a muslim family in Valapatanam river. The net is rectangular in shape with 12-15 pieces of size ranging from 25 to 35 m in length and from 2.5 to 3.0 m in height. Fishing is carried out only during from February to May. Fishes are captured by removing the poles, reducing the enclosed area. This fishing method is reported for the first time.

**Drive-in nets**

It is rectangular net of about 30 m length and 3.5 m width, made of PA multifilament of 210Dx1x3 or 210Dx2x2 twine size and 20-25 mm mesh size. The net is operated by dragging the scare line attached at one end of the net to drive the fishes into the net.

**Scare lines**

The scare line, made of inserting coconut leaves into a 100 m long coir rope, is held in the form of “V” and is dragged along shallow waters by 3 fishermen to scare the fish to burrow and they are subsequently captured by the fisherman moving at the base of the “V”.

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**Stick held drag net**

They are rectangular bag nets made of PA multifilament of 210Dx1x3 twine size with 10 – 22 mm mesh size. Double stick held and multiple sticks held dragnets with shallow bag are operated in shallow areas by 2 to 3 fishermen.

**Scoop nets**

Scoop nets made PA and HDPE are operated in shallow waters to capture shrimps and small fishes. Stick held scoop nets are also operated in some places.

**Baited lift net**

It consists of an iron ring of about 0.5 m dia made of MS rod of 4-6 mm dia to which a basket like net is fastened as to form a shallow scoop net with 15 – 20 cm depth. Eel pieces, chicken parts and beef intestine are used as bait in the net and it is attached to the ropes running across the frame. A series of such nets are operated in rivers and backwaters, with the help of thermocole floats, to catch *Scylla serrata*.

**Cross bow**

It is employed to shoot the fish in the streams and quiet backwaters. Cross bow is operated in Valapatanam river by migrant fishermen from Ernakulam district. It is operated from a canoe during night.

**Spear and trident**

Spear is simple metallic rod with a pointed tip. Three pronged spears are also operated in shallow waters during night particularly to collect shellfish. Hooked rods are used to capture crabs from burrows.

**Miscellaneous fishing methods**

Stupefying methods of fish capture includes use of poisons of plant origin, electricity and use of explosives. Although these are prohibited practices a few people do it as a sort of recreational fishing. Other methods are hand picking for
fish, clams and edible oysters. Locally made knives are used to remove oysters from the rocks.

**Fish aggregating devices**

Artificial fish shelters are made in shallow waters by planting cut branches of trees. The fishes which takes shelter inside such parks are captured after 2-3 weeks by surrounding the FAD using nets and removing the vegetation.

**Chapter IV**

This chapter deals with design, fabrication and performance evaluation of collapsible fish trap for riverine fishing.

The traditional trap is made of natural materials and hence it is prone to biodeterioration. Collapsible trap is made of two SS rods of 1.1x 0.75 m size covered with HDPE netting made of 1.25 mm dia twisted monofilament with 50 mm mesh size. Funnel shaped entrances are provided at both ends. Eight disc shaped PVC floats of 150 x 20 mm size, two each at four corners were used to lift the upper portion of the trap to achieve a box shape during operation. Four disc shaped cement sinkers weighing 1 kg each were attached to the four bottom corners to keep the trap at the bottom.

Performance evaluation was conducted during January 2005 to March 2006 at Kuttieri in Kuppam river in comparison with the traditional fish. Average catch per haul was 0.94 kg in the traditional trap and 0.54 kg in collapsible trap when operated without any bait. In collapsible trap the species composition is *Etroplus suratensis* (34.8 %), *Lutjanus argentimaculatus* (30 %), *Scylla serrata* (28 %) and *Lates calcarifer* (7.2 %). In the traditional fish trap *L. argentimaculatus* (46 %) dominated the catch followed by *E. suratensis* (36.4 %) and *S. serrata* (16.2 %).

ANOVA reveals that there is significant difference in catch between these two traps at 5 % level. There is no increase in the catch when operated with tapioca as bait. There is significant difference in total catch when operated with chicken.
waste as bait, due to the increase in the catch of *S. serrata*. Catch of collapsible trap was comparable when operated with chicken waste.

10-15 collapsible trap can be operated from a canoe whereas only 2 traditional traps were able to operate at a time because of its huge size. Daily income was Rs. 540/- against Rs.188/- realized from traditional trap fishing. Net annual profit in collapsible trap fishing was Rs. 84,992/- against Rs. 21,495/- Since the fabrication, operation and maintenance cost is low, artisanal fishermen can easily adopt it to earn an additional income.

**Chapter V**

**Conclusion and Recommendations**

37 types of fishing gears and methods of fishing are identified from the inland waters of North Kerala. Design drawings of all these gears are prepared and this will form the basis for the gear technologists for efficiency improvements. This will also help the fisheries administrators for formulation of policies for sustainable fisheries development.

1. One new type of fishing craft and four new type of fishing gears are reported for the first time. Split bamboo fishing canoe, design details of four-boat dip net, mini-trawling from non-motorised craft, *Maade valayal* and *thottil vala* are reported for the first time and it is a contribution to the science of fishing technology.

2. The traditional fish traps operated in the region is prone to bio-deterioration and hence its operation is restricted to six months in a year. Service life of the trap is one year. Two fishermen and a canoe are required for its operation.

3. A collapsible, light weight, durable fish trap is developed during the study. A fisherman can operate 10 collapsible traps from a canoe and can earn minimum Rs. 540/- per day. Daily income from the trap operation is approximately Rs. 188/- Total cost of traditional trap fishing is Rs. 17,150/- and that of collapsible trap is Rs. 24,661/-. Net annual profit is only Rs.
21,495/- for traditional trap and it was Rs. 84,992/- for the new trap developed.

4. Catch of *Scylla serrata* in fish trap can be increased, if chicken waste is used as bait. Moreover carnivorous fishes can be lured into the traps, in addition to the normal target species.

5. Details of inland aquatic and fishery resources of the region are made available. The R & D organizations can take up further studies to assess the resources and make appropriate management strategies.

6. Selectivity experiments should be carried out for major species to optimize the mesh size for the most predominant gear, viz. gill nets. Further, use of resource specific nets may be encouraged to eliminate juveniles from the catch.

7. Closed season and area may be observed to reduce the landings of juveniles in seine nets.

8. Number of stake nets may be restricted, mesh size regulated and operation during flood tide banned in order to protect the juveniles.

9. Resource enhancement programmes like stocking and ranching may be strengthened in water bodies like reservoirs to increase the productivity and daily income of the dependent fishermen.

10. Large-scale sand mining is noticed in several rivers during the study. It may be restricted to protect the habitat and increase fish production.

11. Passage for migration of fishes may be provided while constructing check dams, barriers and roads across channels and other water bodies.

12. Awareness programmes on responsible fishing may be taken up for the sustainable development of the sector.