

PROJECT REPORT OF SURVEY, DOCUMENTATION AND VALIDATION OF INFRA-TECHNOLOGIES FOR FISHING CRAFTS AND GEARS

INTRODUCTION

Fishing technology is the discipline dealing with the natural sciences and technology for optimising fish capture and fishing operations the leading to a productive and sustainable capture fishery. It consists of applied research and development serving practical purposes.

The fishes are one of the main exploitable resources of the aquatic ecosystems that provide a cheap source of protein. The rapid development of fishing technology in India during the recent years has paved the way for increased production availability of new synthetic materials, evolution of new designs of fishing crafts and gears and avoidance of ignorant harmful fishing techniques etc.

It is to be taken into account that any developmental activity adopted should also be base rooted in the objective of uplifting the economy of the fishing communities. This implies that the improvisation of the existing tools and techniques and introduction of new ones to enhance fishing efficiency need a careful study of the traditional infra-technologies. This project aims at three activities to take place in a sequence viz:

1. Survey of infra-technologies in fishing crafts and gears.
2. Mordernisation through selection, improvisation and prototype development, and
3. Technology - linked pilot scale industrial activity in fishery.

REVIEW OF LITERATURE

The use of dug out canoes and different type of fishing gears in Lotak Lake was reported by Hora (1921) Choudhuri & Banerjee (1965), Singh (1983), Devi (1980), Mao (1991) and Singh *et.al* (1992), Marak *et. al* (1998) explained the operational details of the fishing techniques carried out by the tribals in North-Eastern India with reference to meghalaya and Manipur. Descriptions of traditional fishing gears and crafts in other regions of India have been made by Patnaik (1973) for Chilka (Orissa), Sehgal (1973) for

Aligarh, Mitra (1952) for Gangetic system, Shivaprakasha *et. al.* (1990) for riverine systems of Karnataka, Jhingram (1991) for Brahmaputra river, Radhakrishna (1989) for Kollern Lake etc.

Other important works concerning the fish and fishries of the wetlands of Manipur Valley are:

1. Fish catching Methods of the world – Fishing News (Books) Ltd. London EC4 – 1-240
2. A consideration of classification of fishing gears & methods IPFC Procs, 3(3): 143 – 165.
3. VISWAS, M. 1978 Fishes of Manipur M.Sc. Dissertation J.N.U.
4. Tombi Singh, H. 1987b: Study on wetland ecosystems in Manipur Valley from management perspectives of fishes, Wild Life and Environment, Second progress report submitted to Dept. of Environment, Ministry of Environment and Forest, New Delhi.
5. Tombi Singh, H. 1987 c: Impact of Loktak Hydro Electric Project and Current land use pattern on the riverine fishery of Manipur. ICAR National Symposium on the impact of current land use pattern and water Resource Development on the Riverine fishery. Barrackpore, April 25 - 27. 1987. Abs - 36p.
6. Tombi Singh, H. 1993: Impact of Ithai Barrage on the Environment of Manipur: an overview. P 1-8, In: G: Kabui(Ed) Ithai Barrage a Boon or scourage for Manipur? AMIBPO, Manipur.
7. Tombi Singh, H. And R.K. Shyamananda 1994: Loktak Lake, Manipur WWF, India, 1- 69. Pp.
8. Meiteileima Year 1994: Impact of Ithai Barrage on Fish and Fisheries of Manipur - Dissertation for post Graduate Diploma Course (Fisheries)CIFE, Bombay.
9. Shyamananda R.K. 1991: Study of nutrient enrichment of Lotak lake w.r.t to biological indices. Ph.D. Thesis, Manipur University.
10. Pishak Singh M. 1996 Ecology of Lotak lake with special reference to Fish & Fisheries of the Lake. Ph.D. Thesis, Manipur University.

MATERIAL AND METHODS:

The materials used during the survey Includes. Measuring taps, measuring scales, one still camera. Fish identification handbook. Drawing paper, pencils for the spot sketch etc. are some of the materials used by the survey staff.

Data are collected from the field directly by the Research Scientist and field assistant of this project by measuring, viewing and direct conversation to the fishermen.

The following are the areas covered by the survey.

1) **Bishnupur district:** (From 1st June 1998 to 13th June 1998)

Ningthoukhong fish seed production farm, Hoatak Pengba seed production farm, the Khuga River at Kumbi area, Ithai dam area. Thanga Chinglak Bazar area visit to the net making houses of Thanga, Thanga Khunjao Thanga Tongbram Leikai area. Takmu Experimental Fish Farm, fishing village of Sendra, Fishing demonstration village, Nungjeng Leikai, Sendra Road, local fishing villages of Moirang, Canoe building yard, Sendra Road, Moirang.

2) **Thoubal district:** (From 22nd June 1998 to 8th July 1998)

Thoubal D.F.O. Office, Heirok river system, Heirok, Wangbal fish seed farm, Wangjing river system of Wangjing area, Tentha Kharungpat and Lousipat, Sugnu river system of Sugnu area, Sherou, Chakpi river system, Sherou, Imphal river system area where the Imphal river meet Chakpi river. Wangoo-Imphal river system, Waithou Pat, Thoubal Kiyam.

3) **Imphal district:** (From 20th July to 31st July 1998)

D.F.O. Office, Lamphel, Lamphelpat area, the Nambul River system, fishing area of Lamsang and Phayeng, Sangaitel, Yurembam, Patsoi, Merakhong, Imphal river system of Lilong (meeting place of the Imphal and the Iril Rivers) Kiyamgei, Kongba river system, Research Station at Pangei, Fishing villages of pangei, Kongba river system of Khurai area, Moirangkampu, Yaral Pat, Mayang Imphal, local fishing villages, Khuman Yangbi Pat, Khelakhong, Ikop Pat, Imphal river system.

- 4) **Churachandpur district:** (From 23rd Sept. To 28th Sept. 1998)

D.F.O. Officer, Churachandpur, Khuga River System of Churachandpur area, Khangvai, Fishing Villages & Khuga River System, Fishing Village of Saiton and Nganukon area, Saiton Khuga River System.

- 5) **Chandel district:** (From 6th Oct. To 14th Oct. 1998)

Chandel D.F.O. Office, Modi Fishing Village, Monshangpantha, Tengenoupal Fishing Village, Pallel Fishing Villages & river system of Pallel.

- 6) **Ukhrul district:** (From 26th Oct. To 1st Nov. 1998)

Ukhrul D.F.O. Office, Hundung Fishing Villages, Litan.

- 7) **Senapati district:** (From 11th Nov. To 19th Nov. 1998)

Senapati D.F.O. Office, Senapati fishing village, Fishing Villages of Kangpokpi, Sekmai Fishing Village.

- 8) **Moreh:** (From 16th Jan. To 19th Jan. 1999)

Fishing Villages of Moreh area, Market survey of fishing net at Moreh.

FISH HABITATS OF MANIPUR:

Topographically Manipur is constituted by two distinct geographic feature viz. 1. An elevated plain and 2. Mountain ranges. The central plain forms a valley of about 2000 sq.km surrounded by rows of mountains on all sides while the valley is very rich in lakes, ponds and wetlands, the mountainous regions are drained by three river systems viz. 1. The Barak river system, 2. The Manipur river system, 3. The Yu-River system (in Myanmar)

Manipur at a glance:

Total area	-	22,327 Km ²
Hill area	-	20,038 Km ²
Valley area	-	2,289 Km ²

Altitude from sea level	-	3,000m above MSL on hill and 790m MSL in valley.
Temperature range	-	0°C to 36°C
Climatic conditions	-	Sub - tropical to temperate
Latitude	-	23°83/E to 25°68/E
Longitude	-	94°0/E to 94°78/E
Capital	-	Imphal
No. of district	-	9(5 Hills and 4 Valley)

The fish habitats of Manipur includes ponds, wetlands, lakes, rivers, stream, canals, paddy field under paddy cum-pisciculture, swampy area etc.

Total water area available in Manipur (Table - 1)

SL.No.	Resources	Water area(ha)
1.	Ponds	7,350
2.	Beels/lakes	40,000
3.	River/Stream/canals	5,000
4.	Paddy field under paddy Cum-pisciculture	40,000
5.	Swampy area which could be utilised by. excavation impounding damming etc.	10,000
Total area		1,02,350

Soil and water quality:

The soil texture of Manipur is loamy and clayey with some percentage of sandy soils. pH of water varies from place to place. Generally swampy areas are slightly acidic in nature whereas the western hilly region is always almost near neutral and slightly alkaline ranging from 7.0 to 7.6.

Physio chemical parameters of Loktak Lake:

Physio chemical parameters of a water body play an important role in the primary productivity, it is prerequisite to study the primary productivity of a water body to find out the productivity of a water body. Since Loktak Lake being the most important water body of Manipur. Physio chemical parameter of this lake play an important role in the fish production of the state.

The depth of Loktak Lake varies from 1.5 to 4.5 m. The Lake soil was reported to be clayey in texture (60% clay content) and characterized by high total nitrogen content.

Water temperature: The mean values of surface and bottom layer varied from 14.88°C to 26.55°C.

Water transparency: The mean values fluctuated within the range of 129.00 cm to 198.25 cm.

Dissolved oxygen: (D.O.) Higher values of dissolved oxygen during winter season (Nov. to Feb.) were followed by lower values during summer (March to June) and rainy (July to October) seasons.

Free carbondioxide (FCO₂): Minimum 1.6 ppm at the surface in April while maximum 15.5 ppm at the bottom in September. Bottom water were found to contain more FCO₂ than that of the surface water. It is also observed that high values of FCO₂ record during the rainy season.

Hydrogen ion concentration (pH): The pH values varied between a minimum of 5.0 at the bottom in October to a maximum of 7.6 at the surface during April 1990. The bottom waters showed lower pH values than that of surface water. Summer months exhibited most of the higher values of pH.

Ammonical Nitrogen (NO₃-N): The mean value of NO₃-N varied between 0.048 and 0.302 ppm in the surface water whereas 0.056 & 0.283 ppm in the bottom water. The minimum (0.0028 ppm) and maximum (0.380 ppm) values were recorded in the surface water. The value is found exhibit higher than that of summer & winter seasons.

Inorganic phosphorus/ortho phosphate (PO₄-P): The average values ranges between 0.009 & 0.046 ppm in the surface water & 0.019 & 0.050 ppm in the bottom water. Higher values exhibited during monsoon season than that of summer & winter season.

Total phosphorus (Total P): The average value ranges between 0.085 & 0.178%. The maximum value 0.074% during January and maximum value 0.189% during June. The concentration of organic matter was low during winter season and high during summer and monsoon season.

The dominant forms among phyto planktons were Dinobryon, Trachelomonas, Euglena, Ceratium and Cyclotella and among zooplankton – Biaptomus, Diffugia, Keraletto, Branchious and nauplii larvae. The ichthyofauna of the lake was dominated by

air-breaking fishes, other forms were *Wallago attu*, *Puntius sarana*, *Puntius ticto*, *Cyprinus cario*, Indian Major Carps etc.

FISHES OF MANIPUR:

Commonly available fishes of Manipur with their local names:

Sl.No.	Scientific name	Local name
1.	<i>Wallago attu</i>	Shareng
2.	<i>Bagarius bagarius</i> (Ham)	Ngaren
3.	<i>Clarias batrachus</i> (Limn)	Ngakra
4.	<i>Mystus gulio</i>	ngasheep
5.	<i>Heteropneustes fossilis</i>	Ngachik
6.	<i>Botia hymenophysa</i>	Sarevig Khobi
7.	<i>Labeo gangasia</i> (Ham)	Ngatin
8.	<i>Labeo calbasu</i> (Ham)	Ngathi
9.	<i>Labeo angra</i> (Nam)	Khabak
10.	<i>Osteobrama belangeri</i>	Pengba
11.	<i>Tor tor</i>	Nunga
12.	<i>Notopterus chitala</i> (Ham)	Ngapai
13.	<i>Notopterus notopterus</i>	Kandla
14.	<i>Channa striatus</i> (Bloch)	Ngamu-porom
15.	<i>Channa punctatus</i> (Bloch)	Bogra
16.	<i>Channa marulius</i> (Ham)	Porom
17.	<i>Channa gachua</i>	Meiteingamu
18.	<i>Anabas testudineus</i> (block)	Ukabi
19.	<i>Colisa faciata</i> (chrides)	Ngapema
20.	<i>Monopterus albus</i> (Zuiew)	Ngaprum
21.	<i>Mastacembalus armatus</i> (Laupide)	Ngaril
22.	<i>Esomus dandricus</i> (Ham)	Ngashang
23.	<i>Ambassis nama</i> (Ham)	Ngamhai
24.	<i>Lepidocephalus guntea</i> (Hamilton)	Ngakrijou
25.	<i>Acanthoptthalmus pangia</i>	Nganap
26.	<i>Puntius sophore</i> (Ham)	Nganoi
27.	<i>Puntius sarana</i> (Ham)	Naghau
28.	<i>Puntius ticto</i>	Ngakha

29.	<i>Amblypharyngodon mola</i>	Mukanga
30.	<i>Glossogobius giuris</i> (Ham)	Nylon-nga
31.	<i>Macrobrachium lamerii</i>	Khajing
32.	<i>Catla catla</i>	Bao
33.	<i>Labeo rohita</i>	Rou
34.	<i>Chirbinus mrigala</i>	Mrigal
35.	<i>Cyprinus carpio - communis</i> (Linnaeus) Scale carp	Puklaobi
36.	<i>Cyprinus carpio nudus</i> Bloch Leather carp	”
37.	<i>Cyprinus carpio specularis</i> Mirror carp	”
38.	<i>Hypophthalmichthys molitrix</i>	Silver carp
39.	<i>Ctenopharyngodon idella</i>	Grass carp
40.	<i>Barilius bola</i> (Hamlington)	Ngawa
41.	<i>Osteobrama cotio</i> (Hamilton)	Ngaseksha
42.	<i>Labeo gonius</i> (Hamilton)	Kuri
43.	<i>Noemacheilus sikmaiensis</i>	Ngatup
44.	<i>Ompok bimaculatus</i>	Ngaten
45.	<i>Tilapia mossambica</i>	Tunghanbi
46.	<i>Colisa sota</i>	Phetin

FISHING METHODS:

Fishing method means the manner in which the fishes are captured. Fishing gear is the implement developed for the purpose. The history of fishing began when man had to be content with what food nature could provide. Fishing and hunting can be traced to be of the same origin.

The behavioural studies of fishes lead to the development of fishing methods by opening the gear at the depths where different types of fishes are present. Thus the fishing at bottom, mid water and surface have evolved. For commercial fisheries it became desirable to change from catching single fish to bulk. Fishing gear capable of catching small quantity had to be enlarged and their efficiency improved. This required mechanisation of crafts, designing of more effective gears etc. Thus parallel with the development of fishing techniques, occurred the development and enlargement of fishing craft from the bamboo craft to the factory ship capable of staying at sea for months together and processing the catch on board itself.

The knowledge of fish behaviour in relation to fishing gear has become one of the most important tools of modern gear development. The choice of material has become very important, since it was found that efficiency of a gear could be increased many fold by using suitable material like the synthetic yarn in place of natural fibres. From all these developments, these developed gear which can be used in many ways such as the gill net, set net, surrounding net, dragnet etc. The fishing technology is an integral part of fishery science. Thus studies in fishing gears and methods provide the essential background for proper exploitation of fishery.

FISHING CRAFTS:

Fishing craft is a carrier of floating plate form by which fishermen go to the fishing grounds along with equipment and back along with the catches to the shore.

The classification of fishing crafts is based on various factors such as

- 1) Depth of the water – where the craft has to be operated.
- 2) Based on the material used: such as wooden, fibre glass reinforced plastic or G.R.P. – (Glass reinforced plastic), ferro – cement, steel, aluminium etc.
- 3) Based on construction of hull: such as open, half decked or decked.
- 4) Based on the propelling: such as rowing and sailing, propelled by oars, propelled by sails.
- 5) Based on the work: auxiliary vessels, fishing vessels, factory vessels.
- 6) Based on the fishing gear and method of fishing: gill netters, trawlers, purse sciner, long liners, drifters etc.
- 7) Craft used for training and research.

FISHING CRAFT OF MANIPUR VALLEY:

The fishing crafts found in the valley of Manipur are of small and medium size wooden canoes, either dugout canoes (made from a single log) and plank build (made by

joining planks). During the survey not a single mechanised boat/canoe was found used by fishermen in fishing.

The wooden canoes used in the valley of Manipur are of multipurpose. They are used for fishing and transportation. These canoes are used in lakes, wetlands, reservoirs and rivers of different depths.

The material used for the construction of dugout canoes are large trunks of trees. There are various types of woods locally used for the canoe construction.

- 1) Cham – *Artocarpus chaplasha*
- 2) Tairel – *Cedrella tuna*.
- 3) Teak – *Tectona grandis* – because of its high price it is not commonly used.
- 4) Uningthou – *Phoebe hensiana*.
- 5) Tan – tolhau – *Terminalia myriocarpa*.
- 6) Mango – *Mangifera indica*.

Cham: Commonly known as Harikokthong. The best wood found in Manipur for the construction of fishing craft is said to be the cham as reported by the craftsman and fishermen of Manipur. It has been found that there are two types of cham a) cham tree with small leaf without bearing fruit. b) cham tree with larger leaf and bear fruit.

It is said that cham tree with small leaf and non-bearing of fruit is better than that of cham tree with larger leaf and bear fruit, for the construction of canoe. Both the dugout and plank build canoe are constructed from cham tree. The cham wood does not absorb water much. It is not too heavy or too light. The craftsmen reports that cham growing on the sunny mountain sides is better than that on the shady mountain side.

The other wood such as Tairen, Uningthou, Ton-tolhou, Mango etc. are also used for the construction of fishing canoe both as dugout canoes and plank build canoes. The use of Teak for the construction of fishing canoe is not common, even though very few are constructed. This is because of the high cost of this wood and also less availability.

During the survey, only the open type canoes were recorded. There was no half-decked canoe or decked canoe. This may be because of the small size of the canoes.

The dugout and plank build canoes are propelled either using an oar (locally known as *noi*) or by using bamboo poles. The oars are used where the water column is deep or in open water. The bamboo poles are used in shallow water.

Depending on the size of the canoe the dugout canoes and plank build canoes are of two types commonly known as the *Lukai hee*. This *Lukai hee* is used for the operation of trap fishing (*Lu* – means trap). It is comparatively small in size. It is a round 14ft in length and 1½ft in breadth.

Injing hee: The construction is similar to that of the *lukai hee*. It is also a dugout canoe. The size of this canoe is comparatively bigger than *lukai hee*. It has about 23 ft in length and about 1.8ft in breadth. It is used for the operation of dip-net midwater. Hence the name *injing hee* (*il – chingba* means operation of small dip-net commonly known as *Nupi-il*). The operation of this gear is done by sitting on the specially flattened platform (*Hirubak*) on the stern.

The dugout canoes are made by scooping a timber in the form of a canoe. The aft side (i.e., the front side) is pointed and the stern side (back side) of the canoe is slightly decked (broad and flat at the top). The hull portion of the canoe is the latter “U” shaped having a flat bottom. No sharp keel canoes are found in Manipur Valley.

The plank build canoes are made by joining the planks. The aft and stern portion of the plank build canoe are made separately by joining several pieces of wood. The aft side of the canoe is provided a hole this portion (aft portion) is commonly known as *bi-nao*. The hole at *bi-nao* is used to tie the canoe at the shore when not in use to avoid drifting by wind or current. The stern side is broadened. The stern side is known as the *Hirubak*.

As larger size logs for construction of dugout canoes are becoming less available, nowadays the plank build canoes are also used. The plank build canoes are commonly known as *Kaichan*. The main problem of *kaichan* is the leaking at the joints. Most of the plank build *kaichan* required repairing after 2/3 years in operation.

The thickness of the side wall varies from 1 inch to 1.5 inches, depending on the size of the canoe. The lower portion of the hull plank is thicker than the side plank. If the thickness of the side plank is 1 inch, the hull plank is 1.5 inches thick. Usually the plank build canoes are made with slightly curving hull which makes the canoe easy for oaring,

but too curving makes the canoe difficult to carry goods when loaded. If the hull plank is less in thickness the canoe is unstable in operation.

The below table shows certain characteristics of the dugout and plank built canoes used in Manipur.

(Table - 2)

Dugout Canoes					
Type of wood used	Over all length OAL	Width of the canoe	Depth of the hull portion	Durability of the canoe	Cost of the canoe (Rs.)
Cham	23'4"	1'8"	1.3'	12 to 18 years	9,200/- to 10,800/-
Cham	13'2"	1'3"	1.3'	12 to 18 years	6,250/- to 7,500/-
Cham	20'	1'6"	1.3'	12 to 18 years	8,500/- to 10,000/-
Tairen	20'	1'6"	1.3'	8 to 10 years	7,000/- to 8,500/-
Ton-tolhou	20'	1'6"	1.3'	7 to 9 years	6,500/- to 7,000/-
Mango	20'	1'6"	1.3'	7 to 8 years	6,000/- to 6,500/-

(Table - 3)

Plank build Canoes					
Type of wood used	Over all length OAL	Width of the canoe	Depth of the hull portion	Durability of the canoe	Cost of the canoe (Rs.)
Cham	20'	1'6"	1.2'	3 to 5 years	5,000/- to 6,000/-
Cham	13'2"	1'3"	1.2'	3 to 5 years	3,500/- to 3,800/-
Tairen	13'2"	1'3"	1.2'	2½ to 3½ years	3,000/- to 3,200/-
Others	13'2"	1'3"	1.2'	2 to 3 years	2,700/- to 3,000/-

Cham build dugout canoes are highly demanded by the fishermen, but the unavailability of comparatively large size log is the main problem for the construction of dugout canoes. When we visited two canoe building yard one at Moirang and another at Moirang Sendra Road. The Moirang canoe building yard was found without any activity.

The yard at Moirang Sendra Road is the lone manufacturing in a makeshift workshop. The order includes from different parts of Manipur including orders from places like Thoubal, Kakching, Sugnu etc. Interestingly enough, no dugout design was seen in the yards. They were waiting for the logs to arrive. These logs come from the Myanmar border of Chandel district and Churachandpur – Mizoram border.

The canoe manufactured here are not treated with any paints even in some cases the outer portion is not fully polished.

When discussed, if there can be a change of material for the construction of canoe by fibre glass or any other suitable materials, the craftsmen were found totally unaware of any materials other than wood.

The construction of dugout canoes its utilisation for fishing activities is an age old practice in Manipur. There is no change in the shape or design of the canoes. No other materials has ever been tried for substitution to wood.

Not a single mechanised fishing canoe operates in Manipur. The fishermen have not visualised this. Many fishermen go to the far fishing grounds covering a distance of 4/5 Km in their canoes for fishing. So there is a scope for introducing the OBM - fitted canoes/boats in the waters of Manipur. This may require design modification of the existing canoes.

FISHING GEARS:

In the evolution of the fish catching methods. The development of fishing gear is an important concern. The term “fishing gear” as it has come to be used, refers to all those implements and devices that are used for quite diverse methods of fishing around the world, which employ gears ranging from simple hook and line to the modern fish pumps. Thus a great variety of gears are used in fishing differing very much in size, construction material, method of operation area of operation and type of fish to be caught.

The introduction of synthetic fibre having more strength, firmness, durability etc. was an important milestone in the history of development of gears. The synthetic fibre introduced in the country and available for fishing are Polyamide (PA), Polyethylene (PE) and Polypropylene (PP). The gill netting was most benefited with synthetic fibres. The

essential requirements like firmness, liability, elasticity, durability and invisibility in water are met with.

Further, the development of fish attracting methods such as light attraction, fishing gear successories such as floats, sinkers, lines, ropes etc. are the important aspects for the development of fishing gears.

CLASSIFICATION OF FISHING GEARS:

According to Dr. Andres Von Brandt the fishing gears are classified into 16 classes:
Fishing without gears:

- a) Grasping by hand.
- b) By diving.
- c) With hunting animals

2) Grappling and wounding gear:

- a) Hand instruments
 - i) Clamps ii) Tongs iii) Raking devices.
- b) Sharp projectiles:
 - i) Spears ii) Fish plumonets iii) Fish combs iv) Bows and arrows
 - v) Harpoonsvi) Cross bow vii) Blowpipes viii) Rifles.

3) Stupefying devices:

- a) Mechanical Stupefying:
 - i) Striking gear (clubs, mall etc.) ii) Explosives.
- b) Chemical Stupefying
 - i) Xhthyo toxic plants ii) Animal poisons
- c) Deoxygenation
- d) Electrical Stupefying.

4) Lines:

- a) Without hook
- b) With gorges
 - i) hand line ii) set line iii) drift lines iv) trawl lines
- c) With rip hooks:
 - i) Pole hooks ii) Fish narrows iii) Squid jigs iv) Rip lines

5) Traps:

- a) Handling places
 - i) Bust traps and cel tubes
 - ii) Octopus pots
 - iii) other hiding places.
- b) Barriers
- c) Mechanical traps
- d) Tubular traps
- e) Baskets
- f) Trap nets

6) Arial Traps:

- a) Box raft
- b) Canoe traps
- c) Varandah nets.

7) Bag nets:

- a) Scoop net
- b) Scraps nets
- c) Gap nets
- d) Gap nets with wings

8) Dragged gear:

- a) Dredger
- b) Deep net
- c) Bottom trawls
- d) Mid-water trawls

9) Seine net:

- a) Double stick net
- b) Beach Seine
- c) Canoe seines

10) Surrounding nets:

- a) Lampara nets
- b) Purse seines
- c) Ring net

11) Drive-in nets:

12) Lift nets:

- a) Hand lift nets
- b) Mechanical lift nets
- c) Blanket nets
- d) Fish wheels

13) Falling gear:

- a) Cover pots
- b) Cast nets.

14) Gill nets:

- a) Set gill nets
- b) Drift gill nets
- c) Encircling gill nets.

15) Tangle nets:

- a) Single walled entangling nets
- b) Double walled entangling nets.
- c) Trammel nets

16) Harvesting machines:

- a) Fish pumps
- b) Conveyer belts.

FISHING GEARS OF MANIPUR:

The fishermen in Manipur use wide varieties of fishing gears. The gears include gill net, cast net, dip net, dragged net, surrounding net, lift net, traps hook and lines, wounding gears, even explosives, fish poisoning (both from plant derivatives and chemical poison) etc. are some of the fishing gears and fishing methods used by the fisherman in Manipur.

(A) Gill net:

These are single walled nets with a mesh opening of such a size that the required fish can gill themselves in the netting. This is a passive gear, but fish can also be driven into the gill nets. The nets are used singly or in series. This is the most widely used fishing gear. They are vertical walls of netting normally set out in a straight line. Floats and sinkers are attached plastic ropes are used as head ropes and foot ropes.

There are various mesh size of gill net used commencing from number 0 to 120 mm. Very few extra large mesh size are also found used in the fishing operation by the fisherman of Manipur. This extra large mesh size is made by the fisherman to suit their requirements.

The gill nets are directly purchase from the market or purchase as twine and making of net is done at home. The other materials such as footrope, head rope, float, sinker etc. are also purchased from the market.

Net No. 0: The name indicates this is the smallest mesh size gill net. Hence, it is known as 0 number. They are used to catch the smallest fish.

Muka-nga lang: Net No. 20: Even though Net No. 0 is come under the gill net the most commonly used gill net for catching smaller size fish is the No. 20. One handful of net is commonly known as One Utong. It is around 180 metres in length and 4ft in depth and it cost about Rs. 400/- to 450/-. It fluctuates from time to time. Generally one utong of net make two or even 3 gill nets according to the convenience by the fisherman. If operate in the lake long net can be used where as used in swampy area, river, one utong of netting can make 3 nets of gill net. The fixing of the gill net with float line float, foot rope and sinkers are done independently by the fisherman or by the experts, cost around Rs. 70/- to 100/- per net depending on the size of the net. The main sinkers used are made of ignited clay with a hole at the centre to pass the food rope. These sinkers are elongated in

shape. The floats mainly used are the rubber plastic. These rubber plastic are found in market in roles and cost about Rs. 20/- per square feet, old unused slipper are also used as float after cutting into small rectangular pieces.

The catch by this net is of smaller size fish such as *Esomus danricus* (Ngasang), *Amblypharyngodon mola* (Mukanga) etc. Fishing is mainly done in the lakes throughout the year.

Net No. 25 (Phabou lang): The number 25 net is commonly known as *Phabou lang*, because the main species caught by these nets are of *Puntius spp* (*Puntius chola* - Phabounga). The other important fish caught in Manipur by these nets are the *Notopterus notopterus* and other similar size fishes. This net operates throughout the year in the lakes of Manipur. Few *Glossogobius giuris* and *Amblypharyngodon mola*. are also caught.

Net No. 35 (Ukabi lang): The net No. 35 is commonly known as *Ukabi lang*. The main species of fishes caught by this net is *Anabas testudineus* (climbing perch). The other fish species caught by these gears are *N. notopterus*, *Mystus spp.*, *Clarius batrachus*, *Chana spp.* etc. The peak season of this gear is June to October (rainy season) even though used throughout the year in lake fisheries. The net No. 40 is also commonly known as *Ukabi lang*.

Net No. 50-60: This type of gill net having mesh size is used for the capture of *Notopterus notopterus*, *Labeo dero* (Khabak), *Labeo angra* (Ngaton). Commonly known as *Khabak lang*. These nets are extensively used in lakes and reservoirs with good catch. Fishing is done throughout the year.

Net No. 70 to 90: This mesh size gill net is commonly known as “Porong (*Chana spp.*) lang”. This net is operated in lakes as well as in riverine. The other species caught are the *Accrossocheilus hexagonolepis* (Ngara) etc.

Net No. 100 to 120: This net is commonly known as the “Langjao”. They are operated in the deep waters of rivers, lakes, reservoirs etc. Catch comparatively larger size fish such as *Wallgo attu* (Sareng), *Crossocheilus burmanicus* (Ngaroi), *Bagarius bagarius* (Ngarel), *Anguilla bengalensis* (Ngarin leina), *Cyprinus carpio*, *Catla catla*, *Labeo rohita* (Rohu), *Hypothalmetrix molitrix* (Silver carp) etc. Because of the different in mesh size of the gill net float and sinkers used are also different. For Net No. 100 to 120 the float used are of

bamboo tubes closed at both the ends the sinkers used are stones which are fitted in a longitudinal bag at the foot rope. this gear is a common gill net in riverine fishing.

The No. 100 to 120 net of about 100 metres in length 10ft in depth cost around Rs. 1,000/- to Rs. 1,300/- including the foot rope, head rope, float sinkers, i.e., as readymade net.

The larger mesh size gill nets are mainly operated to the river. If operate to the river the net are set by fixing one end to the shore and the other end is also fixed after setting the net through an angle according to the intensity of the current and nature of the water depth. These nets are made at home by the fisherman by using gauge and needle. The longitivity of the gear is around 3 to 4 years.

DATA SHEET FOR GEAR: GILL NET (Table - 4)

Sl. No.	Type of gear	Length	Width	Mesh size	Material used	Longevity of the gear	Mode of operation	Cost (Rs.)	Type of craft used	Fish Species Code
1)	Gill net	60 metres	4ft	20 mm	Polyamide (PA)	3 to 4 years	Released from the Canoe	350 to 450	Dugout canoes & Plank build canoe	<i>Esomus denricus</i>
2)	Gill net	90 metres	4 ft	25 mm	Polyamide (PA)	3 to 4 years	Released from the Canoe	480 to 550	Dugout canoes & Plank build canoe	Mainly <i>Punctius spp.</i> & other similar sized fishes.
3)	Gill net	60 metres	4ft	35 mm	Polyamide (PA)	3 to 4 years	Released from the Canoe	380 to 400	Dugout canoes & Plank build canoe	<i>Anabas testudeniis</i> , <i>N. notopterus</i>
4)	Gill net	60 to 90 metres	5ft	50 to 60 mm	Nylon	3 to 4 years	Released from the Canoe	380 to 550	Dugout canoes & Plank build canoe	<i>N. notopterus</i> , <i>C. carpio</i> , <i>L. dero</i> , <i>L. angra</i> .
5)	Gill net	60 metres	7 to 8 ft	70 to 90 mm	Nylon	2 to 3 years	Released from the Canoe	700 to 900	Dugout canoes & Plank build canoe	<i>Wallago attu</i> , <i>C. carpio</i> , <i>L. robita</i> , <i>H. molitrix</i> , <i>Botia dero</i> .
6)	Gill net	60 metres	8 to 10 ft	100 to 120 mm	Nylon	2 to 3 years	Released from the Canoe	1000 to 1300	Dugout canoes & Plank build canoe	<i>Wallago attu</i> , <i>C. carpio</i> , <i>L. robita</i> , <i>H. molitrix</i> , <i>Botia dero</i> .

(B) Cast Net:

These nets are commonly known as “Nupa-il”. These are conical shape nets. The lower edge is provided with footrope attaching a series of sinkers to it. This is a falling gear, here the fishing is done by direct quick movement of the gear to cover the fish. It is mainly operate in shallow water. There are two types of cast net

- i) **“Nupa-il” (Shangbran):** it is a small size cast net operation is done by a single person the fisherman twist the body and hand through the net over the fish shoal when expected. Due to the sinker provided the gear sinks quickly in the form of an umbrella thus cover the fish. This gear is one of the common gears used in Manipur.
- ii) **“Inphul”:** The bigger size cast net is commonly known as “Inphul”. The operation of this gear is done by dragging 2 or 3 persons required for the operation. Half of the net is drawn at the bottom of the fishing ground the upper portion of the net is hold by hand after a short distance the upper portion is lowered again. The hauling of the gear is done by pulling the string provided at the cone end.

The catch is a mixed species. The smaller size cost around Rs. 250/- to Rs. 350/-. The larger size Inphul cost around Rs. 1100/- to Rs. 1250/- depending on the size.

(C) Dip net: (Lift net):

Here the net is rectangular in shape. The net is dip after an interval and again lift. The fishes come voluntarily sometimes some bait such as rice bran are broadcast over the net to attract the fish.

Depending on the size & mode of operation they are of two types:

- i) **Nupi-il:**

Two bamboo frames are tied at the middle by a rope thus divided into 4 tips. The nets are fixed at these 4 tips forming the structure as cross mark “X”. A bamboo pole is fixed at the middle of the cross, this will act as lever to lift the net. This bamboo pole is commonly known as Poura. In some cases one rope is attached to this pole to lift the net. The lift net (Nupi-il) operated in the Loktak Lake & its surrounding peripheral area is of ropeless lift net. This gear is one of the commonly used in Manipur by the fisher-

women hence the name “Nupi-il”. In the ropeless nupi-il the pouira (bamboo pole) is inserted between the thighs and pressing it drawn, thus the net is lift.

The catch by this gear is a mixed species.

ii) **Injao:**

The larger size of lift net is called “Injao”. In this, the rectangular net is made by joining 9 pieces of net. There are bamboo structure fitted at four corners in which the net is tightened. If operation is done in open water-craft is used to lift the net as an operating place or a floating weed mass commonly known as “phum” is used as platform. The lowering or setting of the net is done by lowering the rope provided at one side, the lifting of the net is done by pulling the two ropes at one end.

This type of Injao operation is done only in the lakes. The catches are of mixed species. It is operated throughout the year. The peak period is from September to March. It costs around Rs. 1200/- to Rs. 1350/-.

iii) **Lang-il:**

This is a peculiar type of lift net seen in the Kongba river near the Kongba Irong. The difference of this net from that of the small dip net (nupi-il) is that in the case of lang-il a bamboo structure is provided as a working place. A bamboo rack is installed at the riverbank with the help of bamboo. The size of the net is also comparatively larger having a rectangular shape of 15ft in length and 13ft in width. The net used is the No. 25mm net. the lifting and lowering of the net is done by pulling and releasing the rope fixed to a bamboo pole which in turn fixed to the cross “X” shaped bamboo split structure where the net is fitted. The operation is done at the platform provided at the bamboo rack.

The net alone costs around Rs. 1300/- to Rs. 2000/-. For a new installation of such structure and net cost around Rs. 3000/- to 3500/-.

The species caught by this net are of larger size fishes. In this particular area the operation of this nets are done when the Imphal river water flow into the Kongba river. The Kongba Irong is a place where the Kongba River meets the Imphal River. The main season is during the month of June to September.

The main species caught are *Wallago attu*, *Osteobrama belangeri*, *Labeo dero* (Khabak), *Labeo angra*, (Ngaton), Common carp, *Labeo rohita*, *Heteropneustes molitrix*, Indian major carps, *Anguilla bengalensis* (Ngarin leina) etc.

A rope is fixed at one side of the cross bamboo structure and the other end of the rope is tight to a bamboo pole fixed at the riverbank, this is to avoid the drifting of this gear by the water flow. This is a peculiar type of dip net we have come across during our survey at Imphal district.

(d) Trap:

These are implements in which the fish enters voluntarily but it hampered from coming out. Mostly in these traps a retarding device like gorges or funnels is provided to avoid the coming out of the fish.

The following are some of the traps used in Manipur:

1) **Taijep:**

This trap is rectangular in shape all the six sides of the structure is surrounded by bamboo netting. An entrance is provided at the middle of one side of the longitudinal portion where the fish to enter, but prevent to escape by fixing a comb like bamboo strips which are fitted at a rubber string which is of flexible commonly known as funnel. Once the fish is entered it is trapped inside.

The material used for the construction of this gear is bamboo strips of small and finger size; this is tight by a synthetic yarn. The size of the taijep varies from 3.6ft in length and 1.8ft in breadth. Having the funnel mouth of 5 inches and depth of 8 inches. It costs about Rs. 400/- to Rs. 600/-. The longevity of the trap is around 5/6 years. this traps are set longitudinally by tightening to a floating weeds or by submerging 3/4 portion to the gapes found at floating weeds. They are also operated in shallow water near the shore of channels, paddy fields etc. either singly or even in series.

The main species caught by this gear include *Notopterus notopterus*, *Chana sp.*, *Anabas testudeneous*, *clarias batrachus*, Common carp etc. The gear is used throughout the year

2) **Tekhao-lu:**

The gear is a tubular shape tapering at the end, made by the bamboo splits. A round valve with inwardly projected pointed bamboo sticks is fixed at the mouth of the trap so as to prevent the escapement of fishes commonly known as “sou”.

There are various sizes of takhou-lu. The one, we came across among these types, is the largest one measure 10ft in length, having mouth opening of 3ft 10 inches in diameter. The funnel depth is around 3ft 8 inches. Commonly known as “sou”. In this 10ft log trap there are 23 rings about ½ ft intervals. Bamboo strips are fixed to these bamboo rings at a gap of one inch, which is less at the cod end. These bamboo rings and strips are tight together by the nylon yarns. The life span is around 7 to 10 years. It costs around Rs. 800/- to 950/- per trap.

The season of operation is from June to December. They are operated only in the running water. Some arrangement are, required for the operation of this gear. One bamboo pole or wooden pole is fixed at the bottom of the riverbed at the depth where the gear is to be lower, with the help of one rope the cod end is tight. Two another rope is also tight to the gear near the mouth opening. After lowering the gear at required depth this two ropes are fixed to the shore pole to keep the gear in position. The gear mouth is keep along the direction of the river flow. The fish come up against the current (i.e., migratory fishes) are trap inside. This trap (Takhou lu) is suppose to be the largest trap operates in Manipur. The most common problem of this trap is storage when it is unused because of its larger in size.

We have seen the operation of this trap at the Wangoo river, the Iril River, the Imphal River system etc.

The main species caught by these traps are *Cyprinus carpio*, *Cirrhinus mrigala*, *Wallago attu*, *Anguilla bengalensis*, *Labeo angra*, *H. molitrix* etc. are the some of the species caught by this gear.

iv) **Kao**

This gear is a peculiar indigenous trap used in the river system. It is rectangular in shape having a length of 5ft and height of 2.5ft, breadth of about 3ft at the mouth region. This gear is made by interweaving of bamboo splits with spaces sufficiently to pass the water. One end of the bamboo netting is fold lengthwise in the middle to join

into a single vertical line whereas the other end is left freely open. Bamboo frames are provided all around its mouth.

The setting of the gear is done along with the current. Two bamboo poles are fixed in which the trap is kept intake to avoid drawing by the river current. In some cases the mouth is kept opposite to the current. Green branches of trees and bamboo are placed inside the trap. It acts as shelter/hiding place for the fishes. The upper portion of the trap is fully open. Sometimes rice bran or some bait is kept inside to attract the fish. It is usually lifted after an interval of 4 to 5 hours. The main species of fish caught by this gear are the bottom dwelling fishes commonly *Mystus sp.*, *Clarius batrachus*, *Chana sp.*, *H. fossilis*, and river shrimps. The main season is from June to January. One trap costs around Rs. 70/- to 80/-

(e) Line fishing:

The principle of line fishing is to offer bait to attract the fish to bite it. Once the fishes are hooked it prevents the escape of fish. Bait is an important factor in line fishing. The function of the bait is to attract fish to swallow the hook. The lines are of handline set line, pole and line fishing.

Basically the line fishing consists of a line and a hook tied to a rod, but it may have 50 to 100 hooks fastened to a long line. Commonly known as “khoishang”. The size of the hook is indicated by a numbering system. The higher the number the size is lower. The common numbers are from 4 to 20. A fishhook is a metallic piece with following parts, eye, shank, bend and the spear. The spear end has an inclined barb with two points, outer and inner.

The efficiency of the fishing with hook and line depends upon several other factors such as (i) changes in feeding behaviour of fish (diurnal or seasonal), (ii) abundance of natural food in the water, (iii) density of fish in the water, (iv) setting pattern of the long line.

1. Pole and line fishing:

It is one of the popular techniques of fishing seen in Manipur, operated in almost all the water bodies such as lake, river, reservoir, irrigation channels, pond etc. The gear consists of a pole measuring about 60 to 65 cm. A nylon thread of about the same length with a hook at other end is tied to the tip of the pole. The common hook numbers used are of

No. 15 to 17. Bait is inserted to the hook and lowered to the water. The main species caught by this gear are the *Chana sp.*, *Clarias batrachus*, *Mystus gulio* - (Ngasep) etc. Fishing is done throughout the year.

2. Longline fishing:

Longlines may be set stationary or towed through water or left drifting. They are bottom set with the help of weights, or left drifting with the help of floats.

This is commonly known as “*kboishang thakpa*”. It is mainly operate in lakes. It consists of a main line and a branch line the main line is a nylon twine the length can be of any length according to the convenience generally 150 to 250 metres are common. The branch line is fixed to this main line at an interval of 2 to 2.5 metres. The hooks are tight to this branch line by proper knot. The branch line is having a length of about 1 to 1.5ft. The hook at the branch line is provided with bait. The commonly used bait are small shrimps and small fishes. Float, sinkers are not used in this gear. The branch line touched to the ground in some cases. The main line is tied to the available weeds or fixed poles at several points.

This gear operates in the lakes. One or two fishermen operate the line. If operation is done by two fishermen, one fisherman oars the canoe the another fisherman releases the line and tight at particular intervals to the pole or weeds. The main season is September to December. The main species caught by this hook is similar to that of pole and line.

According to the size of the hooks the price varies. The No. 4 to 7 is commonly used for the larger size fish. One hook of No. 7 costs around Rs. 9/- to 10/-. this hooks are commonly used in the riverine fisheries.

The common fishes caught by this hooks are Ngarins, *Aguilla bengalensis*, *Mastacembolus armatus* (Ngaril), *Wallago attu*, *Bagarius bagarius* (Ngaren), *Botia dero* (Shareng khoibi) etc.

The difference in operation of long line in lake fishing to that of riverine fishing is that, in riverine fishing the line is lower at the bottom of the river in some cases weight are also fitted to this line. No float is used. The main line is tight to a bamboo pole at the shore to avoid missing of this line.

(f) Scoop net:

Here the net is fixed to a frame, it can be of fully fixing or fixed when required. The mesh size of the net varies according to the type of fishes expected to be caught. Here the net move with the help of manpower, it can be operated in almost all the water body. Usually a handle is provided to hold the net in proper shape by the fisherman. There are small scoop net without any handle, they are mainly operated at the shallow water only. The most commonly used scoop nets are:

i) Longthrai: This gear is operated either from shore or from a canoe. this gear consists of an elliptical shape bamboo ring, which is fixed to a bamboo pole. The circumference of the ring is around 17ft. The netting is fixed to this elliptical bamboo ring. The shape of the netting is cone shaped tapering at the bottom. The most commonly used mesh size of this gear is the number 20 net. Few large size meshes are also found in used for catching large fish. The bamboo handle is around 10 to 12ft long. The net material used is of polyamide (P.A.).

The gear is used almost throughout the year at different depth and different water bodies. The cost of this gear is around Rs. 300 to 350/-. The main species caught are *Punctius chola* - (Phounga), *Chana sp.*, *Cyprinus carpio*, *Notopterus notopterus*. The catch is a mixed species.

ii) Long: In a bamboo ring of diameter around 2ft, the bamboo-split netting in the form of a half-elliptical shape is fitted. the mesh size is quite small just as to filtered the water. This operates only in the shallow water, mainly small channel paddy field and near the shallow water of river. this gear is one of the indigenous gears used in Manipur and operated by females. The cost of the gear is Rs. 60/- to 80/-. Caught small fishes, shrimps etc.

iii) Mu (Mu-namba): This is one of the indigenous gear used by fishermen in the riverine fisheries. Commonly used at the Imphal river system, mainly operate at Wangoo region.

The gear consists of two bamboo poles used as handle and fixed the net on it at the tip ends. The bamboo poles have a length of 15 to 17ft in which a bag net is fitted. The mouth portion is fitted to this bamboo poles. The length of the net is around 12.5 to 13ft in length. Depth of the net is around 8.5 to 9ft. the mesh size is 4 inches made by the

synthetic twine. These nets are made by the fisherman himself at home, it takes around 12 to 15 days. The cost of the net is around Rs. 700/- to 850/-.

The net is operated in the running water only to catch the migratory fishes. The net is operated by two fisherman, one fisherman operates the net by dipping the net completely in the water by opening the net mouth with the help of the bamboo poles. The opening of the mouth is along with the current, whereas the other man rows the canoe. Migrating fishes that ascend against the current for breeding or in search of food are entangled in the netting. As the fisherman feels the entanglement of the fish, he clips the net mouth, lift it up and take out the fish. The main season of this gear is the June to August and November to February.

The main species caught by this net are I.M.C. (Indian Major Carps), *Labeo angra* (Ngaton), *Botia dero*, *Labeo dero* (Khabak), *Bagarius bagarius* (Ngaren), *Wallago attu* and other fishes that are of migratory habit.

(g) Dragged net:

This group contains all nets, begs or netwalls which are towed through the water on or near the bottom. The manner of capturing is filtering the passive prey by the active moving gear. The net is sometimes made by stitching many pieces and provided with floats and sinkers fastened to the head and foot ropes, according to the depth of the water body and area to be covered the size of the net is made, this may be of a temporary stitch depending on the size i.e., the depth and the length, suitable float and sinkers are fitted. According to the size of the fish expected to be caught the mesh size of the net is selected.

The smallest mesh size net no. zero are found used by the fish farmer for harvesting fish from the stocking pond. Small dragged net of zero mesh size are also used by the farmers for the harvesting of fingerling fishes from rearing pond for releasing to the stocking pond or for marketing as fish seed.

(h) Surrounding net:

The mode of capture is done by surrounding not only from the side but also from the beneath, thus permitting the capture of fish over very deep waters by preventing their escape into the depths.

In some cases the surrounding nets are used to keep the fish to a particular fishing ground a good example of such type of net is the net used for the operation of “phum namba”. The net used for this particular method of fishing operation is of the smallest mesh size the depth and length of the net is vary according to the size of the “phum” (floating mass of weed). In this case the fishes are kept surrounded by nets, thus prevent from escaping. Here these nets are not used for capturing the fish.

(i) **Fishing without gear:**

This is the simplest method of catching fish without any gear. It needs experience, skill and good knowledge of the natural habit. The most common and simplest method is of commonly known as “Khut humba”. this fishing method is mainly concentrate in the shallow water. The main species caught by this methods are *Chana sp.*, *Clarias batrachus*, *Anabas testudineus*, *Monopterus albus* (fresh water eel). this method of fish catching is done during the dry season.

(j) **Wounding gear:**

These are implements, which had been used since pre-historic time.

Long (Spear): The implement locally known as “long” is of wide used. It has 7 to 9 prongs made out of splitting of bamboo provided with iron points at the tips of around 2 inches in length. This prongs are tight to a bamboo pole of 8 to 10ft long.

Yotchei long: The difference from that of common long is that here the prongs are made by iron rods.

These gears are used in all the water bodies including lakes, rivers, reservoir etc. They usually caught the larger size fish. The gear is widely used for the catch of fresh water eel. *Monopterus albus*. this can be operated from the shore or from a canoe.

Phum namba:

This type of fishing is only seen at Loktak Lake. It is one of the indigenous type of fishing method. (Phum – floating mass of weeds). The whole process required quite long time by a team of fisherman.

Phum thaba: The floating mass of weeds commonly known as the phum are cut from the wild mass. These pieces of phum are transplanted in a circular form in s suitable

water surface at the lake, which serves as shelter for a wide varieties of fishes. This phum is fixed with the help of a bamboo stakes in a circular form. The total length of the phum vary ranging from 500 to 600fts. The width of the phum is around 10ft. After setting this floating mass in circular shape fishes are allow to take shelter, in most cases to attract the fishes rice bran are spread inside this circle. After keeping this for a few days or in months. According to the assumption by the expert fisherman of expecting good gathering of fishes. They are ready to fish out.

Phum namba: Here from the inner side of the ring the net is release to encircle the area weight are provided at the footrope. The upper portion of the net is fixed at the floating mass. The purpose of this is to prevent the fish to escape. Now from the inner side as well as from the outer side are totally block by this net. This net is of very small mesh size in olden days tarpaulin were used. Thus enclosed water area is stirred from the bottom with the help of bamboo poles by a group of fishermen (15 to 20). This process is commonly known as “leihotpa”. This cause the turbid to the body and thus suffocate the fishes, thus the fishes come up to the surface water. During this time the fishes are caught by using a scoop net. (Longthrai). Nowadays after encircling the net another net is again released provided with foot rope and head rope. In this case the 2nd net used as scoop net.

There are two main season for this fisheries. September to October again at February to March.

The catches are of mixed species.

Notopterus notopterus, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Amblypharyngodon mola*, *Cirrhinus mrigala*, *Puntius sp.* *Chana sp.*, *Labio rohita*, *Clarias batrachus*, *Ctenopharyngodon idella*, etc.

The whole operation required around 20 fishermen, two canoes, took around 6 to 8 hours

HILL STREAM FISHERIES:

The hill districts of Manipur include Churachandpur, Chandel, Ukhrul, Tamenglong and Senapati. The important river flowing in these districts includes the Imphal River

system, the Thoubal River system, the Chakpi River system, the Khuga River system, the Barak River system and small tributaries of these rivers.

The peculiar of these river systems are the strong current, rocky nature of the river bed in the rainy season highly turbid water because of the soil erosion due to deforestation in the high range for *jhum* farming, timber business, jungle firing for the cultivation of vegetable and fruits. These are some of the important feature of the hill streams of Manipur.

FISHING ACTIVITIES:

The main important fishing activities carried out in the hill streams of Manipur includes:

- i. Trap fishery.
- ii. Fishing by using explosives.
- iii. Fishing by using certain xhthyo toxic materials
(Plant origin fish poison)
- iv. Fishing by using nets.
- v. Fishing by using hooks and lines.
- vi. Fishing by using bow and arrows.
- vii. Fishing without gear etc.

These are some of the important gears and fishing technique used by the fishermen in the hill streams of Manipur.

TRAP FISHERIES IN THE HILL STREAMS:

Though there are various types of trap used both in the valley and hill streams of Manipur. The method of operation, season of operation are slightly different, this is because of different in topographical nature prevailing in the hills and valley. Unlike in the Valley the trap fisheries in the hill streams are mainly done by constructing a temporary dam along the cross-section of the river. The construction of such dam is a team work by a group of fishermen by using locally available wood, bamboo, stones, mud and tree branches etc. In some cases this dams are constructed in such a way that the water are allowed to pass through but prevent the passing of fishes. Space are provided to this dam for fishing the trap, usually a series of traps are operated in a single dam.

The main season of trap fisheries in the hill streams is during the dry season (September to February). During this period the water level is comparatively low, crystal clear water, low water temperature, high dissolved oxygen content are some of the physico-chemical factors influencing the fishing activities of the hill streams fisheries.

Kabo-lu and Lushut are the two important traps used in the fishing operation in the hill streams.

KABO-LU:

The name itself indicate this trap are originated from Burma, now known as Myanmar. It is an oval shape trap made by the small bamboo splits. There are various sizes ranging from two to four (2 to 4 ft) feet in length having a middle diameter half to one foot ($\frac{1}{2}$ to 1 ft) or even more according to the requirement. The one end of the trap provides a neck with a mouth from which catches can be taken out. The diameter of the mouth vary according to the size of the trap ranging from 2 to 4 inches. A funnel is provided near the middle portion with certain pointed bamboo splits. According to the ascending and descending behaviour of the fishes. These traps are fitted to the bund. The cost of the trap vary according to the size ranging from Rs. 80 – 200/-

LUSHAT (SORALU):

This gear is very much similar to that of the Tekhoulu, having a tubular shape made by the bamboo splits, but without a funnel unlike in the Tekhoulu. The size of the trap is varying according to the requirement. The length of the gear is around 5 to 6 ft. Having a mouth diameter of one to one & half feet (1 to $1\frac{1}{2}$ ft). The cost of the trap ranges from Rs. 150 to 250/- according to the size. In the hill stream these traps are fitted to a hollow tube made from the wooden log which is fitted along the cross-section of the bund. One end of this wooden tube is kept against the current through which the fishes are allowed to pass through, since there is no other place to pass, thus guided to the trap. On the other side of the wooden tube the trap is fitted, the diameter of the wooden tube and the diameter of the trap is constructed in such a way that the mouth of the trap can be inserted without much gap so as to prevent the escaping of fishes. These traps are tight with the help of ropes to the wooden poles of the bund. In such a way a series of traps are fitted to the bund. After an interval of 1 to 2 hours or even more according to the expectation of the catch, these traps are remove and upside down for removing the catches. These traps are kept submerged in the water. The mouth opening of the trap is

kept against the water current. The intensity of the water flow increase because of the bund where the traps are fitted. The fishes so screened cannot swim back against the strong current thus they are caught/trapped.

In some cases a separate platform wing are made by the interweaving of bamboo splits or locally available similar materials with space sufficiently to pass the water. It has a flat bottom slightly curve at both the sides and taper at the end having the shape of latter “V” with a hollow end through which the gear is fitted. The platform is tight to the bund by using sticks, stones are kept inside the platform so as to avoid drifting away by the current. The lushut (gear) is fitted at the tapering end of the platform by using ropes. The mouth of the gear is kept opposite to the water flow. In some cases the gear is fitted to the bund by a special structure erected by using bamboo or wooden poles.

FISHING BY USING EXPLOSIVES AND POISONING:

The use of explosives and poison to catch fishes are quite common and practising for the last many years in the hill stream of Manipur. Even though explosive and poison are used in the valley, the numbers are comparatively quite less compared to the hill stream. Though there are legislation (Manipur Fisheries Regulation Act, 1998) implemented by the State Government; it is very less effective. This may be because of various reasons prevailing in the hill district of Manipur.

Moreover, in the hill stream most of the fishing ground are uneven rocky bottom which are not suitable for the operation of any types of nets, generally the fishing ground are faraway with up and down roads, the fishermen has to walk for 2 to 3 hours to reach for a suitable fishing ground in this circumstances the fishermen are reluctant to carry their fishing accessories. Because of this constraint, the fishermen are part time fishermen. In many cases, fishing and hunting are carried out simultaneously. These are some of the reasons why fishermen used explosives and poison for catching the fishes. Explosives are purchase from the market when they required, they modified the explosives according to the requirement, otherwise this explosive are mainly for other purposes like hunting. Only few experts are operating the explosives other fishermen are just to collect the fishes after the explosion, fishes are killed by damaging their inner ear by the explosion or by making

them semi-conscious. Fishermen used their hand or small scoop net to collect the killed fishes.

FISHING BY POISONING:

There are two types of fish poison used for fishing: i) chemical poison, ii) Xhthyo toxic plants. The chemical poison includes the bleaching powder, Endrin ($C_{12}H_8Cl_6O$) etc. Poison from the plant derivatives (Xhthyo toxic plants) are widely used in the hill stream fisheries. In general, this type of fishing activities is known as *Yaithaba*.

A Xhthyo toxic plant locally called Zetle by the Anal people is widely used for fish poisoning. The poison is used to capture the fishes from the open water by applying directly to the stream. In many cases a temporary dam is constructed by using locally available materials rocks and tree branches. In the shallow marginal area of the stream where the flow of water is quite less. In some cases this area are kept undisturbed for one or two days or even more by providing a mouth to this temporary dam connected to the stream so as to allowed many fishes to enter this area. The expert fishermen watch the availability of fishes. When they satisfied the dam mouth is closed by using stone, mud and tree branches. Thus encircled water body is applied with locally available fish poison. The fishes on contact with the poison become restless and upset where by getting upward agitated. The fishermen used to beat the fishes with sticks or scoop by using a small scoop net (Longthrai) or grasping by hand.

Even though there are legislation to avoid such fishing activities, it is carried out for the last many years by the local fishermen. No matter the type of species and sizes this method caught all size and species available in this encircled area.

FISHING BY USING WOUNDING GEARS:

This is one among the most primitive type of fishing activities carried out by the fishermen. The common examples are the harpoons, blow pipes, rifles, spears, bow and arrows etc.

FISHING BY USING SHOOTING PIPE:

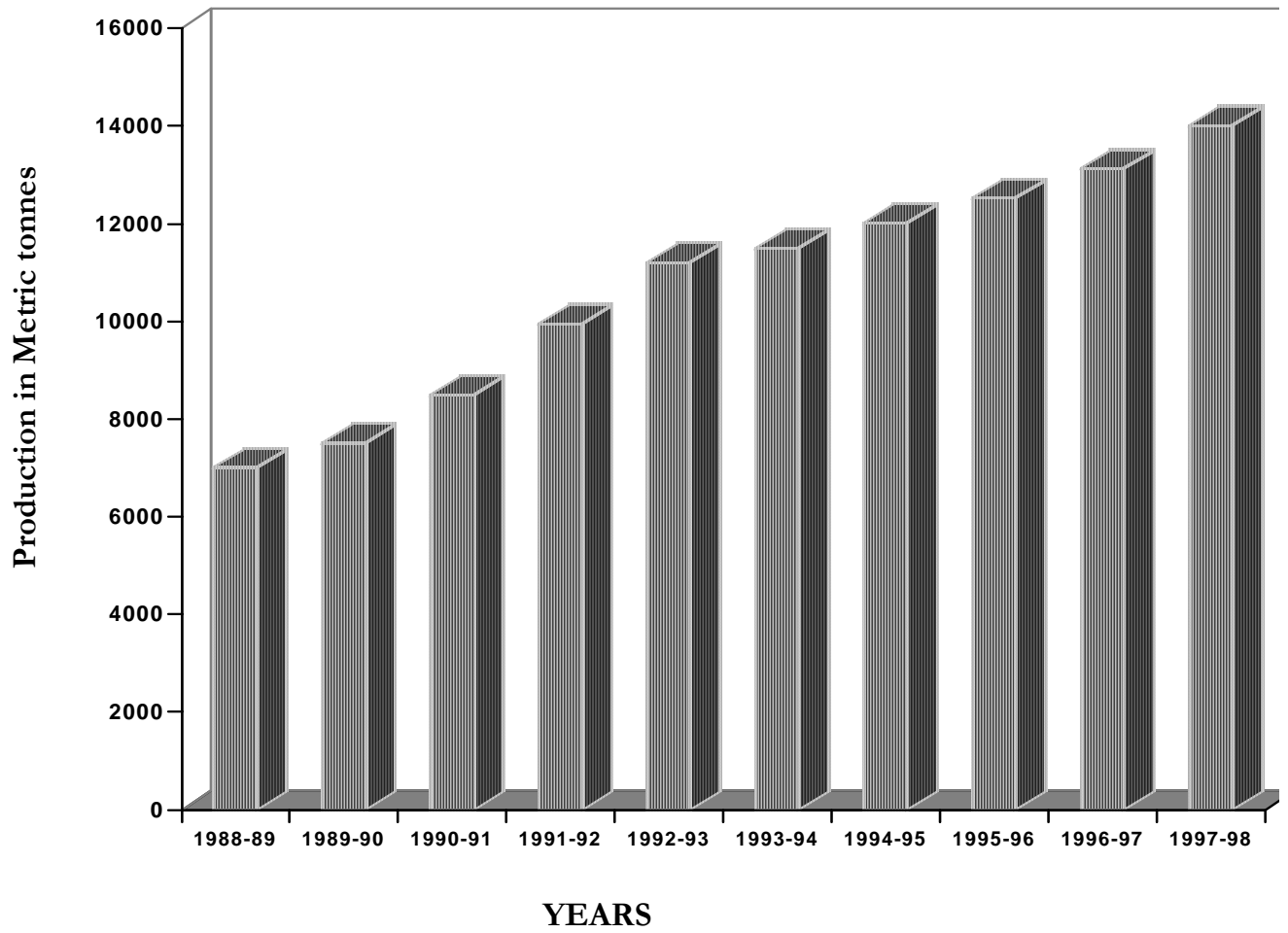
Here a pipe is used as handle having a length of about half a foot through which an arrow is inserted in such a way that it can move freely. One end of a rubber band is fitted

to this handle tube and the other end to the arrow by handling to this tube with one hand and another hand to the arrow, this rubber is stretched to a required length. By the sudden release the arrow moved swiftly in the front. The posinted tip of the arrow penetrate the fishes thus caught. The shooting pipe is used by the expert and can be used only in the clear shallow water. They usually caught large size fishes.

Fish production in Manipur for the last 10 years (Table - 5):

Years	Production(in matric tonnes)
1988-89	7000
1989-90	7500
1990-91	8500
1991-92	9950
1992-93	11200
1993-94	11505
1994-95	12010
1995-96	12520
1996-97	13125
1997-98	14005

**GRAPHICAL PRESENTATION FOR THE FISH
PRODUCTION IN MANIPUR FOR THE LAST 10 YEARS**

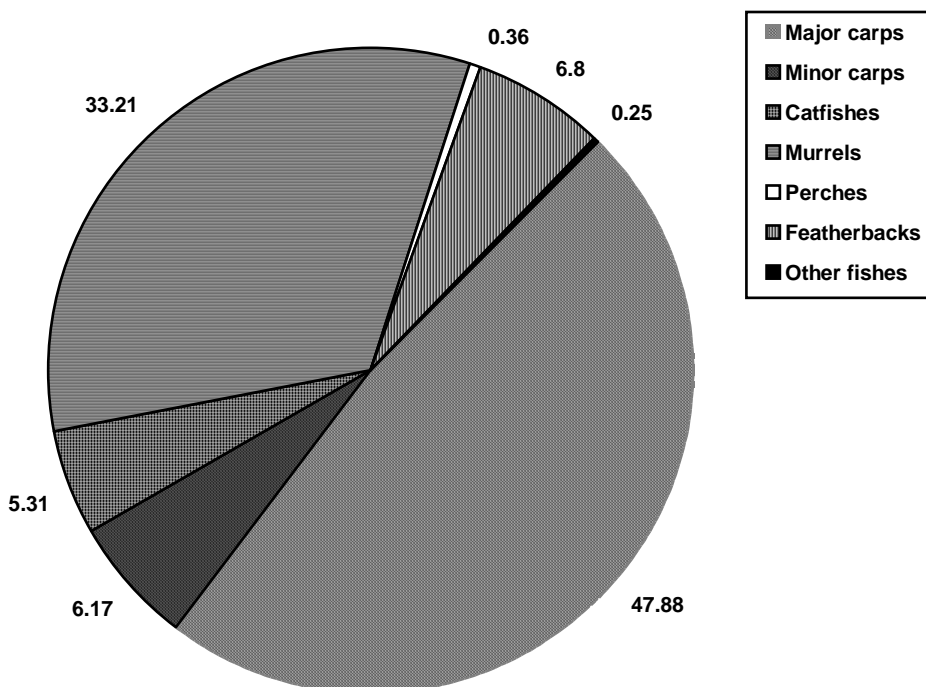


Fish catch composition of Loktak Lake

(Table - 6)

Major Carps	47.88%
Minor Carps	6.17%
Catfishes	5.31%
Murrels	33.21%
Perches	0.36%
Featherbacks	6.80%
Other fishes	0.25%

Graphic Representation of fish catch composition of Loktak Lake (in percentage)



Fish is an important item of diet of Manipur people thus, fisheries plays a great role not only as food resources of the state but also as an important economic activity. It is a fact that 75% of the population of Manipur state are fish eaters. Fish is the only sources of animal protein for the majority of the peoples because they do not take any form of meat due to certain religious obligations. They obtain the fish commodity from the fishery farms, ponds, riverine and lacustrine habitats. Majority of fishes are caught from the Lotak lake which is the largest in the North - Eastern regions of India and also

from other major lakes like Pumlun pat, Ikop pat, Kharung pat, Lausi pat, Sana pat, Waithou pat and Utra pat etc. to a lesser extent.

There has not been report about the fish production of the beels/ lakes of Manipur except the rough estimates of Lotak lake and Takmu beel given by the Directorate of Fisheries, Govt. of Manipur, based on the fish landed at a few selected fish markets, using Khwai bazar of Imphal as the main centre for Loktak lake and extension unit of Takmu commercial fish farm for Takmu beel. For Loktak lake a number of fish landing centres have not been taken into consideration and the total fish production recorded is under estimated. Hence a proper investigation has to be carried out to assess an accurate data on the fish production of Loktak lake considering all the available fish assembly centres of the lake so as it may be able to guide any concern like local organisations, Government agencies, state planners and researches to work out fishery development programmes in the lake. The first and the foremost step in this regard is modernisation of fishing gears and crafts through scientific intervention. The trauma in the fishermen's economy due to change in water regime and resultant effects on fishing techniques etc. demands an urgent step.

MARKET POTENTIAL:

The State has a good fish market potential. The present consumption requirement of fish in the State (1997-98) is estimated at about 23,350 metric tonnes, while the production is hardly of about 14,000 metric tonnes. These indicate a huge gap between the demand & supply of fish in the state. At present fishes are imported from other parts of the country in various forms such as fresh, dried and semi-fermented form. The present per capita availability of fish in the state is only 5.7 kg against the desirable 11 Kgs. To meet the demand new technology has to come up with proper management. The state has a good scope for the aquacultures.

Regarding the market potential of fishing crafts and gears in the state, there is no organised industry for fishing crafts and gears. Local artisans have made the dugout and plank built canoes in a very low scale without much scientific knowledge, which cannot meet the demand made by the fishermen of the state. Most of the fishing nets used in the state are smuggled into the state across the international border with Myanmar. The inadequate and ineffective fishing crafts and gears are identified as one of the main constraints in the development and improvement of fisheries in the state.

The fishing crafts and gears have a key role of improve the overall fish production. These can be achieved by introducing to meet the demand by around 45,000 fishermen of the state.

Result:

During the survey of the fisherman population, the number and types of fishing crafts and gears have been carried out along with the fishing techniques used by the fisher folks in the ponds, beels/lakes, river/stream/ canals, paddy field under paddy - cum pisciculture, swampy area which could be utilised by excavation/ impounding damming etc. of an area of about 1,02,350 hectares, about 45,000 fishermen used different types of fishing crafts and gears including a number of indigenous fishing techniques. These fisher folks who maintain a subsistence economy still resort to their primitive and traditional fishing crafts and gears. The only crafts they used in the dug - out wooden canoe, and a very few plank build canoe. The various gears include wounding spears, pole and line, gorges, hooks, traps, nets (mostly small) etc. Groping and stranding which are very primitive techniques of fishing are also used till today. Therefore, their fishing activity is so low that when there is a resource potential of fishing not less than 60,000 metric tonnes per year of fish from these water bodies, the annual fish landing is hardly 14,000 metric tonnes. These fisherfalks are sinking more and more in their drudgery of working with primitive tolls and techniques. The first and the foremost step in this regard is modernisation of fishing gears and crafts through scientific intervention. The trauma in the fishermen's economy due to change in water regime and resultant effects on fishing techniques etc. demands an urgent step.

Along with these certain measures have to be taken for the overall development of fishery such as:

I. Culture Fishery:

Introduction of large number of major carp fingerlings, in the lakes and wetlands of Manipur Development of cage and pen cultures, establishment of fish seed farm, establishment of fish aquarium and museum. Culture of air breathing fisher. Development of shell and crustacean fisheries. Establishment of local indigenous fish farm.

II. Capture fishery :

Prohibition of destructive fishing methods, control of aquatic pollution, provision of fish pass/fish ladder, strict enforcement of Manipur fishery rules, complete ban of

catching brood fishes, regulation mesh size of gill nets. Observance of close season, size limitation of fish to be caught, control of floating aquatic weeds licensing of fishermen, control of siltation etc.

Suggestion and recommendation:

Lotak lake being the largest freshwater lake in North-Eastern India, emphasised as a wetland of international importance from the “Ramsar Convention” maintained its own alternate high and low water levels before the commissioning of the Loktak Hydel project. But after the permanent construction of Ithai barrage across the Imphal, Manipur river, its ecology as well as capture fishery aspects were drastically changed to a great extent.

For increasing fishing efficiency in reservoirs and lakes, replacement of age old fishing crafts and gears by modernised ones is highly necessary. Most of the fishermen of Loktak lake are still using traditional fishing crafts and gears which are obsolete because of their inefficiencies.

In the absence of local manufacturers the fishermen these days remain helpless but to depend on nylon nets smuggled into the state across the international border with Myanmar. No organised scientific intervention has been caused by any agency to the rescue of the fisher folks in this regard. Some local artisans have made some attempts to build canoes made of planks which they call “Khaijan” at home scale. This plank canoe has been well accepted in certain sectors except for certain drawbacks like less durability.

In view of the above consideration, certain suggestive measures and recommendations have been listed below the proper management of the ecosystem and development of fishery in the lake and wet lands of Manipur.

1. To cause modernisation or introduction of appropriate technologies through modification of existing gears/crafts or introduction of new ones under scientific guidance and research.

(a) Fishing Crafts:

- (i) To find out a suitable sealing material for plank built canoes and water resistance paints for canoes.
- (ii) To find out a suitable additional attachment to increase stability.
- (iii) Introduce of FRP boat on Pilot scale.
- (iv) To develop a suitable prototype fishing canoes.

(b) Fishing Gears:

- (i) Trial of medium size purse seine for phoom fishing.

- (ii) Introduce of Lantern net, Collapsible box trap, light fishing, prawn fishing.
- (iii) Trial of surface and mid-water trawl at Barrak River system.
- (iv) Electric fishing by using DC current (dry cell), specially in the hill stream.

(c) Establishment of Auxiliary Industries like:

- (i) Local entrepreneurs to start small industry for net making.
 - (ii) Polythene fibre clothes industry.
 - (iii) Ice making industry.
 - (iv) Establishment of standard fish smoking small industry.
 - (v) Insulated vans for fish transportation.
 - (vi) Boat building yard.
 - (vii) Aquarium fishing industry.
2. To save ecology and environment in the state through reduction of felling of large trees for canoe making and use of pesticides in capture fishery.
 3. To bring about the overall economic development in a sustainable manner for the fishing community in Manipur.
 4. Training of fishermen.
 5. Establishment of research laboratory for monitoring and management.

Imphal, the 5th March 1999

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