INDIGENOUS TECHNICAL KNOWLEDGE IN FISHERIES OF MANIPUR

A dissertation submitted in partial fulfillment
of the requirements
for the degree of

M.F.Sc. (Fisheries Extension)

By

Beishamayum Nightingale Devi, B.F.Sc.
(FEX -01)

CENTRAL INSTITUTE OF FISHERIES EDUCATION
(DEEMED UNIVERSITY)
Indian Council of Agricultural Research
FISHERIES UNIVERSITY ROAD
VERSOVA, MUMBAI- 400 061

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Dedicated to my Parents and Guide

Dated: 30 June 2009

CERTIFICATE

Certified that the thesis entitled **" INDIGENOUS TECHNICAL KNOWLEDGE IN FISHERIES OF MANIPUR"** is a record of independent bonafide research work carried out by Ms. Beishamayum Nightingale Devi during the period of study from September 2008 to August 2009 under our supervision and guidance for the degree of **Master of Fisheries Science (Fisheries Extension)** and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or any other similar title.

Major Advisor/ Chairman

(S. K. Mishra)
Senior Scientist
Fisheries Economics, Extension
and Statistics Division

Advisory Committee

(S. N. Ojha)
Principal Scientist
Fisheries Economics, Extension
and Statistics Division

(Arpita Sharma)
Senior Scientist
Fisheries Economics, Extension
and Statistics Division

DECLARATION

I hereby declare that the dissertation entitled**, "INDIGENOUS TECHNICAL KNOWLEDGE IN FISHERIES OF MANIPUR"** is an authentic record of the work done by me and that no part thereof has been presented for the award of any degree, diploma, associateship, fellowship or any other similar title.

30th June 2009
Mumbai

(B. Nightingale Devi)
FEX – 01
M.F.Sc. Student
Central Institute of Fisheries Education

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Mumbai ***(Beishamayum Nightingale Devi)***

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ABSTRACT

Now-a-days, indigenous technical knowledges (ITKs) in fisheries are considered to be the backbone of sustainable fisheries development, which are developed by the people based on their experiences, continuous observations, evaluation and improvement over a period of time by trial and error, and they use these traditional wisdoms to solve many of their problems. It plays an important role directly or indirectly in the protection of the heritage and life of the fishermen. Fisheries form a gainful occupation to a large number of people in the state of Manipur. Very little effort has been made so far to study the ITKs of the state. Therefore, the present investigation was undertaken to study details of different indigenous technical knowledge being practiced in the central valley of Manipur, which comprises of four districts of the state. The specific objectives of this study were to document the different indigenous technical knowledges relating to fisheries activities in Manipur by surveying, interviewing, site-observations and also from the available secondary sources, and to explore the fishermen's rationale and perception behind the use of these knowledge.The socio-economic profile of the study area revealed that respondent fishermen were well-experienced in fisheries activities, but need improvement in their living conditions. ITKs in fisheries activities of central valley region were found widely distributed in different fields starting from fishing methods, fish aggregating devices (FADs), fish health management practices, processing & preservation methods to the importance of fish in different rituals and customs of the state. In addition to this, efforts have also been made to assess the appropriateness and scientific value of twelve selected Indigenous technical knowledges as perceived and scored by different experts from different organizations, based on six parameters, *viz*, cost-effectiveness, materials availability, social acceptability, cultural appropriateness, environmental soundness and scientific value. As per the experts' assessment, all the twelve selected ITKs were found more than 75 percent appropriate and having scientific value.

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INTRODUCTION

INTRODUCTION

The introduction of the concept of sustainable agriculture in late 80's in Indian agriculture scenario has evoked interest on indigenous technical knowledge (ITK) that has the element of use of natural products to solve the problems pertaining to agriculture and allied activities. India's ancient scriptures consisting of 4 *Vedas,* 108 *Upanishads*, 2 *Epics, Bhagwad Gita, Brahmasutras,* 18 *Puranas, Manu Smriti, Kautilya Shastra* and *Smritis* as well as the teachings of innumerable sayings, proverbs and sages contain profound literature of ideas, concepts and practices which are designed to address the process of building harmonious relationship among man, animal and nature. The enhancement of the quality of life of the Indians who in great majority live in and depend on agricultural production systems would be impossible by keeping this rich tradition of ITK aside (Das, *et al*., 2002).

Indigenous Technical Knowledge (ITK) which is also termed as "indigenous knowledge", "people's knowledge" "traditional knowledge" or "local knowledge" is limited within a community. It is unique to a given culture, location or society. This knowledge has been developed outside the formal education system and refers to the large body of knowledge and skills which includes variety of fish to culture, when and where to catch, how to process fish with a cost effective method, and how to maintain their environment in a state of equilibrium. ITK is collective in nature and is often considered the property of the entire community, and not belonging to any single individual within the community. It is transmitted through specific cultural and traditional information exchange mechanisms such as by orally through elders or specialists and often to only a selected few people within a community.

Fishermen all over the world use some kind of traditional knowledge or other. ITK provides valuable insight into sustainable aquaculture, because it passes through considerable adaptation, upgradation and modification over a period of time and carried on from one generation to another as a family technology. Naturally, ITK fits well to a particular environment rather than modern technological knowledge.

These are preserved in people's memories and are transferred from generation to generation in the form of advices, beliefs, community laws, stories, songs, folklore, proverbs, myths, dances, rituals, etc. It is transformed orally, by specific examples and through culture. The development of indigenous knowledge systems, covering all aspects of life including management of natural resources, has been a matter of survival to the people who generated these systems. Such knowledge systems are cumulative representing generations, experience and trial and error experiments. Indigenous form of communication and organization are vital to local level decision making process and to the preservation, development and spread of indigenous knowledge.

India is endowed with vast and varied fishery resources in the form of seas, brackish water areas, rivers and canals, reservoirs, ponds and tanks, floodplain wetlands and so on. The fisheries sector plays an important role in Indian economy by way of contribution to national income, improved nutritional security and employment generation, meeting social objectives and earning valuable foreign exchange. India secures fourth rank in World total fish production with an annual production of about 6.57 million metric tonnes, with inland and marine sector contributing 3.67 and 2.9 million tonnes respectively.

The inland fisheries sector especially inland aquaculture, on the other hand, has tremendous potential for enhancing fish production. In recent years, aquaculture has emerged as the fastest growing food sector in the world poised for significant growth. India has 29000 km of rivers and canals, 0.3 million hectare estuaries, 0.19 million hectare of brackish water and lagoons, 3.15 million hectare of reservoirs, 0.2 million hectare flood plain wetlands and 0.72 million hectare of upland lakes. The potential fish production from inland fisheries of India is estimated to be 4.5 million metric tones against the present production of 3.67 million metric tonnes. Thus inland fisheries sector offers tremendous scope for increasing fish production. Aquaculture with an annual growth rate over 6 %, the country recognized herself as 2nd largest producer of fish through aquaculture in the World after China (Ayyappan and Modayil, 2007).

Marine fish production from open seas has become stagnant since last decade and fishing is still restricted to near shore areas. Against the estimate potential of 3.9 million tonnes, the sector has already reached the 2.9 million tonnes mark, thus leaving a balance resource of one million tonnes in deeper and oceanic zone. Fisheries have always been playing a pivotal role in the food and nutritional security of the people, employment generation besides contribution to its national income. At present, contribution of fisheries to total GDP is around 1.07% and 5.4 % to the agriculture GDP (Ayyappan and Modayil, 2007). The annual export earning from fish and shellfish is more than Rs. 8000 crores, accounting for 18% of the agricultural exports and 2 % of the total export. India trades about 2.5% in the global fish market and produces about 4.7% of the World's fish.

If we look at the north-eastern states of India, which comprises of the eight landlocked states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, is one of the richest regions of India in terms of biodiversity and natural resources. The landlocked northeastern states are located between latitude 1°57" N and 29°30'' N and longitude 89°46'' and 97°30'' E. The region is blessed with rich aquatic resources including rivers (19,150 km), reservoirs (23,742 ha), beels, lakes and swamps (143,740 ha), ponds and mini-barrages (40,208 ha), and low-lying paddy-cum-fish culture systems (2,781 ha). It is spread over an area of 262,190 sq km, which represents about 8% of the geographical area of the country. It is one of the most thinly populated regions of India, with about 39 million people, representing about 4% of the whole population of the country with a population density of 103 persons per sq km, compared to the national average of 324 persons per sq km. The region has international borders with Bhutan, China, Myanmar, and Bangladesh. The region has rich and diverse aquatic resources in different topographical and climatic conditions in the plains of the Brahmaputra and Barak valleys in Assam, from upland plain lands of the Imphal valley in Manipur to the predominantly hilly regions of Meghalaya, Mizoram, Nagaland, Tripura, and Sikkim with elevations ranging from 200–900 m above mean sea level (MSL). The annual rainfall in the region exceeds 2,000 mm and more than 60% of the area is covered by forest. More than 95% of populations are fish eaters (Munilkumar and Nandeesha,

2007). The rich fish diversity of the region has been attributed to many reasons, viz., the geography, which consists of hills, plateaus, and valleys and results in the formation of a variety of torrential hill streams, rivers, lakes and swamps, and drainage patterns, which include the Ganga-Brahmaputra, Koladyne, and Chindwin-Irrawady systems. The unique tectonic setting in South East Asia resulted from the collision of the Indian, Chinese, and Burmese plates, resulting in the formation of the mighty Himalaya, and the Indo-Burman ranges (Vishwanath, 2002).

Manipur, lies in the north – easternmost corner of India within latitude 25.83°N and 93.93°E longitude. The entire state has an area of 22,327 sq km of which the valley has only 1920 sq. km. and the rest belongs the hills. The valley area is about 10% of the total but inhabited by 65% population. Majority of population are non-vegetarian and prefer fish. Because of different geographical entity, the aquatic resources in the state exhibit diverse characteristics and fish biodiversity. The total water area of Manipur state was around 1,00,000 ha comprising of beels, lakes, swamps, ponds, tanks, irrigation canals, rivers and small reservoir, low-lying paddy fields etc, which have been shrunk to around 56,461.05 ha.

The annual requirement of table fish by the end of Eleventh Five Year Plan period (2007-2012), calculated at 11 kg per capita consumption of fish for about 24.50 lakhs population of the state is estimated at 25,600 M.T. against the present production of 18,600 M.T. In order to cope with the increasing demand of fish, steps are being taken up by the Govt of Manipur to exploit the potentialities of about 38,000 M.T. per annum.

While exploiting the potentialities, any government does planning at the top with the inputs from the so called white-colored development experts and scientists, without involving the grass root level stake holders neglecting the indigenous knowledge base the rural mass. Therefore, the ultimate outcomes of many rural development programmes end with failure to a large extent. The evolution of modern scientific knowledge is very recent in its origin. But indigenous knowledge is unique to and as old as a given culture and society, the information base of which continuously evolves. Evidently, this knowledge is built from and is based on

thousands of years of experiences. Until and unless we ground ourselves in the knowledge and experiences we already have, we will not be able to bring about a major change in the development front (Mishra, 1998). Development programme always emphasized the use of modern scientific technology. No doubt these technologies contribute for increasing the productivity and augmenting the net profit. However some of the improved technology do not find place equally in all the places because of the local variation in multifactor scenario. Similarly it requires costly inputs and these are complex to understand and practice by the small fishermen. In fact, it is these segments of fishermen who need the research support more. These people could not derive the benefit of the technologies because of either technologies are not relevant to them or they have no access to the knowledge, technology, input, services, etc., often ignored by outsiders promoting modern technologies. However with increasing awareness of the limitations and hazard of conventional fishing a growing number of scientists have began to recognize indigenous knowledge as a major untapped resource for sustainable fish farming.

The Indian fish farmers practice their own indigenous technology as a common practice through natural resource management. The close and intimate observation of farmers through their age old practices has developed the expertise of acquiring knowledge in aquatic ecosystem in particular. Admittedly, the multifarious knowledge and skill possessed by local people can substantially contribute to productive efforts and endeavors. Scientific attitude to these indigenous technologies of the farmers are yet to be exposed. The viability of indigenous technologies failed to approach short and long-term perspective.

Farmers' innovation is based on their indigenous knowledge. The indigenous knowledge is the accumulated knowledge, skills and technology of the local farmers derived from the interactions of ecosystem. Since the evolution of mankind, man has been entrusted with resources and location specific avenues like agriculture, fishery, dairy, animal husbandry, indigenous, medicine and weather study, etc. Farmers' innovations have little or no cost, readily available, socially acceptable, economically viable and sustainable, involve minimum risk to rural farmers and

producers, and are widely believed to conserve resources. The use of farmers' innovation, skills and wisdom promotes active community involvement because people depend more on each other. The farmers' innovation encourages transparency and accountability. Farmers use traditional wisdom to solve some of their problems, especially in India where farming is as ancient as human civilization. Over thousands of years, fish farmers have evolved various technologies of fish farming and harvesting by trial and error and by continuous observation and evaluation (Barman, 2002).

In spite of the fact that the modern technology contributes substantially to increase productivity and more profits from fisheries and aquaculture but it is costly and often quite complex to understand the practices by the fishermen as most of the new technology generally ignore the indigenous knowledge which is existing in the local environment. Indigenous knowledge refers to the unique, traditional local knowledge existing within and developed around the specific condition of men and women to a particular region or geographical area (Grenier, 1998). It is set of tools which are developed to encounter the problem by the community people and use to manage the natural resources. Indigenous Technical Knowledge offers low cost approach with potentially high benefits which is also easy to incorporate these into existing efforts for more effectiveness (Warren and Rajasekaran, 1993).

Statement of the Problem

Literatures from different sources reveal that very few ITKs relating to fisheries and aquaculture have been documented so far, that too, only from some selected pockets of our country. During 2000, Indian Council of Agricultural Research (ICAR) launched a nationwide Mission Mode Project on "Collection, Documentation and Validation of Indigenous Technical Knowledge" under National Agricultural Technology Project (NATP), where fisheries was one the broad subject area. The ICAR came out with several documents during 2002-04 (Das *et.al.,* 2002, Das *et.al.*, 2003a and Das *et.al.,* 2003b). However, it was realized that the coverage from north-eastern states was also not adequate enough. As discussed earlier, north-eastern

states are a rich source of ITKs and hardly any study has been conducted so far to document the available ITKs relating to fisheries in practice. Unless those ITKs are documented properly, those can not be subjected to prioritization and scientific validation and there is always apprehension of extinction of these ITKs in the era of scientific technological invasion in rural society. Therefore, realizing the importance and magnitude of the problem, the present study entitled "Indigenous Technical Knowledge in Fisheries of Manipur" was undertaken in the central valley of Manipur with the following objectives.

Objectives of the Study

The broad objective of the investigation was to collect, document and categorize the ITKs relating to fisheries activities. With this end in view, the specific objectives of the study were:

1. To study the socio-economic profile of the respondents of the study area.
2. To collect and document the Indigenous Technical Knowledge relating to different aspects of fisheries available in the study area
3. To study the rationale behind the use of the Indigenous Technical Knowledge by the respondents.
4. To assess the appropriateness of some most widely used Indigenous Technical Knowledge in Fisheries of Manipur.

Scope and Importance of the Study

The study is an attempt to document indigenous knowledge in fisheries activities of the state of Manipur as the state is rich in fisheries resources as well as indigenous knowledge exist in the state is less documented. The outcome of the study is expected to generate new dimensions in fisheries sector of the state since fishers can transfer this rich and varied knowledge which are not static. And also the documentation will help in bringing up a new platform for the policy makers, planners,

administrators and fisheries scientists in incorporating the modern technology with the indigenous knowledge effectively.

Limitations of the Study

1. There are always certain limitations and constraints in every study. Though all possible precautions and measures were taken to make the study precise, objective and reliable, yet because of the limited time and resources at the disposal of a student investigator, the study was restricted to only four central valley districts of Manipur, that too some selected villages, and could not be extended to a larger area.

2. One of the foremost requirements of the study was free and frank interactions with fishermen, who are bounded with daily schedule for their livelihood. Although it was a difficult task, however, efforts were sincerely made to fix time for interactions as convenient to the fishermen.

3. As many of the ITK activities relating to fisheries are seasonal and some are occasional, like disease occurrence, “words of mouth” of the respondent fishermen were documented. Individual’s biasness and prejudice on part of the respondents might have influenced the systematic documentation of ITKs.

4. In spite of honest efforts to document all ITKs relating to fisheries in the surveyed area, there might be some other important ITKs relating to fisheries available with non-respondent fishermen.

REVIEW OF LITERATURE

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2. REVIEW OF LITERATURE

For carrying out any research in a scientific way, review of the past researches is prerequisite for making a framework and methodology to be adopted for the research to be studied. In this chapter, an attempt has been made to review briefly and systematically the past available researches, having direct or indirect bearing on the present study. An effort has been made to present the reviews of most of the available recent studies under the following heads.

2.1. The Evolution and Concept of Indigenous Technical Knowledge (ITK);

2.2. Importance of Indigenous Technical Knowledges;

2.3. Distinction between the Indigenous knowledge and Western knowledge;

2.4. Related works done on Indigenous Technical Knowledges in Fisheries;

2.5. Gender and Generation Aspects to Indigenous Knowledge;

2.6. Legitimizing Indigenous Knowledge;

2.7. Assessment and validation of Indigenous knowledge;

2.8. Traditional Knowledge and Intellectual Property;

2.9. Incorporation of Indigenous Knowledge in Research and Extension Network;

2.10. Constraints in use and acceptance of Indigenous Knowledge

2.1. Evolution and Concept of Indigenous Technical Knowledge (ITK)

According to the Oxford English Dictionary and Collins student's Dictionary "Indigenous" means native born, originating or born naturally in a country, and opposite to exotic. It also means original, innate and inherent.

According to Levi-Strauss (1955) contact and exchange among different cultures, including between Asia and the Americas, was a fact of life from as early as thousands of years ago.

Haskell *et al*. (1981) pointed out that Indigenous knowledge are not primitive, left over from the past, but on the contrary, are system of finely-tuned and adopted, both biologically and socially, to counter the process of what are often harsh and unfavorable environment, and often represents hundreds, sometimes thousands of years of adaptive evolution in which vagaries of climate, the availability of land, water and basic needs of people and their animals for food, shelter and health have been amalgamated in a system, which has allowed the society to exist and develop in face-to-face tremendous odds.

According to Farrington and Martin (1988), "ITK is based on knowledge, beliefs and customs which are internally consistent and logical to those holding them but at odds with the objectively deduced findings of formal science.

In the words of Wang (1988), IK may be defined as the sum total of knowledge and practices which are based on people's accumulated experience in dealing with situation problems in various aspects of life and such knowledge and practices are special to a particular culture.

According to the Atteh (1989), Indigenous Knowledge is the untapped and unwritten body of language which held in different brains, languages and skills in as many groups, languages, cultures and environments.

Thrupp (1989) opined on indigenous knowledge that it also encompasses non-technical insights, wisdom, ideas, perceptions and innovative capabilities.

Warren (1989) defined Indigenous Knowledge as "Local Knowledge" – knowledge that is unique to a given culture and society. This knowledge is the information base of that society, codified in the language of the society and it facilitates communication and decision-making.

Odhiambo (1990) viewed that Indigenous knowledge as knowledge which has been accumulated by the people over generation by observation, by experimentation and by handling on old people's experience and wisdom in any

particular area of human endeavor. It includes both technical and non technical fields governing various social and religious taboos, belief and customs, communication patterns, music, ecology, vegetation, climate etc and so on.

Technically, Indigenous Knowledge is defined as knowledge originating in and characterizing a particular region or country. The quantum and content of IK, however, vary across space and change over the time. Also, the indigenization of knowledge originating outside a region often involves adaptation to suit the specific characteristics of the region. Consequently, the knowledge embedded in the practices or technology, its users and innovation in a region at any point of time may not necessarily be whole (Basant, 1990).

Mundy and Compton (1991) highlighted that indigenous knowledge implies that the knowledge originates in an area without borrowing from or being influenced by knowledge outside it. It offers cheap, locally adopted solutions to development problems or that it can be molded with Scientific Knowledge to boost productivity and living standards.

Warren (1991) states that the ITK is unique to a given culture or society and is used to distinguish the knowledge developed by a given community from international knowledge system or scientific knowledge.

Rajesekharan (1993) stated that IK is the systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture.

Dei (1993) defines indigenous knowledge as the "common sense knowledge and ideas of local peoples about the everyday realities of living".

Flavier (1995) stated that indigenous knowledge is the information base for a society, which facilitates communication and decision-making. Information systems are dynamic, and are continually influenced by internal creativity and experimentation as well as by contact with external systems.

The term indigenous knowledge refers to the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area (Grenier, 1998).

According to Das *et al.,* (2002), the concept of sustainable agriculture in Indian agricultural scenario has aroused interest in indigenous technical knowledge (ITK). These ITKs are based on experiences which gathered momentum through generations and are being developed and improved through informal experimentation. Thus, ITKs are based on the experiences, tested in most cases over centuries, and endowed with best adaptability to local environment. These are dynamic, holistic, eco-friendly and sustainable, and interwoven and assimilated in the cultural life of the people.

2.2. Importance of Indigenous Technical Knowledges

To ignore people's knowledge is almost to ensure failure in development (Brokensha *et al.,* 1980).

Fishermen are more likely to comply with management measures when they are able to see the benefits which will rise from those measures and where they have been involved in formulation of measures (FAO, 1986).

ITK is potentially an important complement to formal scientific knowledge, principally in its capacity for location-specific classification of aspects of the biophysical environment, though it may supplement science in the functions of explanation and prediction. Science's principal role lies in the provision of technology of options to address the problems and constraints identified by farmers and those relevant to their conditions of which farmers might be yet unaware (Gupta, 1987).

Warren (1989) highlighted the importance of putting time and effort into understanding, recording and utilizing indigenous knowledge system in agriculture. He also added that Indigenous Knowledge Systems offer low cost approach with

potentially high benefits. It can be incorporated into existing efforts to enhance and expand effectiveness. It can also serve as a basis for new initiatives.

Indigenous Knowledge systems are tuned to the needs of local people and the quality and quantity of available resources (Pretty and Sandbrook, 1991).

Warren (1991) stated that understanding and working with IK and decision making system can enhance participation, capacity building and sustainability in a cost effective way.

Local knowledge is constantly evolving, absorbing information from outside (whether from extension workers, markets, neighbours or other sources) and seeking new knowledge through experimentation which makes difficult to find out where local ideas came from. This diversity and adaptability make indigenous knowledge a rich source of information for participatory research, which can enhance the results, and improve its relevance and adoption (Blaikie *et al.,* 1996).

Grenier (1997) reported that rural communities have a local set of indicators that they use to monitor and evaluate their environmental quality and to predict environmental change. He cited some example of grassroots indicator such as appearance and behaviour of flora and fauna (in particular, flowering and sprouting the scheduled of key plants and arrival and activities of birds, insects, frog and toads), wind pattern or changes in flow of wind and position of stars groups.

De and Saha (2001) identified ITKs mainly in aquaculture nutrion in course of a research work and concluded that there may be a large number of indigenous practices related to feeding and nutrition of fishes. There are perceived to be feasible, and user friendly. They involve low cost resources which are locally available moreover they donot required a high degree of technical skills. These ITKs are constantly evolving. As they interact with new types of information, these are likely to be enriched and can be used to solve emerging problems. Infact ITKs may provide many useful strategies in the search for new sustainable fisheries. Appropriate new

and modern technologies can be developed by integrating indigenous knowledge into the research and development projects.

Kafarowski (2006) gave the view that fisheries management is enhanced and effective when knowledge and experience of both the men and women are valued.

According to Scoones and Thompson (1994), Indigenous Technical Knowledge (ITK) combines with Traditional Ecological Knowledge (TEK) and fits within a wider social and cultural framework of knowledge to create, what has been referred to as, Rural People's Knowledge (RPK).

Woodley, (1991) highlighted that in rural area, traditionally associated technical knowledge of fish farmers followed from generation to generation to cope up with different situational constraints. The tested and proven innovations of our ancestors need to be valued, validated and blended with new technologies support. Indigenous knowledge and peoples, the argument goes, are disappearing all over the world as a direct result of the pressures of modernization. The development process must be based on an understanding of traditional knowledge if projects are to be sustainable both environmentally and sociologically.

Van der Bleik and Van Veldhuizen (1993) gave perhaps the most comprehensive definition with IK referring to: "ideas, experiences, practices and information that has been generated locally, or is generated elsewhere but has been transformed by local people and incorporated into the local way of life. Indigenous knowledge incorporates local technologies but also cultural, social and economic aspects."

Global interest for role of knowledge in development was manifested at the 1st global knowledge for development conference, the 1998 world development report on "knowledge for development conference (GKII). According to the reports of sixth UNESCO-ACEID International conference 12-15 December 2000 held at Bangkok, Thailand, the global revival of the knowledge for development debate

coincide with the revolutionary developments in information and communication technologies. This technologies have far reaching effects on the role of knowledge (Products of education and research) in development. Indigenous knowledge has not receive proper attention from the development professionals and the scientists. The oral rural and powerless nature of indigenous knowledge has made it largely invisible to global science or it has been dismiss as unsystematic and incapable of meeting the productivity needs of the modern world (Prain, 1994).

2.3. Distinction between the Indigenous Knowledge and Western Knowledge

Howes and Chambers (1980), referring to indigenous knowledge as indigenous technical knowledge (ITK), prefer to differentiate it from scientific knowledge on methodological, rather than substantive grounds - a discussion that recalls and reproduces the dimensions highlighted by Levi-Strauss in his two books, Totemism and The Savage Mind. They say: an important difference between science and ITK lies in the way in which phenomena are observed and ordered. The scientific mode of thought is characterized by a greater ability to break down data presented to the senses and to reassemble it in different ways. The mode of ITK, on the other hand, is 'concrete' and relies almost exclusively on intuition and evidence directly available to the senses. A second distinction derives from the way practitioners to the two modes of thought represent to themselves the nature of the enterprise in which they are engaged. Science is an open system whose adherents are always aware of the possibility of alternative perspectives to those adopted to any particular point of time.

Some researchers have attempted to distinguish indigenous knowledge by claiming that women have particularly rich insights in many indigenous cultures and local knowledge systems (Thrupp, 1989).

Thrupp (1985, 1988 and 1989) described the range of attitudes that local populations display towards new knowledge - these run the entire gamut from pride in

traditional methods and rejection of new knowledges to admiration for new ideas and shame about older practices.

According to Conway (1990), modern agriculture development effort often ignores this IK replacing traditional infrastructure with new construction. Under the stress of intensive agriculture and with indiscriminate use of external inputs the production base is after eroded.

The indigenous knowledge offers cheap locally-adopted solution to development problems or that it can be molded with scientific knowledge to boost productivity and living standards (Mundy and Compton, 1991).

Greenfeldt (1991) suggested that for the reasons of environmental conservation as well as institutional stability, indigenous system should be intelligently assisted rather than simply replaced. Realistically sustainable agriculture models that combine elements of both traditional and modern scientific knowledge need to be developed.

Warren (1991) stated that IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision-making in agriculture, health care, food preparation, education, natural resource management, and a host of other activities in rural communities. Such knowledge is passed down from generation to generation, in many societies by word of mouth. Indigenous knowledge has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities.

Johnson (1993) in her book LORE has made an attempt to compare and contrast the Traditional Environmental Knowledge (TEK) with Western Knowledge as follows – TEK is generated, recorded and transmitted differently as compared to Western Scientific Knowledge. Several works on this subject (Usher, 1986; Osherenko, 1988; Johnson and Rutten, 1991; Berker, 1992; and Wolfe *et al.,* 1992) have outlined some of the following generalized differences:

(a) TEK is recorded and transmitted through oral tradition, while western science employs the written words;

(b) TEK is learned through observation and hands-on experiences, while western science is taught and learned in a situation usually abstracted from the applied context;

(c) TEK is based on the understanding that the elements of the environment (earth, air, fire and water, etc) which are classified as inanimate by western science, also have a life force;

(d) TEK does not view human as superior to other animate and inanimate elements; all life forms have kinship and are independent, unlike western science; humans are not given the inherent right to control and exploit the nature for their own interests at the expense of other life forms;

(e) TEK is holistic, while western science is reductionist, i.e., western science deliberately breaks down data into small elements to understand whole and complex phenomena. For TEK, all elements are viewed as interconnected and can not be understood in isolation;

(f) TEK is 'intuitive' in its mode of thinking, while western science is 'analytical';

(g) TEK is mainly qualitative and sometimes quantitative, but western science is mainly quantitative;

(h) TEK is based on data generated by resource users. As such, it is more inclusive than western science, which is collected by a specialized group of researchers who tend to be more selective and deliberate in the accumulation of facts;

(i) TEK is based on diachromic data (long time series of information on one locality), while western science is largely based on synchronic data "(short time series over a large area);

(j) TEK is rooted in a social context that sees the world in terms of social and spiritual relations between all life forms, while western science is hierarchically organized and vertically compartmentalized; and

(k) TEK explanations of environmental phenomena are often spiritual and based on cumulative and collective experiences, while western science employs the methods of generating, testing and verifying hypotheses and establishes theories and general laws as its explanatory basis.

Howes and Chambers, (1980) stated that if science cannot be distinguished from traditional knowledge on the basis of the contents or characteristics of the two categories of knowledge, foundationalist hope of some neo-indigenistas leads them to submit that the two may still be separated on the basis of distinct methodologies and distinguishable philosophies of knowledge.

Indigenous knowledge has permitted its holders to exist in "harmony" with nature, using it sustainably; it is seen as especially pivotal in discussions of sustainable resource use (Compton, 1989; Flora and Flora, 1989).

Moock and Rhoades (1992) considered indigenous knowledge as cultural knowledge producing and reproducing mutual understanding and identity among the members of the farming community, where local technical knowledge, skills and capacities are inextricably linked to non-technical ones (i.e. cultural, ecological and sociological factors.

The collection and storage of indigenous knowledge in archives should be supplemented with adequate dissemination and exchange among interested parties using newsletters, journals and different networks (Warren *et. al.,* 1993).

Agarwal (1995) made an attempt to compare and contrast indigenous knowledge and scientific knowledge. He noted similarities between the two in terms of intellectual process organization, data acquisition methods, concepts and goal, while the difference between two were observed in terms of data sources transmission, speed , methods, data type and analysis.

Warren *et al.* (1995) saw indigenous knowledge as local knowledge that is unique to a given culture or society and contrasts with the western scientific knowledge, or as they prefer to call it the "international knowledge system" which is generated through a global network of universities and research institutes.

Bisht and Bhatt (2001) noted that traditional knowledge system which is developed and acquired through observation and practical experience and it is holistic, intuitive, qualitative and practical, generated by resource users in a diachronic (long term) time scale, whereas western scientific system is generally learned in a situation, which is remote from its applied context and it is essentially reductionist, quantitative, analytical and theoretical, generated largely by specialist researchers on a synchronic (short time) time scale. The former knowledge is used to make suitable decisions under variable conditions and later knowledge is used to put forward hypothesis and to verify underlying laws and constants.

2.4. Related works done on Indigenous Technical Knowledges in Fisheries

Bhuyan and Lakhamanan (1974) studied for seasonal clearing of cultivated ponds in Assam by using various indigenous plants of known piscicidal properties such as seed of *Croton tiglium* (3-5ppm), roots of *Milletis pachy carus* (2-6ppm) and seed of *Milletis placidis* (4-5ppm).

According to Singh (1977), no systematic works on the fish catching method of Manipur have so far been reported except for Loktak Lake.

By identifying gaps in farmers' knowledge, or areas where explanations for results are lacking, scientists can provide useful ideas which farmers can test out. This approach in Bangladesh led to a four-fold increase in the number of farmers adopting aquaculture (Dolberg, 1991).

Hossain and Alain (1993) found that the aquatic weeds get tied in a bunch and then hung from a rope into water as a means of catching freshwater shrimp in Naogaon, Bangladesh.

Bentley (1994) shows in his studies that ITK does not cover everything; if it did, farmers would probably already be developing the technology such as farmers are not aware of interactions between pests which lead to natural biological control.

Tsai and Ali (1997) provided a valuable overview of the indigenous fishing technologies utilized in Bangladesh. People use every conceivable type of fishing gear including hands, spears, traps and nets. Many of these are technologies originally provided by one of the many fisheries projects that were initiated in the 1980s and have since been adapted by the local population. The study found a total of 51 types of fishing gear in operation over the survey period. The type of fishing gear changes with the seasons, according to flood conditions, target species and size of fish. This includes 11 types of trap which display a bewildering variety of shapes, sizes and modes of operation. The *Polo* for example is a bell shaped trap with an open bottom and a small opening at the top. This type of trap is used throughout Bangladesh during the dry season from December through May. The trap is pressed into the mud in shallow water. The *charai* by comparison is a rectangular box like trap. The trap has a door extending from the base of the front to the apex at the back. At the top there is an opening for the removal of fish. The trap is set at the surface under floating vegetation. Often snail meat is placed inside as bait. A fisherman may operate about 100 traps which are set in the evening and checked in the morning.

The Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) funded the development of the National Aquaculture Development Strategy for Indigenous Communities in Australia (Lee and Nel, 2001).

Nirmale (2002) studied indigenous knowledge in management of marine fisheries of Maharashtra and documented rich, varied and potential ITKs in fishery management of the study area. The validity of a few ITKs on fishery management has also been established by the study. He revealed that traditional and artisanal fishing practices have their own importance in sustaining the marine fish production on one hand and environmental conservation on the other.

Barman (2002) studied different indigenous technical knowledges in fisheries of Assam and also studied the socio-economic condition of the fishermen who practice the indigenous knowledge.

Jha (2003) has reported about the use of weed fishes as fertilizer in rice field in village Okhargarth of Ranchi district and use of light to provide live feed to the cultured fish of Sitamarhi district of Jharkhand.

Pandey (2003) said about the use of ash dust and neem cake for treatment of EUS disease in fishes in fish pond in the Pranpura of Rewari district in Haryana for more than six years.

Pseudo stems of banana, after harvesting the bunch, are added to the pond by cutting longitudinally, which increases the pH of pond water and oxygenation in water and it results in increase in fish yield by the farmers in the Basta village of Balasore district in Orissa (Mishra, 2003).

Gurumayum *et al.* (2006) has reported that, for generation, the dependence of Manipur valleys population on fish has been so high that several fish based-beliefs and customs have evolved.

Goswami *et. al.* (2006) reported some of the farmers' innovation in aquaculture in Namkhana and Kakdwip blocks of West Bengal. Manual removal and uprooting the weed with the help of bamboo poles with toothed prongs or coir rope to control algae (*Jahanesbaptistia sp*.) for proper growth of *Bagda (Peneaus monodon*). Bamboo logs are placed into the water, as fish rub their body, the lices of fish are removed. Also, mixture of garlic and salt are sprayed into the water to avoid from Epizootic Ulcerative Syndrome (EUS).

It is important that indigenous people or communities are informed before making a decision on whether to proceed with investing in a new aquaculture venture (Tedesco and Szakiel, 2006).

Jain, *et al.* (2007) reported 43 aquatic/semi-aquatic plants species from the wetlands of Manipur valley for curing 45 ailments along with the methods of preparation which are empirically formulated and accepted prescriptions by the various ethnic communities of Manipur.

Panda and Misra (2007) reported the traditional methods of mollusc shell collection for lime preparation from sea and estuaries in Ganjam district of Orissa. Two communities *Nolias* and *Bauries* are mainly engaged in mollusk shell collection, as their livelihood depend on the collection and marketing of the mollusk shell. They collect the shell by using specially designed net made out of nylon thread and bamboo sticks in deep cut edge in the sandy shore where only the dead shells were collected. They concluded that any modernization of the method of the shell collection will disturb the ecological balance and therefore should not be developed.

Tynsong and Tiwari (2008) reported about different traditional fish-harvesting practices which are most suited to local conditions, help in perpetual fish harvest and conservation of aquatic diversity of the region of *War Khasi* community of Meghalaya, locally known as *Buh Kroh, Riam Kriah, Riam Khohka, Riam Kyllong, Ring Khashiar, Buh Ruh* and *Bia Dohpieh*. Traditional Knowledge (TK) and practices can play a great role in enhancing our understanding for conservation of fishes and other aquatic life of hill streams.

According to Singh and Sureja (2008), resource conserving practices of local people drawn from their traditional knowledge systems have been described from many parts of the world and for many different cultures and environments. Looking to the importance of role of indigenous knowledge in sustainable use and management of agriculture and natural resources, an attempt has been made by them to identify the tribal farmers' wisdom regarding the local practices in vogue among community to manage and sustain the agriculture and natural resources

Dutta and Bhattacharjya (2008) attempted to describe an indigenous community fishing practice of Tirap district of Arunachal Pradesh. In this practice, fishing was facilitated in the pool zones of the hill stream by making the stream water

muddy. Fishes gasping for air in muddy waters is then caught using cast nets operated from indigenous bamboo rafts. They also revealed that community fishing is a part of the cultural heritage of the *Wancho* tribe of Tirap district.

The ITKs regarding soil and water management systems were collected and compiled through PRA and household interviews in the remote and rural area of Himachal Pradesh. Villagers of the Himachal's Himalayan base often harvest rainwater by building small water storage ponds. There is traditional practice to plough the fields early in the morning before dew or fog is evaporated for the conservation of water. Heavy snow is melted with the help of ash. Ash mixed with household waste and human excreta is spread/ broadcasted aver field for weed control, surface soil crust breaking, and making soil more porous by conserving the rainwater (Lal and Verma, 2008).

2.5. Gender and Generation Aspects to Indigenous Knowledge

Gender differentiation comes about as a result of the specific experiences, knowledge and skills which women and men develop as they carry out the responsibilities assigned to them (Feldstein and Poats, 1988)

Warren (1989) said that Indigenous Knowledge is gender sensitive as it is accessible and developed within the framework of, those members of society who are responsible for resources management and production.

2.6. Legitimizing Indigenous Technical Knowledge

Farrington and Martin (1988) suggested that participation is a useful device for strengthening and supplementing farmer knowledge system and then capacity to experiment on their account.

Thrupp (1989) discussed the issues related to appropriation of local knowledge and established legitimacy of such knowledge to serve the interests of poor marginalized people.

Dulcire (1989) suggested a real approach which enables scientists to adopt a pragmatic strategy suggested by Compton 1989 include increase academic interest in IKS, increase interaction between government bureaucratic and local system integrating identification, selection and intensively studying areas of IKS which suggests merit for further exploration, facilitating lateral transfer of knowledge among rural population.

Titilola (1990) conducted a study with an objective of proposing and testing a method to evaluate the incorporation of ITK in agriculture to development process and also developed a model which can be used to determine the potential effectiveness of incorporating ITK into practice.

Kohnert and Weber (1990) proposed that one of the main tasks of research and extension services should be to support farmers experimentation in provding liable option, limiting risks and analyzing and developing indigenous knowledge. The communication of solution developed by farmers should be left to more efficient external channels.

A model developed by Rajasekharan *et al.* (1991) includes, among the salient features, promoting small scale farmers participation recording individual technology, conducting diagnostic interviews conducting On-Farm Farmers Oriented Research (OFFOR) trial for integrating indigenous and modern technologies. Disseminating Rapid Rural Appraisal (RRA) is an emerging new methodology can help exploring, identifying and diagnosing rural situations problem, issues as well as developing, extending and transferring knowledge.

Marsden (1991) stated that community participation allows people to control their welfare by drawing on IK and familiar technique as opposed to the extraneous control imposed on them by previous forms of intervention.

As Warren (1991) proposed, it makes sense to incorporate into development planning a process of understanding and using local knowledge systems and conducting participatory research to strengthen those systems.

2.7. Assessment and Validation of Indigenous Technical Knowledge

Gupta (1990) recognized many reasons for documenting traditional wisdom of farmers in particular and ancient people in general. Few important ones are

1. Some of the innovations will help to extend the frontier of knowledge by providing basis for developing new concepts or adding value by grafting or budding available formal biological science knowledge to the farmers' own knowledge;

2. Inclusion of these innovative practices and ancient knowledge in the graduate and post-graduate curriculum will help instill pride among young minds in their own heritage, make them more humble and respectful towards farmers and old rural elites; and

3. Agricultural scientists working in agricultural universities, development departments and extension agencies will find in this knowledge a rich opportunity for recasting their research and action agenda wherever felt necessary.

Sivanarayana (1993) apprehended that unless a consorted effort is made to track and document the valuable knowledge these will be lost soon and cannot be regained in future at any cost.

Kakonge (1995) stated that on-station and on-farm comparative testing can be used to determine whether it would be more practical and economic to use an indigenous innovation on its own or to combine it with the modern technology.

Benfer and Furbee (1996) argued that anthropologists validate models of Indigenous Knowledge through intensive interviews and observation of those who practice, therefore they said that validation of IK is not restricted to scientific criteria only.

Grenier (1997) suggested that after the validation of the farmer's IK, the extension personnel should conduct local and regional workshop to represent the results.

Grenier (1998) stated that one needs to identify the reasons for a particular practice or beliefs when evaluating and assessing the effectiveness of IK systems.

Rai (2007) concluded that traditional ecological knowledge systems and institutions could serve as entry points into the sustainable utilization and management of natural resources.

2.8. Indigenous Knowledge and Intellectual Property Rights (IPR)

Intellectual property rights (IPRs) are the legal protections given to persons over their creative endeavors and usually give the creator an exclusive right over the use of his/her creation or discovery for a certain period of time. Intellectual property is codified at an international level through a series of legally binding treaties. Traditional knowledge holders should be concerned about intellectual property rights as it should guarantee both an individual' s and a group's right to protect and benefit from its own cultural discoveries, creations and products. Western intellectual property law, which is rapidly assuming global acceptance, often unintentionally facilitates and reinforces a process of economic exploitation and cultural erosion. It is based on notions of individual property ownership, a concept that is often alien and can be detrimental to many local and indigenous communities.

Intellectual property rights can actually benefit traditional knowledge holders by promoting both their material and moral interests. The key to realizing these benefits is in understanding how the intellectual property rights system works and the place that traditional knowledge can have in the system.

According to Das, *et al.,* 2002, in today's concept of IPR regime, it is all the more imperative to document and protect our valuable ITK for posterity.

An important purpose of recognizing private proprietary rights is to enable individuals to benefit from the products of their intellect by rewarding creativity and encouraging further innovation and invention. But in many indigenous world-views, any such property rights, if they are recognized at all, should be extended to

the entire community. They are a means of maintaining and developing group identity as well as group survival, rather than promoting or encouraging individual economic gain (Hansen and Vanfleet, 2003).

As per the Aarticle-29 of the Convention on Biological Diversity (CBD), "Indigenous peoples are entitled to the recognition of the full ownership, control and protection of their cultural and intellectual property. They have the right to special measures to control, develop and protect their sciences, technologies and cultural manifestations, including human and other genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs and visual and performing arts'. But, neither the field functionaries nor the ITK holders are hardly aware of these rights. Therefore, extensive efforts should be made to protect theses intellectual property of the poor illiterate masses, before they are perpetrated by others" (Hansen and VanFleet, 2003).

2.9. Incorporation of Indigenous Knowledge in Research and Extension Network

Chambers and Jiggins (1987) supported the need for developing a framework for incorporating indigenous knowledge into Research and Extension system due to following reasons:

1. The transfer of technology (TOT) model fits badly with the needs and priorities of resource-poor farmers;

2. Agricultural extension programmes are still biased towards techniques and strategies which are capital-intensives; and

3. Resource-poor farmers (RPF) are scattered and are not able to make their needs and priorities readily known and felt;

In the interests of cost-effectiveness of research, indigenous knowledge systems should be strengthened, so that their capacity to classify, evaluate, and to some extent predict the outcome of innovations in the local environment can complement science-based development of technology. Strong ITK systems are likely

to facilitate incorporation of a component of farmers' demand into the usually driven agenda of on-station research, and the development of ITK is essential for empowerment in a wider context (McCall, 1987).

According to Warren and Rajasekaran (1993), the incorporation of ITK system in agricultural development has three components:

1. Participatory on-station agricultural research (scientists and farmers);

2. On-farm farmer-oriented research (scientists, extentionists and farmers); and

3. Validation of farmers experiments (farmers and extentionists)

The first two components are sequenced and the third one is a separate process.

IRRI (1996) identified three components for improving indigenous knowledge:

1. Formal research in laboratories and on experimental farm;

2. On farm research managed by scientists; and

3. Farmers managed participatory technology development.

Warren and Rajasekaran (1993) advocated using well trained, research-minded extension personnel to

1. Determine the rational behind the farmer's experiment

2. Record the farmer's experimental methods.

3. Identify the farmers evaluation criteria (the criteria may differ from farmer to farmer and one farmer may have different criteria for different crops).

A framework for incorporating IK system into agricultural research and extension has been developed by Rajesekaran (1993). Following features are some of the important ones:

1. Strengthening the capacities of regional research and extension organizations;

2. Identifying the need for extension scientists/social scientists in an interdisciplinary regional research team;

3. Formation of sustainable technology development consortium to bring farmers, researchers, NGOs and extension workers together well ahead of the process of technology development; and

4. Understanding that it is impractical to depend entirely on research stations for innovations, considering the inadequacy of human resource capacity of the regional research system.

According to Rath (1993), PRA has become the strategy for incorporating local technical knowledge with formal research. While, Sivanarayana (1993) asserted, there is an urgent need to make all scientists aware of ITK to coming forward to evolve in a participatory approach, through supplying publications and conducting meetings, seminars, workshops, symposia etc. He also suggested a model for generating and transferring appropriate technology by utilizing ITKs.

Gupta (1993) developed a model for Participatory Technology Generation involving four groups, viz., Scientists, Extension Personal, Farmers and NGOs. At least six basic activities have been suggested as necessary in the generation of technology with the participation of all the four groups. They were (a) rapport establishing and awareness camps (b) gathering problems and local knowledge (c) reconsidering formal experimentation process (d) conducting experiment and evaluation (e) communicating the results and (f) follow-up and reorientation.

Mishra *et al.* (1994) were of the view that greater sustainability in the agricultural growth and development can be achieved by exploring and utilizing our ancient knowledge. According to them, it seems to be an appropriate time for scientific communities to conduct more and more researches on the ancient knowledge covering larger geographical areas.

Another comprehensive model has been developed by Parasar (1994) for incorporating indigenous knowledge in Research and Extension Network (REN) of his studied state, *i.e.,* Orissa, although the same model can fit well to all states with little or no modification. Major features of the suggested model are:

1. To set up a Centre for Indigenous Knowledge (CIK) in the premises of State Agricultural University, assigning broadly at least three-fold work, viz., (a) collection, (b) documentation and (c) preservation of IK in a kind of knowledge bank;

2. Other activities of CIK should include coordination and monitoring, management of research outputs and related publications for developing literature on IK, and dissemination of center's activities;

3. Curricular sanction for indigenous knowledge in the undergraduate courses and integration in the pre-service training courses of village level agri-extension workers to remove attitudinal barrier against IK;

4. Support of general academia in addition to agricultural disciplines;

5. Involvement of NGOs in the process;

6. In order to popularize IK among the scientists, extension functionaries as well as the farming communities, adequate scope for publicity through electronic and print media should be provided; and

7. The collected indigenous agricultural knowledge should be subjected to preliminary screening and ready assessment in different professional forums before final recommendation.

Qayum (1994) was in strong favour for a blending of the modern scientific knowledge and the indigenous knowledge. He was of the opinion that it would be the most appropriate approach to make any technology cost-effective, hazardless and self-reliant.

In addition to the above mentioned literatures, many more scientists have also argued for the need of building bridges between modern science and local knowledge system; Verma and Singh (1969), Gupta (1981), Chambers (1983), Prasad (1987), Atteh (1989), Warren (1990), and Pal (1991).

Cordell (1990) stated that in some small scale fishing societies, knowledge is or was transmitted via formal apprenticeship system. For example, canoe fishers in Bahia, Northeastern Brazil, Passed on their knowledge through a limited members of apprenticeships that can last for as long as ten to fifteen years.

2.10. Constraints in use and acceptance of Indigenous Knowledge

Chambers (1980) reported it is difficult for some professions to accept that there is anything to learn from rural people or to recognize that there is a parallel system of knowledge to their own which is complementary, usually valid and in some respects superior.

Johannes (1981) stated that in Palau district of Micronesia, fishers began to abandon their traditional management schemes to trade with Japanese colonists and the US administration in 1940's.

In new Caledonia, the processes of discrediting localized knowledge of resources have been going on for generations among European colonists administrators, educators and missionaries (Dahl, 1989).

Swift (1979) identified a number of constraints, in particular the transfer and use of information is likely to be constrained and error-prone, since it has to be passed on orally or by direct experience and held in the heads of practitioners. Biggs and Clay (1980) detailed further limitations like:

1. The scope for improvement via pure ITK is limited to what can be done with the local pool of techniques, materials and genetic resources;

2. Many genetic possibilities are not explored within the informal system, such as the crossing of self-pollinating crops where specific plant breeding techniques are required;

3. The capacity of individuals to generate, implement and transfer ITK varies; and

4. Difference in the function of social groups will influence the type and extent of ITK developed by each.

Kalyansundaram (1993) stated the following points as the limitations of indigenous knowledge:

1. The practices, their intricacies and rationale are known to uneducated and aged people in the villages; and

2. Scientists by and large have scant respect for the utility of such practices and scientific elite methods such as publication, seminar etc, are needed to create awareness.

Johannes (1989) reported that local people's beliefs are erroneous on occasion and do not necessarily lead to sustainable resource management.

Samarakoon and Vanzon (1996) stated that the tension between the desire by some for nation building with centralized planning and others who prefer traditional systems based on local control as the most important issue blocking the appropriate use and acceptance of traditional management system.

Parasar (1994) revealed some formidable, though not wholly unamendable, constraints in developing an operational model for indigenous knowledge in agricultural development. He classified the constraints into eight broad categories, viz., (i) social (ii) psychological (iii) resource-related (iv) infrastructural (v)

promotional (vi) communicational (vii) technical and (viii) political. He stated, the state does not officially recognize the ancient/ indigenous knowledge in the same way as it does with regard to modern scientific knowledge.

Traditional knowledge continues to be ignored by some researchers because its discovery and analysis require in-depth sociologic, economic and anthropologic observations, which are often difficult and time consuming. They further stated that professionals also ignore traditional knowledge because they cannot discredit the knowledge on which their education and careers are based by going outside of their expertise (Christie and White, 1997).

MATERIAL AND METHODS

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3. MATERIAL AND METHODS

This chapter deals with the methodology adopted in carrying out the present study. It includes the selection of locale, the specific tools and approaches used in collection of data, the selection procedure and techniques used in the scientific assessment of appropriateness the indigenous technical knowledge. In order to achieve the objectives under study, the convenient methods and procedures for the collection of data and information were designed for the study area. The present study was carried out during the months of November, 2008 to January, 2009 in the central valley of Manipur state. The methods and procedures applied for the collection of the data are given below under the following sub headings:

3.1. Locale of the Study

The present study was carried out in the state of Manipur. In view of the limited time and resources, the study was further restricted to the Central Valley region of the state which constitutes four districts of the state where, major fishing activities are done.

3.2. Brief Description of the Study Area

3.2.1. General view of Manipur

3.2.1.1. Salient physiography

Manipur, one of the eight states of the North Eastern Region of India, is an isolated hill- girt state stretching between 92°58´E to 94°45´E longitudes and 23°50´N to 25°42´N latitudes. It is a charming place encircled by nine hill ranges on all sides with a small and beautiful oval shaped valley at the centre. The state has 352 kms. long international border with Burma (Myanmar) to the south-east and 502 kms. long border with the adjacent states of Nagaland on the north, Cachar District of Assam on the west and Chin Hills (Myanmar) and Mizoram on the south and the south-west and Surma Tract and upper Chindwin of Myanmar (Burma) on the east. Imphal is the capital of Manipur.

Topographically, Manipur is constituted by two distinct geographic features

1. An elevated plain and
2. Mountain ranges.

The central plain forms a valley of about 2000 sq.kms 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, namely,

1. The Barak river system,
2. The Manipur river system,
3. The Yu-river system (in Myanmar)

Manipur has a geographical area of 22,327 sq. kms. which constitutes 0.7 percent of the total land surface of India. About ninety percent of the total geographical area of the state, i.e., 20,089 sq.kms. is covered by hills, the remaining area is a small valley covering only 2,238 sq.kms. accounting for only one-tenth of the total area of the state. These two areas are not only distinct in respect of physical features but are also conspicuous with regard to various flora and fauna. The valley

region would have been a monotonous, featureless plain but for a number of hills and mounds rising above the flat surface. The Loktak Lake is an important feature of the central plain.

Total geographical area	-	22,327 sq.km
a) Hilly region	-	20,089 sq. km (89.98 %)
b) Valley region	-	2,238 sq. km (10.02 %).

3.2.1.2. Climate

The climate of Manipur is largely influenced by the topography of this hilly region which defines the geography of Manipur. Altitude from the sea level is 3000 m above MSL on hills and 790 m above MSL in valley. Manipur is wedged between hills on all sides. It has sub-tropical temperate climate Manipur enjoys a generally amiable climate, though the winters can be a little cold. The maximum temperature in the summer months is 32ºC. In winter the temperature often falls below 0ºC, bringing frost. The coldest month is January and the warmest July. The state is drenched in rains from May until mid-October and the actual rainfall varies from 1.47 to 2.44 cm per annum (Economic Survey, 2007-08, Govt. of Manipur). The normal rainfall of Manipur enriches the soil and helps in agricultural processes and irrigation.

3.2.1.3. Population Pattern

According to 2001 Census, the population of the state is 22.9 lakhs with a population density of 103 per sq.km. Population of Manipur constitutes nearly 0.22 percent of the total population of India. The population has increased by 4.57 lakhs during the decade 1991 to 2001. Out of the total population of the state, 11.6 lakhs were males and the rest 11.3 lakhs were females. The sex ratio for the state as a whole has improved from 958 females per 1000 males in 1991 to 974 females per 1000 males in 2001. There are 7 (seven) scheduled castes communities and 33 (thirtythree) different scheduled tribes of different ethnic groups presenting complicated socio-economic phenomena.

The total fishermen population in the state is 34,064 numbers in which 19,889 numbers are full time, 8,395 numbers are part time and occasional fishermen constitute 5,780 numbers.

The total number of villages in the state is 2391, where 2315 numbers are inhabited and 76 numbers are uninhabited. And the total number of towns is 33.

3.2.1.4. Literacy

In terms of literacy, Manipur ranks second among the North-Eastern states of India as per 2001 census. The literacy rate has increased from 59.89 percent in 1991 to 70.53 percent in 2001. Among the males, it has increased from 71.63 percent in 1991 to 80.30 percent in 2001, whereas among females, it has increased from 47.60 percent in 1991 to 60.50 percent in 2001. The literacy rate for the rural areas is 67.30 percent and for the urban areas it is 79.30 percent as per 2001 census (Source: Census Publication of the Office of the Registrar General, India, 2001 Census).

3.2.1.5. Fisheries Resources

Though the state has no marine fishery, it has vast inland fishery resources like ponds, tanks, natural lakes, marshy areas, swampy areas, rivers, reservoirs, submerged cropped land, low lying paddy fields etc. The target source of fish is the Loktak Lake. The production of fish in Manipur for the year 2005-06 was estimated to be 18.60 thousand tonnes as against the 17.80 thousand tonnes in 2004-05 showing an increase of 2.36 percent over the previous year.

Table 1: Fishery Resources of Manipur

Sl.No.	Category	Area in ha
1	Ponds and Tanks	9939.00
2	Lakes/ marshy/ swampy/ bheels	22632.73
3	River/streams	13888.27
4	Reservoirs/ canals	782.45
5	Submerged cropped land/ water logged area/ low-lying paddy field suitable for pisciculture purposes	9218.60
Total		**56461.05**

(Source: Fishery Department, Government of Manipur 2007-08)

3.2.1.6. Fish and fish seed production of the State

The year-wise fish and fish seed production of the state are shown in the table 2.

Table 2: Year-wise Fish and Fish seed production of Manipur

Sl.no.	Year	Fish seed production (in millions)	Fish production (in metric tonnes)
1	1990-91	40.00	8,500
2	1991-92	50.00	9,950
3	1992-93	63.00	11,200
4	1993-94	71.00	11,505
5	1994-95	80.00	12,010
6	1995-96	90.00	12,500
7	1996-97	91.50	18,500
8	1997-98	94.50	18,250
9	1998-99	105.50	15,309
1	1999-00	115.10	15,506
0	2000-01	115.00	16,050
11	2001-02	116.00	16,500
12	2002-03	117.00	16,600
13	2003-04	117.00	17,600
14	2004-05	117.00	17,800
15	2005-06	118.00	18,000
16	2006-07	120.00	18,500
17	2007-08	125.00	18,600

(Source: Fishery Department, Government of Manipur 2007-08)

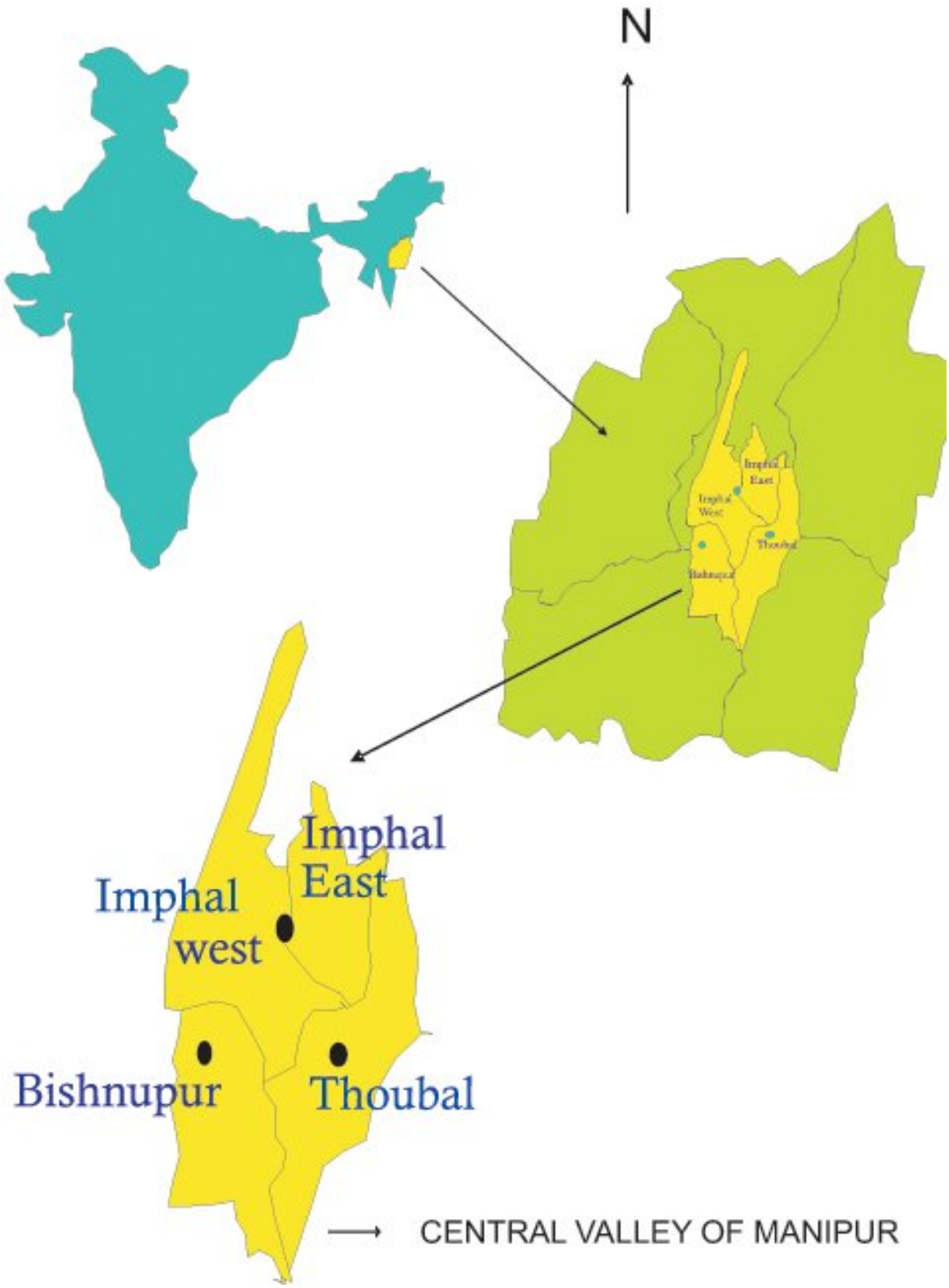


Plate 1: Outline map of India showing the study area

3.2.2. General views of the central valley of the state

The Central Valley of Manipur comprises of four districts, namely, the Imphal West, Imphal East, Bishnupur and Thoubal District. Its total area is 2238 sq.km. which constitute 10% of the total area and total population of 14,11,766 which is 61.5% of the total population of the state of Manipur.

3.2.3. Description of the selected districts

Imphal West - The district of Imphal West covers an area of 709 square kilometers. Located at an altitude of 790 meters, the districts falls between 24º30' and 25º00' N Latitude and 93º45' and 94º15' E Longitude. According to the last census in 2001, the total population of the Imphal West District is 3,94,876. Total fishermen population in district is 2186 numbers in which 2165 are full time fishermen and only 21 are part time fishermen (Quinquennial Livestock Census, 2003). It has literacy rate of 80.61% with 89.1% male literates and 72.24% female literates. The district enjoys a pleasing moderate climate throughout the year with an average rainfall of around 1260 millimeters.

Imphal East – The district came into official existence on 18th June 1997. The district encompasses an area of 519 sq. km. located at an altitude of 790 m above mean sea level. According to 2001 Census Report, the population of Imphal East District is recorded to be 4,44,382. The total fishermen population in the district is 380 numbers. The literacy rate is also commendable at 68.05%. Its climate is moderate throughout the year.

Bishnupur District – This district was originally called Lumangdong. The district area is 496 sq. km. with total population of 2,08,368 (2001 census). According to the Quinquennial Livestock Census of 2003, Govt of Manipur, the total fishermen in district are 3857 numbers out of which, fishermen engaged in full time are 2831 and 1026 of part time. The district of Bishnupur is geographical coordinates of 93.43 º E and 93.53 º E longitudes and 24.18 º N and 24.44 º N latitudes. The Loktak Lake is a huge freshwater lake in this region covers an area of 216 sq.kms., is

the biggest natural source of fish supply which is one of the important food items of the people of the state.

Thoubal District – The district encompasses an area of 514 sq. km and stretches between the latitudinal parallels extending between 23° 45' N and 24°45' N and the longitudinal meridians of 93°45' E and 94°15' E. According to the 2001 census report, Thoubal district records a population of 3, 64,140. Total fishermen population is 1000 out of which 902 numbers are part time and 92 numbers are full time fishermen.

Table 3: District-wise area and population distribution of the Valley of Manipur

Sl.no.	District	Area (in sq.km)	Rural Population	Urban Population	Total Population	Population Density Per sq. km
1	Imphal West	709	286,566	1.08,310	3,94,876	557
2	Imphal East	519	1,97,699	2,46,683	4,44.382	856
3	Bishnupur	496	1,33,627	74,741	2,08,368	420
4	Thoubal	514	2,32,868	1,31,272	3,64,140	708
Valley total		2238	8,50,760	5,61,006	14,11766	631

(Source: Directorate of Economic & Statistic, Govt. of Manipur 2007-08)

Table 4: List of Govt. Fish Farms in the selected Districts of Manipur

Sl.no.	District	Name of Fish Farm
1	Imphal West	D.L.F.S.F., Lamphel
2	Imphal East	F.R.C., Khudrakpam
3	Thoubal	D.L.F.S.F., Wangbal
4	Thoubal	Waithou E.F.F.
5	Bishnupur	D.F.F.S.F., Ningthoukhong
6	Bishnupur	Regional Pengba Seed Farm, Haotak
7	Bishnupur	Takmu E.F.F., Takmu

3.3. Sampling Procedure

The main objective of the study was to collect, document and categorize the Indigenous Technical Knowledge on various aspects of fisheries and aquaculture. Considering the nature and the magnitude of information and data requirements of the study in the central valley of the state, random sampling procedure was used to select respondents from the fishing villages.

3.3.1. Selection of the State

Manipur state was selected purposively for study due to the following advantages.

1. Manipur has rich fisheries resources and stands second in fish production among the eight North-Eastern states of India.

2. The state is rich in Indigenous Technical Knowledges on fisheries and aquaculture related activities.

3. The researcher herself belongs to the study area of the state and is well versed with the ethno-cultural of the state which served good means for the communication with the fishermen of the study area.

3.3.2. Selection of Districts

Manipur has nine districts, five in hills namely, Churachandpur, Senapati, Ukhrul, Tamenglong and Chandel; and four in valleys, namely Bishnupur, Thoubal, Imphal West and Imphal East. Considering the time limitation, only four districts which constitute the central valley of the State viz. Bishnupur, Thoubal, Imphal East and Imphal West district were selected for study because major fishing activities of the state are carried out in these four districts. The Loktak Lake also falls in the valley districts.

3.3.3. Selection of Villages

Seeing the availability of the resources and in consultation with the fisheries extension officers of Department of Fisheries, two fishing villages from each selected district were chosen randomly for the purpose of collecting data for the study. Therefore, in total, eight fishing villages were selected for the study. The selected villages from each district were as follows:

Bishnupur District – i) Thanga Tongbram Leikai area
ii) Nambol Thiyam pat

Thoubal District - i) Heirok fishing village
ii) Tentha Kharungpat

Imphal West District – i) Yurembam, Patsoi
ii) Sagol tongba

Imphal East District - i) Kongba river system of Khurai area
ii) Kiyamgei

3.3.4. Selection of Respondents

From each of the selected villages, ten fishermen who practiced the traditional fishing methods were randomly selected as respondents for the study. Therefore, in total 80 respondents were selected for the study.

3.4. Methods and Tools for Data Collection

3.4.1. Collection of ITKs in Fisheries

The data on socio-economic profile of the respondents and the available indigenous technical knowledge in fisheries were collected by employing different methods. They were:

(a) Direct Interviews

A semi-structured interview schedule (attached as Annexure-I), specifically prepared by incorporating all aspects of fisheries on which data and information were required, served as the major tool and means for collection of data. The respondents were contacted individually and interviewed in an amicable atmosphere, either at homes or at work places. In addition to the structured questions in the schedules, they were also asked to explain and describe the methods and practices they were following. All the responses and explanations were recorded in the schedule.

(b) Field Observations

Apart from personal interviews, personal visits were made to the work places, reservoirs and lakes alongwith the respondents to observe the ITKs methods, practices, equipments and documented vital information. Wherever felt necessary, photographs were also taken for systematic documentation of the collected ITKs.

(c) Focus Group Discussion

Focus group discussions were also organized in each of the selected villages alongwith the heads of the villages and communities and the respondents in a healthy rural environment to gather more detailed and concrete ITK practices of their villages.

(d) Conversation with Experts

During the course of data collection, conversations with different experts and fisheries officers of the department of fisheries were also made to collect all available ITKs in the study area as far as possible. As they were well aware about different sources of ITKs in fisheries, they often guided in identifying the potential sources.

(e) Secondary Sources

Due to difference in the time of activities of some indigenous fishery practices and the time of the research work, collection of secondary data from different sources such as researchers, fisheries department and NGOs served as major tools to fulfill the required data.

3.4.2. Categorization and Documentation of collected ITKs in Fisheries

For systematic documentation of the collected ITKs, they were categorized based on different aspects of fisheries, namely:

I. Fishing methods
II. Fishing Traps
III. Fish Aggregating Devices
IV. Fish Processing and storage
V. Fish health management
VI. Construction of gears and crafts
VII. Preservation of gears and crafts materials
VIII. Paddy cum fish culture
IX. Rituals, belief and custom based on fish
X. Others (Unclassified)

3.5. Assessment of Appropriateness of Selected ITKs in Fisheries

3.5.1 Assessment of Appropriateness

To make use of the ITKs, assessment of their appropriateness and scientific value is equally important besides collection and documentation. Appropriateness of ITK means identifying its potentially useful rational knowledge embedded in it and evaluating its effectiveness for making use of it in developmental process. In view of the above and in the light of the purpose of the present study, it was felt essential to assess the appropriateness documented ITK's of fisheries to establish their rationale and validity. The assessment of appropriateness of twelve identified ITKs were made based on responses of experts on six parameters, namely, (i) Cost-effectiveness, (ii) Materials availability, (iii) Social acceptability, (iv) Cultural appropriateness, (v) Environmental compatibility and (vi) Scientific value (Nirmale, 2002).

3.5.2 Parameters for assessing the Appropriateness

For assessing the appropriateness and scientific value of the ITKs in fisheries, selected parameters were operationalized as given below.

1) **Cost Effectiveness:** It is the degree to which the fishermen find any ITK method or practice cheaper as compared to any other similar practice and affordable within their existing purchasing capacity. In other words, cheaper the practices or methods, more will be the score.

2) **Materials Availability:** It is the degree to which the fishermen would find the materials required for any ITK method or practice are easily available in sufficient quantity in the local area of fishing villages. In other words, easy and sufficient availability of materials in the area, more will be the score.

3) **Social Acceptability:** It is the degree to which fishermen would find any ITK practice or method suitable, comfortable and useful to their existing fishing

conditions. In other words, more acceptability and usefulness by the society, more will be the score.

4) **Cultural Appropriateness:** It is the degree to which any ITK practice or method is in consonance, compatible, matching and appropriate with the existing socio-cultural norms and values of the fishing communities. In other words, more appropriate to the culture, more will be the score.

5) **Environmental Compatibility:** It is the degree to which any ITK practice or method is friendly and compatible to the environment i.e., without having any disturbance or negative effect on different components of the environment, viz., soil, water, air, flora and fauna. In other words, more the environmental friendly, more will be the score.

6) **Scientific Value:** It is the degree to which any ITK practice or method is consistent, rational and agreement with the established and proven scientific theories, laws and principles. In other words, more the scientific values, more will be the score.

3.5.3. Selection of ITKs for assessment of appropriateness

Before assessment, the collected ITKs were prioritized based on the frequency and common use by fishermen. Then, twelve commonly used ITKs under following four aspects were selected for subjecting to assessment of their appropriateness and scientific value.

1. Fish Aggregating Devices (FADs)

a) *Phoom-namba* - Transplantation of *Phoom* (aquatic plants) for FAD in lake

b) *Kao* - branches, twigs in bamboo-made triangular-shaped structured as FAD in river

c) FAD for Grass carp - Putting of grasses in selected area before catching the fish

d) Use of “Ising kambong” (*Hygoryza sp.)* as FAD for air-breathing fishes in low-lying areas

2. Fishing Traps

a) Operation of Box Traps (*Taijeps*) with identification marks in Ponds as well in Lakes

b) Splits of bamboo are heavily smoked before making traps

3. Fish Health Management

a) Turmeric powder and lime are put in pond as prophylactic measures to prevent from EUS

b) Banana stem are used in pond to improve water quality

4. Fish Preservation Methods

a) *Hentak - (*fermented fish paste) - *Alocasia micrrohiza* is used to accelerates fermentation

b) *Ngari - (*semi fermented fish)- earthen pot is used as container for fermentation process

c) *Nganam* - (steamed fish product) - turmeric leaves is used as preservative

d) Fern *(Microlepia strigosa)*gives golden yellow color when its fumes is passed through smoked fish

3.5.4. Collection of Responses from Experts

The assessment of appropriateness and scientific value of these twelve identified ITKs were made based on responses of experts on six parameters, namely, (i) Cost Effectiveness, (ii) Materials Availability, (iii) Social Acceptability (iv) Cultural Appropriateness, (v) Environmental Compatibility and (vi) Scientific Value. The responses were collected by sending a “Response Sheet” (attached as Annexure-II) through emails and by hand (for CIFE, Mumbai) along with the brief description of the ITKs to 45 scientists, researchers, extension personals, fisheries experts and subject matters specialists of different recognized institutes, namely, Central Institute of Fisheries Education (CIFE), Mumbai; Central Marine Fisheries Research Institute (CMFRI), Cochin; Central Institute of Freshwater Aquaculture (CIFA), Bhubaneshwar; Project Directorate of Cold Water Fisheries (PDCWF), Dehradun; College of

Fisheries, Tripura; Institute of Bio-resources and Sustainable Development (IBSD-DBT), Imphal and Department of Fisheries, Manipur. Response Sheets were received by return mails and/or by hand. Out of 45 experts, responses from 22 experts were received, analyzed and discussed.

3.6. Scoring Techniques for Assessment of Appropriateness

Experts were asked to give scores in a five point continuum scale, i.e., 1,2,3,4 or 5 as per the weightage they give to each of the ITKs, based on their expertise and conscience, in an ascending order as given in the Table-5. Then, all the scores of a particular parameter of any ITK are added and average scores were calculated for all the parameters. To assess the overall appropriateness of these ITKs, average scores of all the six parameters are added. For easier discussion, the percentages were also calculated and tabulated.

Table 5: Scoring Pattern of the Parameters for Assessing the Appropriateness

S.No.	Parameters	Continuum Scale	Score Assigned
1	Cost effectiveness	Very High Cost	1
		High Cost	2
		Moderate Cost	3
		Cheap	4
		Very Cheap	5
2	Materials Availability	Very Less Availability	1
		Less Availability	2
		Somewhat Availability	3
		Easy Availability	4
		Very Easy Availability	5
3	Social Acceptability	Very Low Acceptability	1
		Low Acceptability	2
		Moderate Acceptability	3
		High Acceptability	4
		Very High Acceptability	5
4	Cultural Appropriateness	Very Less Appropriate	1
		Less Appropriate	2
		Moderate Appropriate	3
		High Appropriate	4
		Very High Appropriate	5
5	Environmental Compatibility	Very Low Compatibility	1
		Low Compatibility	2
		Moderate Compatibility	3
		High Compatibility	4
		Very High Compatibility	5
6	Scientific Value	Very Low Scientific Value	1
		Low Scientific Value	2
		Moderate Scientific Value	3
		High Scientific Value	4
		Very High Scientific Value	5

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

The required data collected from different respondent fishermen of the study area, i.e., central valley of Manipur were compiled together and discussed below. Some of the data were tabulated and analyzed wherever it is necessary and presented in concise form. Based on the objectives of the study, the results and discussions are broadly organized and presented under the following sub-headings.

4.1. Socio-economic Profile of the respondents (fishermen) of the study area

4.2. Documentation of the ITKs and fishermen's rationale behind their use

4.3. Assessment of Appropriateness of ITKs in Fisheries

4.1. Socio-economic Profile of the Respondents of the Study Area

The socio-economic profiles of the respondents were tabulated and discussed below under the following parameters:

I. Age.
II. Sex.
III. Marital status.
IV. Size of the family.
V. Type of house.
VI. Educational status.
VII. Experience in fishing.
VIII. Income pattern.
IX. Source of fisheries information.
X. Expenditure pattern.

Table 6: Socio-economic profile of respondents

Sl.No.	Characteristics	Categories	Respondent (n = 80)	
			Freq.	%age
1	Age	Young (Upto 30 years)	18	22.50
		Middle (31-50 years)	46	57.50
		Old (Above 50 years)	16	20.00
2	Sex	Male	59	73.75
		Female	21	26.25
3	Marital status	Married	57	71.25
		Unmarried	23	28.75
4	Family size	Small (≤ 4 nos)	8	10.00
		Medium (5-7 nos)	34	42.50
		Large(> 7 nos)	38	47.50
5	Types of House	Thatched	20	25.00
		Kutcha	50	62.50
		Pucca	10	12.50
6	Education	Illiterate	20	25.00
		Upto Primary level	18	22.50
		Upto High School	37	46.25
		Above High School	5	6.25
7	Fishing Experience	Upto 10 years	16	20.00
		11-20 years	17	21.25
		Above 20 years	47	58.75
8	Annual Family Income	Below Rs. 10,000	20	25.00
		Rs. 10,000-20,000	40	50.00
		Rs. 20,000-30,000	14	17.5
		Above Rs. 30,000	6	7.50
9	Sources of Fisheries Information	Fisheries Dept / Extension Officer	35	43.75
		NGOs	20	25.00
		Radio/ Television	15	18.75
		Others (neighbours, relatives, friends, etc)	10	12.50

As per the table 6, most of the respondent fishers belonged to the age group of 31-50 years which constitute 57.5 percent of the total respondents. It shows the active involvement of the middle age fishers in the fishing activities. This was followed by the young age group of less than 30 years (22.5%). 20.0 percent of the fishers were of old age.

According to the table, out of the 80 respondents, 59 numbers (73.75%) were male and 21 numbers (26.25%) were female, which shows that more male fishers were engaged in fishing activities than the female in the fishing villages.

As far as their marital status is concerned, the table shows that majority of the fishers, i.e. 71.25 percent of the respondents (57 respondents) were married and very few of 28.75 percent were unmarried (23 respondents).

Majority of the fish farmers i.e. 47.5 percent of the respondents belonged to large family size and 42.5 % belonged to the medium size families with 5 to 7 members, while only 10.0 percent of the respondents had small family size of four or less members.

Very less number of the fishermen (12.5%) had *Pucca* houses in the study area. Most of the fishermen (62.50%) have *Kutcha* houses and around 25.0 percent of the respondents were living in the thatched houses.

From the table 6, it is observed that only 25.0 percent of the respondents were illiterates, while the rest of 75.0 percent are literates. Out of the 75.00 percent, most of the literate fishers had acquired education upto high school (46.25%), 6.26 percent above high school level and 22.5 percent had acquired education upto primary level.

Analysis of the fishing experience in the above table revealed that the majority of the respondents (47 respondents), i.e., 58.75 percent had the experience of fishing activities for more than 20 years. Also, 21.25 percent and 20 percent had experience of 11-20 years and for less than 10 years respectively.

Income is an important parameter which shows the quality and standard of living. In the study area, around 50.0 percent of fish farmers had an annual income between the range of Rs. 10,000-20,000. Around 17.5 percent had an average annual income of Rs. 20,000-30,000, 25 percent had an average annual of less than Rs 10,000 and only 7.5 percent of the respondents had an average annual income of more than Rs. 30,000.

The main sources of fisheries information in the study areas were recognized as Fisheries Department/ Extension Officers, NGOs, Radio/Television and others. Majority of the fishermen (43.75%) in the study areas got information from the Fisheries Department/Extension Officers followed by the NGO (25.00%), Radio/Television (18.75%) and 12.5 percent of the respondents got information from other sources such as neighbors, friends and relatives, etc. The findings relating to socio-economic profile of the respondents have also been depicted in bar diagrams from Figures 1-9.

Table 7: Average Annual Expenditure Pattern of Respondents

Sl. No.	Item	Percentage of expenditure (%)
1	Food	55.00
2	Clothing	15.00
3	Education	18.00
4	Medical	8.00
5	Entertainment	2.00
6	Others	2.00
Total		**100.00**

In table 7, the average annual expenditure pattern of the respondents has been analyzed. It is found that 55.0 percent of the income was spent for their food. This was followed by the expenditure on education (18.0%) and cloths (15.0%). On an average they spent 8.0 percent of their income on medical treatment of family members. The results have also been shown in pie diagram in Figure-10.

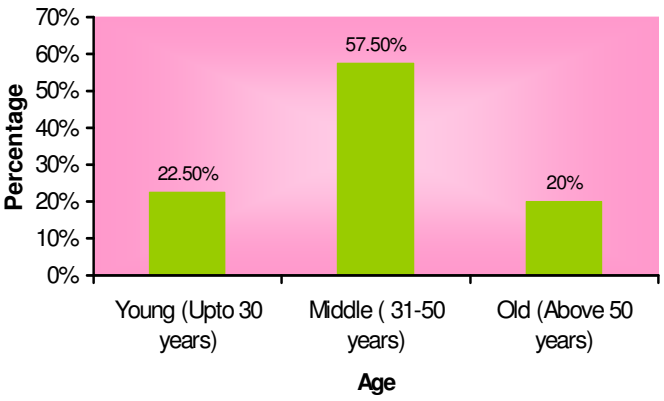


Figure 1: Distribution of respondents according to age

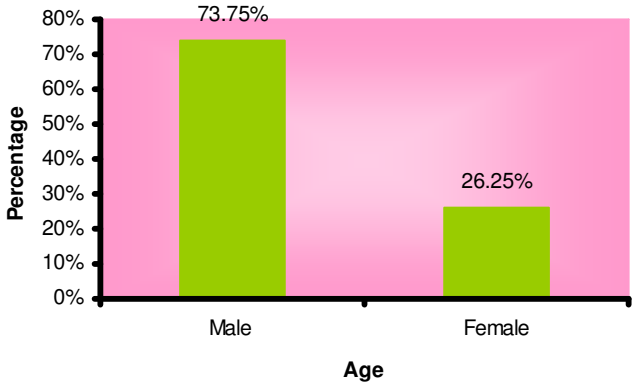


Figure 2: Distribution of respondents according to sex

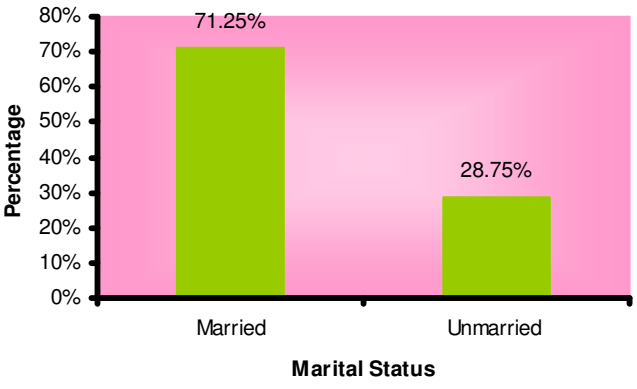


Figure 3: Distribution of respondents according to marital status

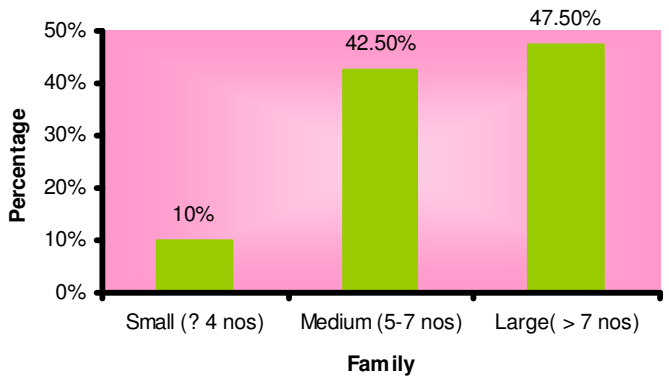


Figure 4: Distribution of respondents according to family size

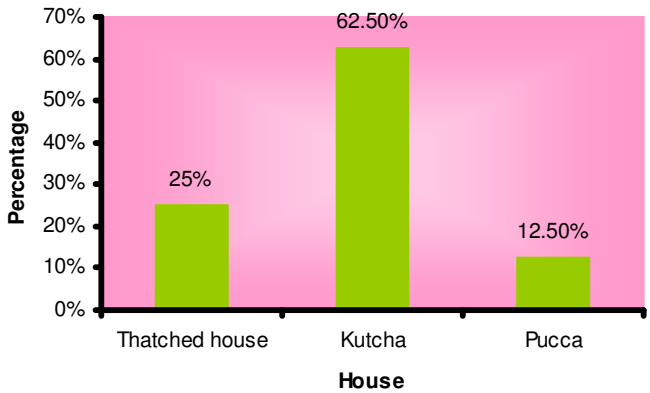


Figure 5: Distribution of respondents according to type of house

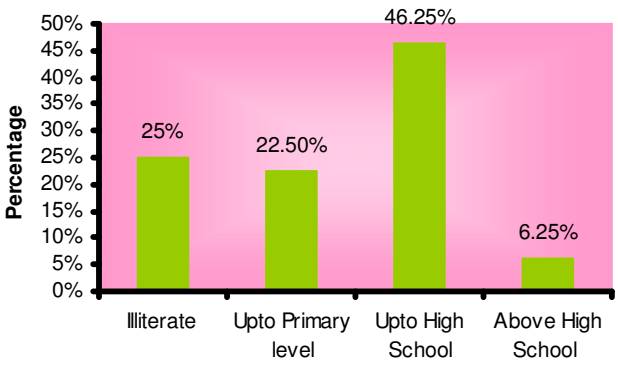


Figure 6: Distribution of respondents according to educational status

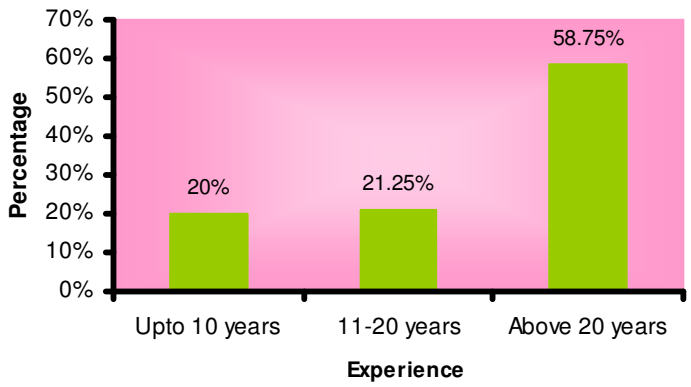


Figure 7: Distribution of respondents according to fishing experience

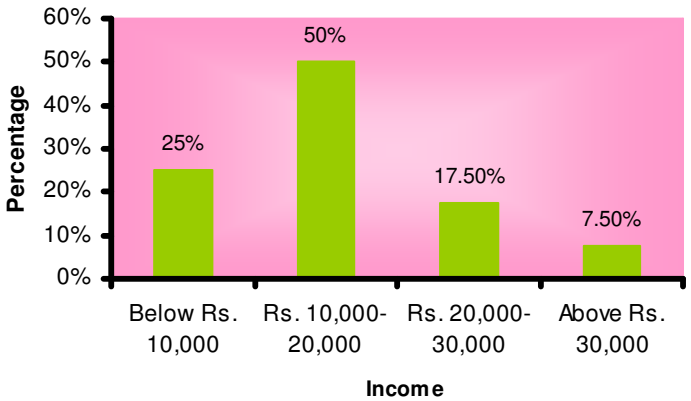


Figure 8: Distribution of respondents according to average annual income

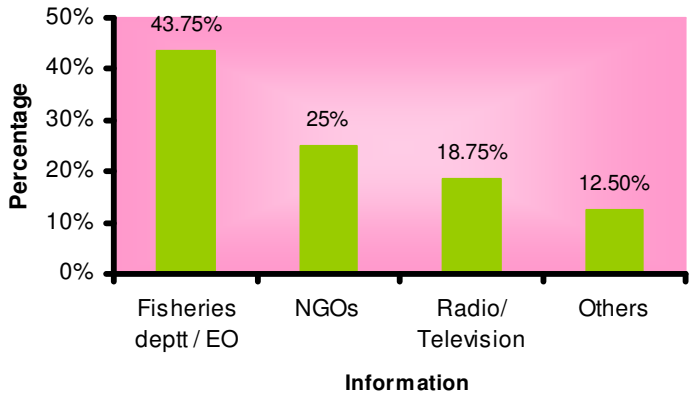


Figure 9: Distribution of respondents according to source of fisheries information

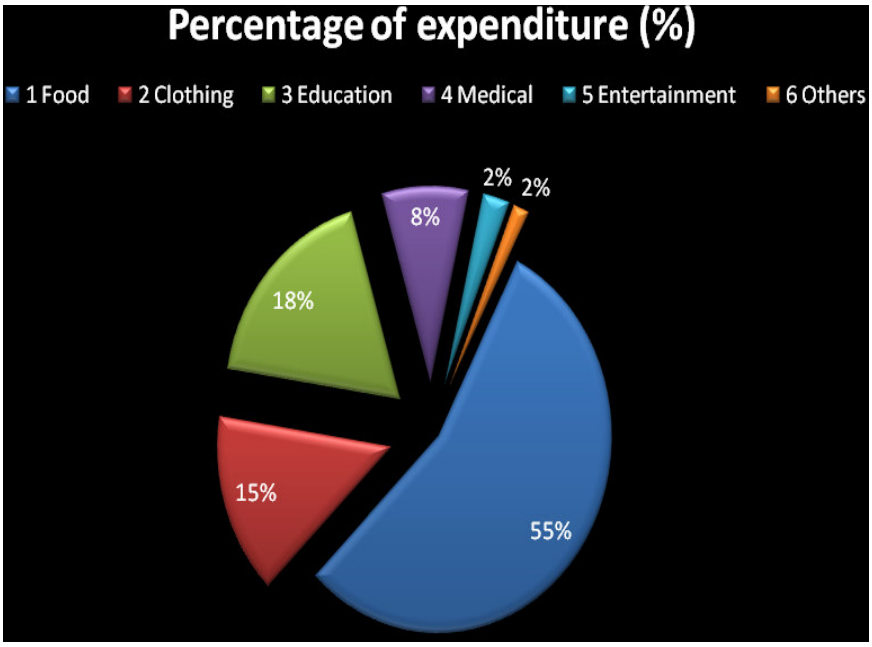


Figure 10: Pie diagram showing Average Annual Expenditure Pattern of Respondents

4.2. Documentation of the ITKs and fishermen's rationale behind their use

The Indigenous Technical knowledge (ITKs) related to fisheries and aquacultures of central valley of Manipur were collected and documented. These were widely practiced throughout the central valley, but some of the practices were unique to certain area such as the Loktak Lake. The ITKs presently being used by the fishermen and collected are broadly categorized and presented under the following sub-headings. In addition to the documentation of different ITKs relating to fisheries, the rationale behind their use, as perceived and mentioned by the respondents, were also concurrently discussed to facilitate comprehension.

4.2.1. Fishing methods

4.2.2. Fishing traps

4.2.3. Fish aggregating devices

4.2.4. Fish processing and storage

4.2.5. Fish health management

4.2.6. Construction of gears and crafts

4.2.7. Preservation of gears and crafts materials

4.2.8. Paddy-cum-Fish culture

4.2.9. Rituals, Belief and Customs based on Fish

4.2.10. Others (Unclassified)

4.2.1. Fishing methods

The fishing methods of Manipur can be broadly classified into two groups based on the operation and catch of fish:

i) Major fishing methods and

ii) Minor fishing methods

Major Fishing Methods

4.2.1.1. *Nupi-il* / Lift Net

"Nupi" means woman and *"il"* means net in Manipuri. It is mainly operated by women. The net is supported by two bamboo frames each of about 3 - 3.5m length (plate-2). These two bamboo frames join together in the middle using cane strips so that it gives out four tips. Each tips of the bamboo is made a round cut mark for proper fastening of the net. The four tips of the net are fasten into the tips of bamboo. The net is mainly made of nylon, previously cotton net was also used. A bamboo pole locally known as "*poura*" supports the whole structured by means of fulcrum in the middle of the bamboo frames. It helps to haul the whole net especially with help of hauling rope of about 7m length. Details of this net are given in table 8.

It is operated either from the bank of lakes, rivers and ponds or even from a constructed platform or from the deck of a boat. The fishermen haul the net by inserting the "*poura"* in the dyke tightly (or with support of thighs when it is operated from boat) and pressing it down. The net thus lifts up from water and they collect the catches by hand. It is practiced throughout the year. The species which are normally caught by this method are Indian major carps, exotic carps, *Puntius sp., Chanda ranga*, *Chanda nama*, *Botia sp.*, *Colisa fasciatus, Esomus dendricus,* etc.

Table 8: Details of *Nupi il (Lift Net)*

Material used	cotton or nylon, bamboo
Type of net (knot)	mosquito netting
Mesh size	2-3mm
Length	3-3.5m
Breadth	2-2.5m
Fishing season	Throughout the year
Species caught	*Indian Major Carp, Exotic carp, Puntius sp., Chanda ranga*, *Chanda nama*, *Botia sp.*, *Colisa fasciatus, Esomus dendricus,* etc

Plate 2: Operation of *Nupi-il* from (A) Dyke and (B) Boat

4.2.1.2. *Il-jao* / Dip Net

Bigger dip net is known as *"il-jao"* in Manipuri where *"il"* means net and *"jao"* means big. It is made by stitching about 9-12 numbers of small dipnets in a rectangular form. The four corners of the net are tightened to four bamboo poles and again these bamboo poles are supported by another pole to secure them in position (Plate-3). On one side, a platform or dyke acts as a sort of platform. The net is operated by fulcrum by pulling the net ropes. Fishing operations are done by fixing the net under water, kept immersed for 4-5 hours or even 1 day of setting. In order to increase catch efficiency, feeds like rice bran soaked in water is made into lump paste and spread over the net so as to attract the fishes. While hauling the net, two fishermen from two boats start pulling the rope from the platform side lifting the net. The net is lifted up by untying the lower two ropes and pulling them gradually above water surface. Details of this net are given in table 9. Fishes caught are collected by means of smooth bamboo pole "*pou"* beating the net one after another by two persons to the collection side. It is operated in the month of May-September in the Loktak Lake.

Fishes which are caught in this gear are small shoal of *Puntius sp. Esomus dendricus* and *Amblypharyngodon mola, Notopterus sp*, IMC and air breathing fishes.

Table 9: Details of *Il-jao* / Dip Net

Area of operation	Lake
Material used	Cotton/nylon
Knot	Mosquito netting
Length	15m
Breadth	10m
No. of person required	Two
Peak operation season	May-September
Bait used	Rice bran

Plate 3: Operation of *Il-jao* in Lake

4.2.1.3. *Lang* / Gill net

These are single wall nets with required mesh size for the desired fishes which are entangled by the gills themselves in the netting. It is one of the most widely used gear by fishermen. They set the net mainly at the surface of the pond or lake for few hours and they haul it either from the dyke or from the boat (plate-4). It is made of monofilament, so once fishes are entangled in the net, are not able to escape. Depending on the catch of fish, it is mainly classified into five types. Those are

1. Ngapai Lang (*Chitala chitala* gillnet);
2. Ngarang Lang (*Nangra viridecsens* gillnet);
3. Phabou Lang (*Puntius* gillnet);
4. Ukabi lang (*Anabas testudineus* gillnet); and
5. Langjao (Big gillnet)

4.2.1.4. *Khoisang thakpa* / Longline

"Khoisang thakpa" means setting of the longline on the water surface. It is made of nylon/cotton twine of about 50-100m long fixed with series of baited hooks of about 30-50 numbers at an interval of 2-3m on the main line which is stretched on the surface of the water. While in operation, one end of the mainline is tied firmly to a fixed pole and setting is continued with successive ties of the mainline to the available weeds until the tail end is again tied to another fixed pole (plate-5). The most common live bait fishes used are *Punctius sp.*, insects, earthworms, *Esomus dendricus, Amblypharyngodon mola,* prawn and sometime small size *Channa sp.* It is set early in the morning and hauled after 7-8 hrs and reset it again on the desired region. It is operated mainly during the summer. Species caught are *Channa sp., Clarias batrachus, H. fossilis, Anabas testudineus, Notopterus notopterus, Wallago attu, Glossogobius giuris, Osteobrama sp., Macronagthus aculeatus, Ompok sp., Mystus bleekeri, Tilapia sp., Monopterus albus, etc*. Details of this long line are in table 10.

Plate 4: Setting (A) and Hauling (B) of Gill Net/ *Lang*

Table 10: Details of *Khoisang thakpa* / Longline

Total length of the main thread	50-100m
Materials used	Nylon thread, iron hook
Distance between two branch line	2-3 m
Total number of hooks used	30- 50nos
Nature of setting	Surface
Type of operation	Whole day setting and hauling
Number of fishermen required	1 or 2
Baits used	*Puntius sp.*, insects, earthworms, *Esomus dendricus, Amblypharyngodon mola,* prawn
Peak season	Summer

4.2.1.5. *Moirang Lang* / Encircling Net

This fishing method is same to that of purse seine and setting of gill net. Generally, 8-10 gill nets are joined together and they encircle fish shoals (plate-6). The fishermen drive out the fishes from the boats on-board by striking the edge of the boat or by using spear from inside the centre of the encircling area. The fishes are then gilled in the nets encircled. This is operated in any suitable area like lake where shoals of fishes are observed. Fishermen identify the shoals of fishes by seeing the water colour and also get indication from movement of the aquatic weeds. Catches depend on the mesh size of the nets. Species caught are Indian Major Carps, Exotic Carps, *Rohtee alfridina*, *Wallago attu*, *Anabas testudineus,* etc. Main fishing season is when the water level reduces to its minimum i.e. November to June.

Plate 5: *Khoisang thakpa*/ Longline

Plate 6: *Moirang Lang* / Encircling net

4.2.1.6. *Moonamba* / Drag net

This fishing method is mainly practiced during dry season in beels, ponds and lakes. Fishes from the shallow water areas or almost dried area are dragged out by this net and different kinds of fishes varying from small to large size fishes are caught. Two fishermen are required for the operation of this gear. This gear is operated by dipping the net completely inside the water and turning the net mouth along with the current. As soon as the fishermen feel the entanglement of the fish, they clip the net mouth, lift it up and take out the fishes.

Minor Fishing Methods

4.2.1.7. *Longthrai fishing* / Scoop Net

Scoop net is locally known as "*Longthrai"*. It is of various shapes such as cup shaped, triangle shaped, circular or trapezoidal etc. This gear has a netting of nylon or mosquito net mounted on the bamboo frame or jute frame with long handle attached to the frame (plate-7). It is operated both from the dyke as well as from the boat in the deeper water or from the margin near to dyke of the pond or lake especially in the weed infested area. It is practiced throughout in all seasons both by the men, women and also children. It is regarded as most easy means for catching fish. Species caught are Minnows, prawn, *Channa sp., Anabas testudineus*, *Clarias batrachus*, etc.

4.2.1.8. *Long-oop* fishing / Plunge Cover-basket

It is bell-shaped basket made of Bamboo strips/ lee having a height of about 50-55cm with foot diameter of 40-50cm and top opening diameter of about 13-15cm (plate-8). It is operated during the dry season, when the water reduces to its minimum level. The gear is operated by one man. It serves as compulsory gear for all the fishermen as it is available in all fishermen houses. Species caught are Indian major carps, Exotic carps, *Notopterus sp., Channa striatus, etc.* Similar practiced has been reported by Barman (2002) about the used of bamboo basket in Nalbari district of Assam.

Plate 7: Operation of *Longthrai* / Scoop-net

Plate 8: (A) *Long-oop*/ plunge cover-basket (B) operation

4.2.1.9. *Long* fishing / Spear

This fishing method is practiced throughout the state. It is mainly operated by the expert fishermen only. It has 5-9 prongs of steels or bamboo with iron point at the tips attached to a long bamboo pole of 3-4m (Plate-9). After locating the fish in water by seeing the bubbles or the movement of fish, the spear is thrown from the boat or from the dykes. It is a destructive fishing method. Species caught are *Channa striatus, Labeo rohita,* Common carp, Exotic carps, *Wallago attu*, etc.

4.2.1.10. *Khoi choppa* / Pole line

This type of fishing method is operated starting from children into old aged fishermen. It consists of a pole made from bamboo branch or splits with a length of about 1.5-2 metres or even more as per the convenience of the fishing ground (Plate-10). A nylon or cotton twine of about 2-3 meters length with a hook at one end is tied at the tip of the pole. A reed of around 3-4 cm length is attached in the middle of the twine which acts as float. This float will move when fishes are hooked. For using this gear in running water a lead weight is attached to the line at about 10-15 cm above the hook in order to avoid the line to be drifted away and to maintain proper hanging inside the water. Baits used in the hooks are earthworm, maida paste, *hentak*, paste of boiled rice, *etc*. Details of the *Khoi choppa* is given in table 11.

Table 11: Details of *Khoi* / Pole Line

Materials used	Bamboo pole, nylon thread, hook , float
No of hook used	1 number.
Nature of setting	Column
Type of operation	Setting/ hauling / Whole day operation
Man labor required	One person
Baits used	Earthworm, paste of maida, paste of boiled rice etc
Species caught	*Channa sp., A. testudineus, Notopterus*, Singhi etc

Plate 9: Operation of long/spear

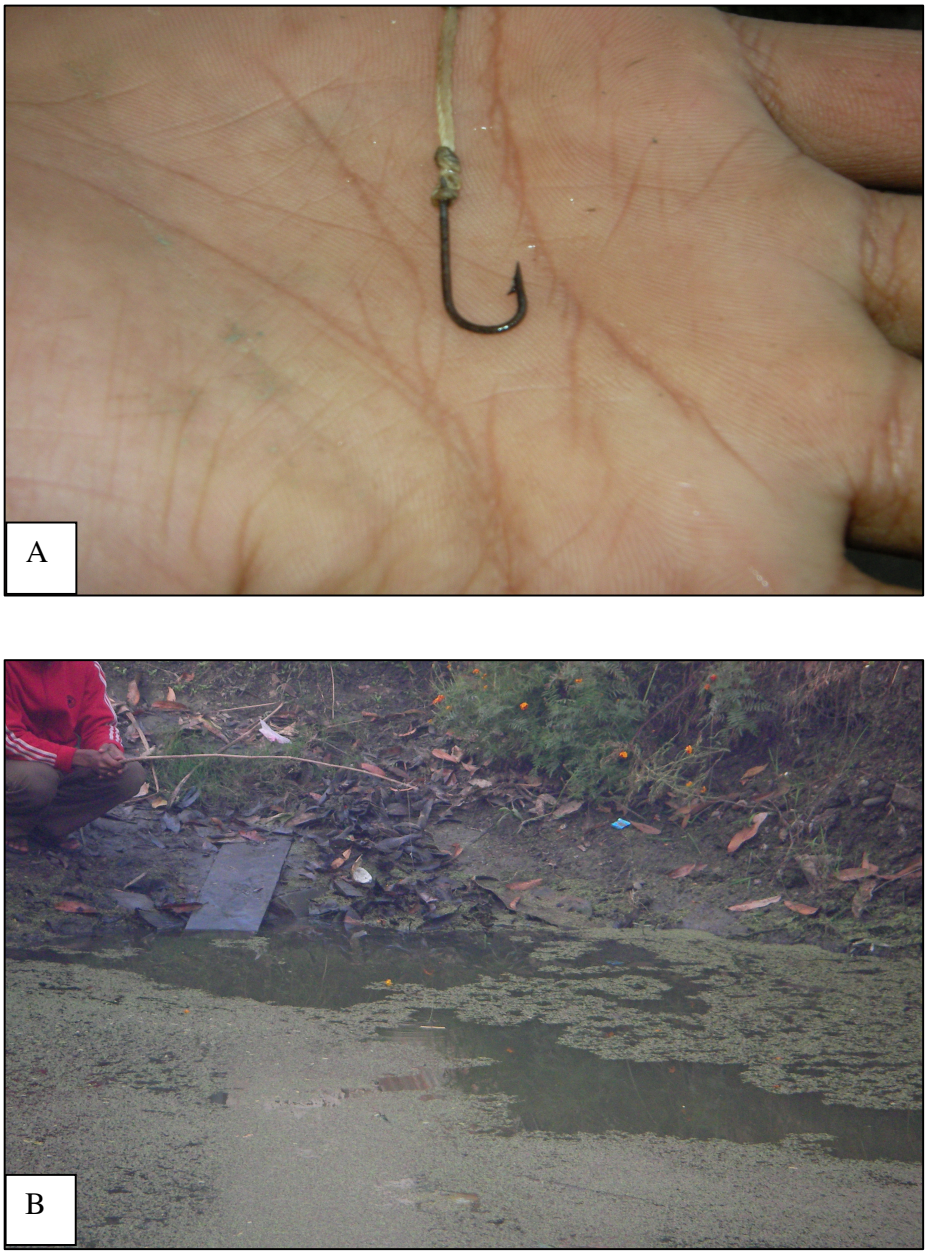


Plate 10: (A) Shape of Hook (B) Setting of Pole line (*Khoi-choppa*)

4.2.2 Fishing Traps

4.2.2.1. *Taijeps* / Bamboo basket/ Box trap

These are rectangular box shaped traps made from seasoned bamboo splits fastened by polythene straps (Plate-11). It is operated in the lakes and ponds by setting among the weeds in rows. They have longitudinally open mouth at one side with non-returnable longitudinal valves fixed in the mouth pointing the valve stick inwardly. Three-fourth of the box are kept set either for ascending or descending fishes in a row facing different directions or as desired by the fishermen.

Some of the commonly accepted norms and procedures strictly followed by the fishermen in setting of traps in lake were;

1. No fisherman should set gillnet in front of box traps.

2. No surrounding nets or gillnets can surround any other fishing gear set by other fishermen.

3. Fishes which are already hooked, but trapped in the box cannot be taken by other fishermen who are fishing nearby with same gear.

4. Identification mark, locally called "*looyek*", on the trap should be there (Plate 12).

Table 12: Details of Rectangular /Box traps / *Taijep*

Height	40-50 cm
Breadth	15-20 cm
Length	16 cm
Width of valve opening	4-5 cm
Gap between the splits	0.5-0.7cm
Materials used	Bamboo splits of 3-4mm diameter
Baits used	Earthworm, kitchen waste
Longevity	2 years

Plate 11: Operation of *Taijeps* / box traps, (inset) shape of *Taijep*

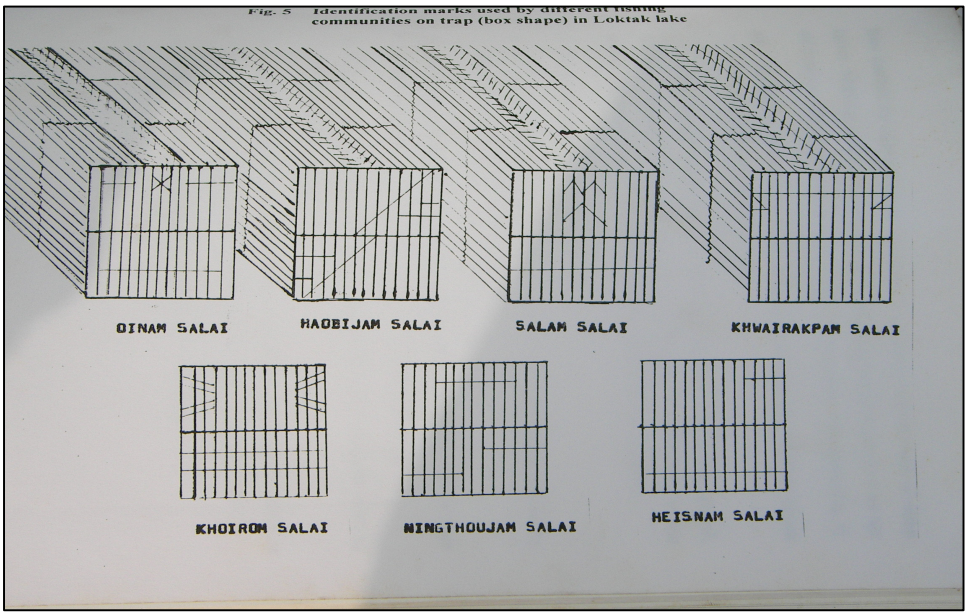


Plate 12: "*Looyek*"- Traditional Marks on Traps

4.2.2.2. *Kabo-Lu* / Tubular trap

This trap has valves at both ends. Opening is there in the middle portion which is relatively larger in size and tapering towards both the top ends (Plate13). It is made of bamboo splits and the openings are made in such a way that fishes once entered are not able to come out again. It is fastened by cane / polythene straps. This is set among the thick aquatic weeds or in the water channel / outlet from the ponds. The catfishes are the main species which are caught in this tubular trap. Details are of *Kabo-lu* are given in table 13.

Plate 13: *Kabo*-lu / Tubular Trap

Table 13: Details of *Kabo Lu* / Tubular Trap

Length	45-50 cm
Body circumference	50-56 cm
Diameter of valve	4cm
Diameter of opening at the cod end	4cm
Construction materials used	Bamboo splits
Space between bamboo splits	2-3mm
Longevity	2 years
Major species Caught	catfishes

4.2.2.3. *Sora-lu* / Conical Trap

"Sora-lu" is the biggest trap among all the traps operated in Manipur. This trap is mainly used for catching small fishes like air-breathing fishes and weed fishes. Mainly operated in the river and lake mouth in medium water current and also in the paddy field during rainy seasons in the month of June to August. It consists of two parts, bigger one is of conical shaped tapering with circular end in which two detachable ropes are tied at opposite directions and the smaller one is given a tubular shape with tapering towards the end (Plate 14). The former part serves for congregation/aggregation and the later act as fish collecting cod end. The two parts are joined together by a detachable rope which is tied at the mouth of the smaller one.

During operation, the trap is placed in a pre-selected area. The placement of the trap has to be done by fixing two poles at opposite directions where two ropes of the trap are to be tied. In the mouth of the second part, the tapering circular end of the first part is inserted and made it continuous one. The rope attached to the trap is again tied to the pole in order to protect it from being flown away. Operation is carried out during evening, the trap is kept for whole night and in the early morning fishes are harvested by detaching the smaller part of the trap. Its operation can be continued for whole day. Details of this *Sora-lu* are given in table 14.

Table 14: Details about *Sora-lu*

Name of the gear	*Sora-lu*
Length	30- 36 cm
Width of mouth (bigger one)	100-120cm
Materials used	Season bamboo splits and cane strips
Shape	Uniformly tapering towards cod end
Baits used	May or may not
Longevity	3 years
Species caught	Small air breathing fishes and weed fishes

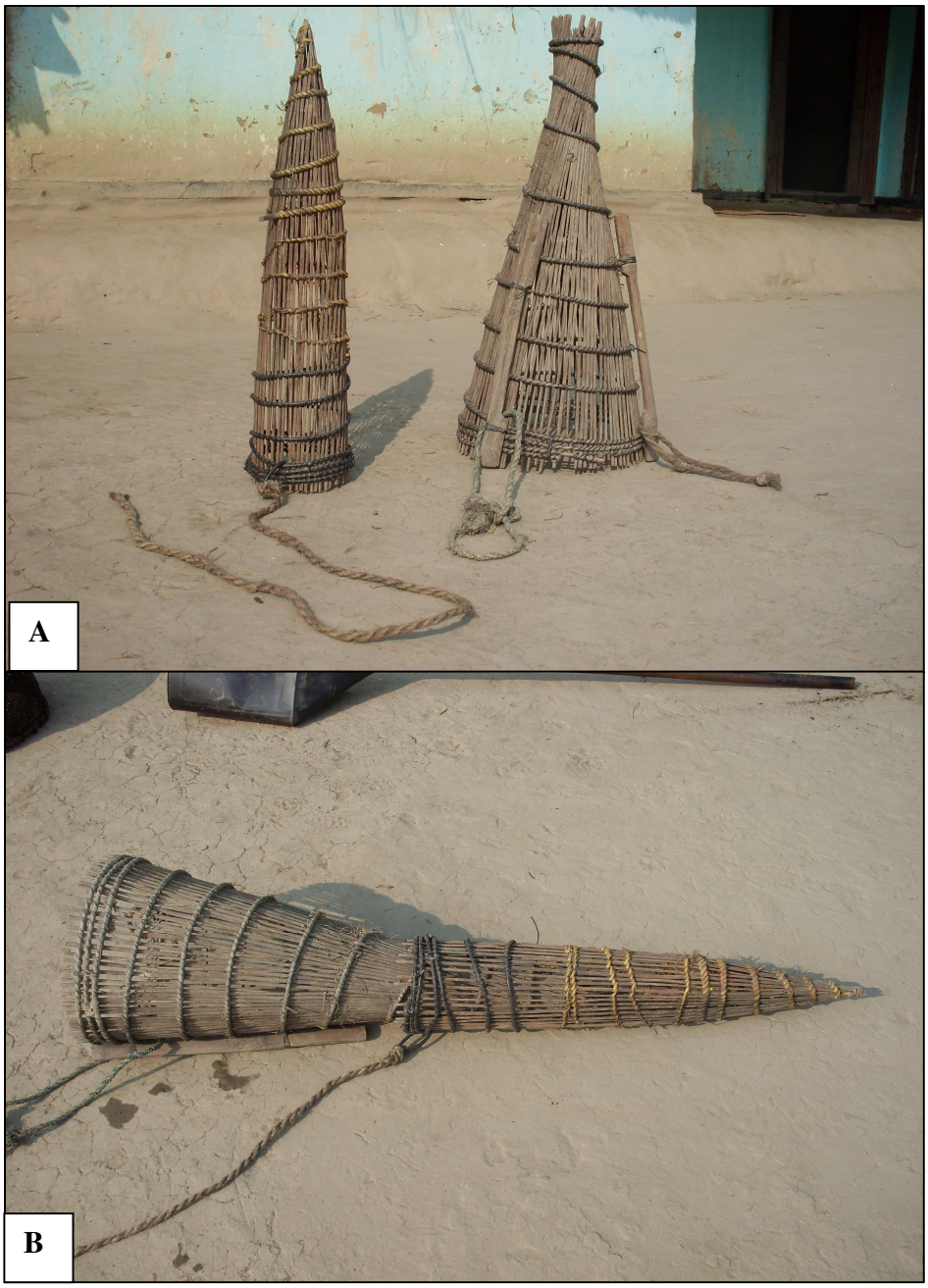


Plate 14: (A) Parts of the *Sora-lu* (B) Setting of the *Sora-lu*

4.2.3. Fish Aggregating Devices

Fish Aggregating Device (FAD) is the man-made artificial habitat for attracting the fishes. It helps the fishermen to catch the fish in huge quantity with less effort in bigger water bodies. Different types of Fish Aggregating Devices are there. However, the FADs being in practice and documented from the study area are discussed below.

4.2.3.1. Fish Aggregating Devices in Loktak Lake

Loktak Lake has a unique ecosystem called *'phoomdi'* (a Manipuri word meaning floating mats of soil and vegetation). *"Phoomdis"* attract a variety of fishes as it provides feed and shelter for the fishes (Plate-15). A number of flora is found in these *phoomdis,* a list of which is given in Table-15.

Plate 15: Floating Mat - *Phoomdis*

Table 15: List of flora mostly found in *Phoomdis*

Scientific name	Local name
Leerisa hexandra	Hoop
Phragmitis karka	Yendhou/ Tou
Succharum munja	Shingnang
Thysanolaena agrostis	Narengbi
Eluesine aegyptiaea	Eemanbi Napi
Hygoryza spp.	Kambong
Eichhornia crassipes	Kabokang
Euryale ferox	Thangjing
Nelumbo nucifera	Thambal angangba
Trapa natans	Heikak
Oryza sativa	Fou
Persicaria Chinensis	Yengkhuman

4.2.3.1.1. *Phoom* fishing / *Phoom namba*

It is a very common practice in Loktak Lake of Manipur. In this practice, it uses the *"Phoomdis"* i.e. the floating mass which acts as an important mean for the attraction of fishes. It involves two phases. The first phase is transplantation of "*phoomdis*", which is locally known as "*phoom thaba"* (plate-16). In this phase, the fishermen locate the productive area in the lake based on their indigenous ideas such as by seeing the colour of the water and depending on the availability of aquatic weeds in of area. The "*Phoomdis"* from other areas are cut longitudinally into desired size and transplanted in a circular form surrounding the required pre-selected area of water (plate-17). It is fixed with the help of bamboo stakes in different parts (plate-18). This is meant to attract the fishes by providing their shelter surrounded by different aquatic weeds mainly with the water hyacinth (*Eicchornia sp*). The size of the circle may vary, usually its circumference ranges from 150-200 m.

The second phase is catching of fish which is locally known as *"Phoom namba"* (plate-19). It is carried out after one or two months when the fishes will settle and aggregate under the *phoom* as well as inside the circular *phoom*. In this, the setting *phoom* is encircled by long cloth with sinkers at the bottom and; the height of the net is adjusted with the depth of the water. The weeds inside the circular structure are removed completely for the convenience in catching fish. Before the practice of dragging, 20-30 fishermen churn the whole water with the help of bamboo poles from dyke as well as from the crafts to make the fishes come out of suffocation. Fishes are then caught by using the drag net with repeated netting.

This is a peculiar fishing method in Loktak Lake. In one operation, the fishermen catch about 800-2000kg of fish and these fishes are distributed equally to different fishermen who are involved in the practices. The peak season of this fishing method is December to March. Species caught are mainly Indian Major Carps, *Esomus dendricus, Amblypahryngodon mola*, Exotic carps, *Wallago attu, Puntius sp.* and other catfishes.

Plate 16: Fixing of *Phoomdis* in circular form

Plate 17: Circular structure of *Phoomdis* "Phoom"

Plate 18: Fixing of net before catching fish

Plate 19: *Phoom namba* – Hauling of fish

4.2.3.1.2. *Phoomdao thumba* / FAD for Air Breathing Fishes

"Phoomdao thumba" is a popular fishing method practiced in Loktak Lake. Its unique feature is that it uses the traps in the *phoomdis* and it catches only the air breathing fishes. This method is practiced throughout the year. The foremost requirement in this method is the selection of a productive region which is done through farmer's indigenous knowledge such as by seeing the colour of the water, bubbles from water and by the movement of the plant locally known as "*Yendhou" or "Tou"* (*Phragmatis karka*). If the plant moves slightly then it indicate the availability of small fishes, if it moves little faster then it indicates the availability of the big fishes in that region. The selected *phoomdis* are placed fixed with the help of bamboo poles and indigenous pulley system (nylon rope or iron chain) which helps to navigate the *phoomdis* from one place to another (plate-20). To remain in one place, the *phoomdis* are anchored to the bottom with the help of heavy stones.

On the selected *phoomdis*, they make holes by cutting the *phoomdis* with the help of sickle with sizes ranging from 5 -6 feet long and 2-4 feet wide in different places (plate-21). The traps are set above cut out holes vertically or in slanting position (Plate-22). Around 50 traps can be set in one-hectare area. The air breathing fishes used to come up in the hole to inhale the atmospheric air and they are entrapped eventually (plate-23). The entrapment is increased by blowing of strong wind, where the floating weeds are blown towards the *phoomdis*. Normally traps are operated once in a day but sometime three to five times daily if the water is productive.

If the fish catch in the selected region is less then the *phoomdis* are dragged to other places using the indigenous pulley system called *'Kangdren'*. For this a pole is fixed and two bamboo poles are also erected at an angle to the pole to support it. Then the rope is tied to the pole and the other end is attached to the pulley on the *phoomdis* and the rope is wounded on a drum. Thus, the *phoomdis* are dragged near to the pole. Once this is over, the fishers either drop anchor or fix the pole to another place for dragging the *phoomdis* to a desired place.

Plate 20: Traditional pulley system

Plate 21: Holes in *Phoomdis*

Plate 22: Setting of traps in hole

Plate 23: Hauling of trap

4.2.3.2. Fish Aggregating Device for *Ctenopharyngodon idella*

Grass carp (*Ctenopharyngodon idella*) is basically an aquatic weed feeder. It grows luxuriantly with aquatic foliage and receives considerable attention as instrumental in the biological control of nuisance vegetation. This fish is mainly introduced in order to control the weed in water. So the typical feeding habit has become a mean for the fishermen in catching this fish. Grass carp**,** being a macrophagic and voracious feeder as compared to other Indian Major carp, the fishermen place bunches of grass in one selected region before 2-3 hrs of catching the fishes (Plate-24). This lead to aggregation of fishes in the prescribed area which enhances the fish catches by dragnet without putting much labour in less time. This is practiced by almost all the fishermen around the lake captivity.

4.2.3.3. *Kao* – Fish Aggregating Device in river system

It is an indigenous way of catching fish by making a Fish Aggregating Device from locally available materials where the branches and twigs of trees are used (Plate-25). It is locally known as *"Kao*". It is preferred by all the fishermen, as its cost of production is very low. It is mostly practiced by the *Meitei community* in different parts of the state.

The gear consists of triangular / dustpan-shaped structure made from bamboo strips. Inside this, branches of trees and twigs are placed which are means for the aggregation of fish. Sometime fish attractants such as ant nest are also kept under the branches. The gear is operated in small rivers, streams and lakes etc (Plate-26). It is placed inside the water facing the inflow of water current, away from the bank or dyke with rope/ bamboo tied on it for maintaining its position. It is set in morning and harvested after 24 hours. Fishes are caught after lifting the gear and those branches. Species caught are *Esomus dendricus, Channa sp. Clarius batrachus, Anabas testudineus, Amblypharyngodon mola,* etc.

Plate 24: Grass as FAD for *Ctenopharyngodon idella*

Plate 25: *Kao*- Branches, twigs in triangular basket as FAD for river system

4.2.3.4. Fish Aggregating Device – Macrophytes in lowlying area

The macrophyte "*Kambong" (Hygoryza sp.)* grown in the lowlying area is preferably consumed by most of the people in the state. The traditional fishermen used this macrophyte as fish aggregating device mainly for catching the air-breathing fishes. In this practice, the fishermen grow this macrophyte in lowlying area besides beels and create an environment, which is favorable for the fishes to take shelter. During the rainy season, the fishes from the beel or wetland aggregate in this area. They make them remain there for several months. During the dry season (mainly in the months of November-December), the lowlying areas are dewatered. In this process, some fishermen harvest the "*Kambong"* and some other fishermen/women catch the fishes with small scoop net or by hand locally known as *"khut humba*", simultaneously (Plate-27). This enhances the fish catch as the fishermen stir up the bottom mud in the shallow water which is locally known as *"Nga-neiba*" while harvesting the macrophytes, which make the fishes suffocated and hence come up and make the fishermen easy to catch. The species caught in this practice are air-breathing fishes which fetch good prices in the market. Major species caught are *Anabas testudineus, H. fossilis, Channa sp., Colisa fasciatus, Clarius batrachus, etc.*

This finding is in line with finding of Dutta and Bhattacharjya (2008), where fishermen of Tirap district of Arunachal Pradesh caught fishes from streams by making the stream water muddy.

Plate 26: Setting of *Kao* in River

Plate 27: Harvesting of Macrophytes and catching fish

4.2.4. Fish Processing and Storage

In order to avoid the fish and fish products from spoilage and preserve those for longer use during the off-season, the traditional people adapt different indigenous techniques for the preservation as well as for storage. The indigenous methods practiced by the fishermen of the study area for fish processing are discussed below.

4.2.4.1. Preparation of "*Hentak"* – fermented fish paste

"*Hentak"* is a unique fermented fish cuisine of Manipur. It is ball-like thick fish paste product which is indigenous to Manipur. Ethnic people of Manipur are very fond of this product. It is prepared by the local people in indigenous way as and when required and can store for longer duration.

Raw materials required

a) Fish (*Ngasang*) – The fish which is used for making *Hentak* is *Esomus dendricus* (*Ngasang*). The fishermen procure them from the rivers, beels and wetland by using dipnet. Then these fishes are made fully dried by spreading above the net which is kept fixed, above the ground, in poles (Plate 28).

b) *Hongyu (*A*locasia microrrhiza*) – The petioles of this plant is the main ingredient for making this product (plate-29). It is widely available in the state. It is said that it helps in fastening the degradation process and acts as binder. Without this, the said product cannot be formed.

c) *Shungban* (locally made wooden crusher) – This has round bottom and round surface with tapering towards the middle made from wood. It is used for crushing the ingredients (Plate-30).

d) Mustard oil – It is used for making the paste more sticky and acts as binder.

Plate 28: Ngasang ngari (*Esomus dendricus*)

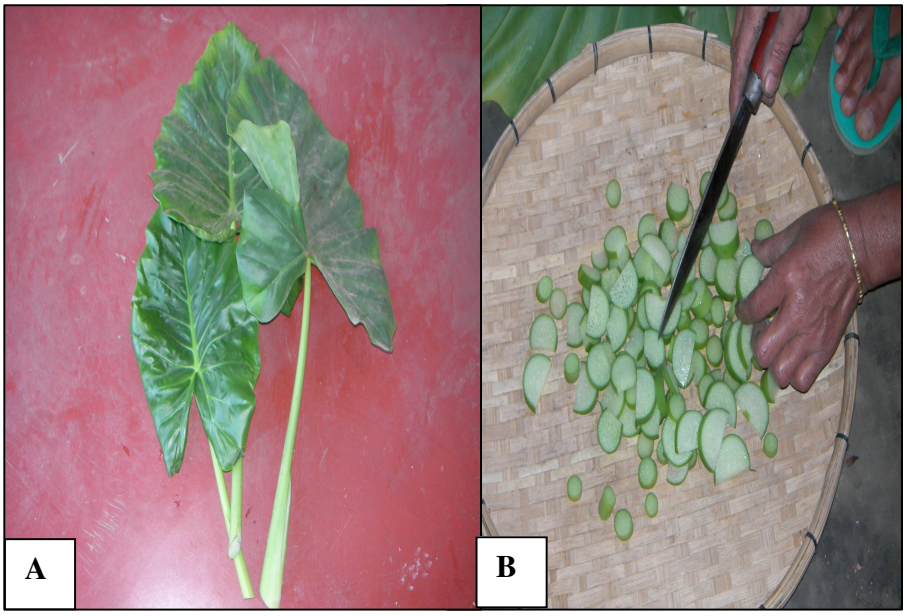


Plate 29: (A) A*locasia microrrhiza (Hongyu)* (B) Slices of petioles

Procedure for Preparation of *Hentak*

The fishes (*Esomus dendricus*) brought from market are washed properly and made fully dried. The fishes are crushed into powder using the wooden crusher. Then, the petioles of the plant (A*locasia microrrhiza*) are cut into slices. Equal proportion of these petioles as that of the fishes is put into the fish powder (Plate-31). Then fish powder is again crushed along with the slices of petioles and made into paste (Plate-32). From this, ball-like thick pastes are made with mustard oil in hand (Plate-33). These ball-like pastes are kept in an earthen pot for fermentation upto five days in clean place. After five days, these fish pastes are again pressed by the crusher and again stored in the earthen pot for 6-7 days.

After this, it can be served along with other additives like onion leaves, mustard leaves or as such. It can be kept stored as long as upto one year. It is consumed as curry as well as a condiment with boiled rice. It is regarded as an important item and given to the pregnant women and patients in convalescence. It is preferred by almost all the people of Manipur.

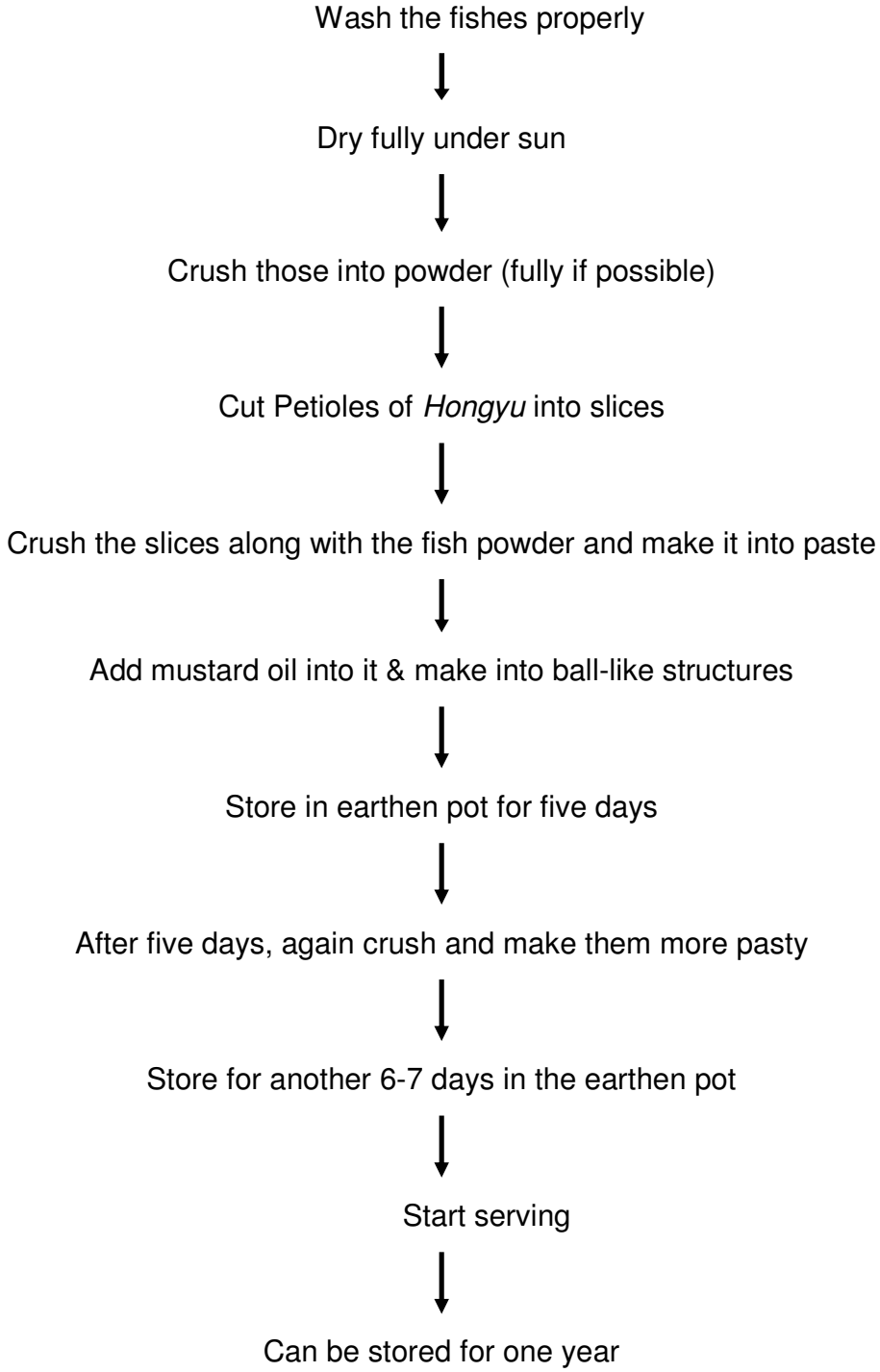
Plate 30: Crushing the fishes in the wooden crusher

Plate 31: Adding the slices of petioles of A*locasia microrrhiza*

Plate 32: Petiole and fish together made into paste

Plate 33: Fish paste made into ball-like structure

Flow chart: Preparation of *Hentak*



4.2.4.2. *Ngari* – Semi-fermented Fish product

Ngari is a semi-fermented fish product prepared from *Puntius sp.* It is consumed in any form and treated as a necessary food item for daily consumption. It is prepared by the local people mainly in the month of October to December. The important characteristic of this product is that it can be kept stored for more than a year. It is said that "Older the product, more in its taste". Therefore, the commercial preparation of this product is carried out throughout the central valley of the state.

For commercial preparation, the gutted dried fish (*Puntius sp*) is imported from the state of Assam (Plate 34). The fish is available there in the names of *Lakhipur, Bordela, Chenikuti* etc. The fermentation process is carried out in a round bottomed and narrow necked earthen pot. If the pot is new one, in order to make it impermeable to air, they smear mustard oil on the inner surface and remain exposed to the sun for several days until they become fully saturated with oil. Therefore, they prefer old earthen pot as it absorbs less oil as compared to new one and hence the cost of production is less. The capacity may range from 10-40 kg. For sealing purpose, during the fermentation process, they prepare the lids from the paste of mud and sometime they put fresh cow-dung in order to avoid from cracking in the mud. It is tightly wrapped with plastic cover. In order to keep the pot fixed vertically and avoid from cracking because of packing pressure on it, a pit is dug on the ground upto the height of its neck.

Plate 34: *Puntius sp.* for making *Ngari*

Procedure for preparation of *Ngari*

The gutted dried fishes are washed properly in the early morning and exposed under sun. After 5-6 hours, those are turn up and down for removal of moisture (plate 35A). After 5 hours, fishes are spread above a clean sack on the ground (plate-35B) and covered with sack. The fishes are then pressed using heavy stone roller (plate-36). The pressed fishes are then piled up letting them dry upto next day.

Before putting the processed earthen pot in the pit, a cross rope is put into it to hold and uplift the pot after fermentation (plate-37). Then an empty earthen pot is kept above this rope inside the pit and made remain immovable (Plate-38). A layer of mustard oil is coated on the inner surface of the pot, then fishes are poured and spread into the pot (Plate-39) and pressure is applied on it (making very tight and compressed), either by clean foot or using wooden stick *"suk" (*plate-40). Again another layer of fish is spread above it and then pressed and is continued until it fills upto 3/4th of the pot, while the neck portion is kept empty for the cover. A layer of mustard oil is poured when it is filled. A plastic cover is placed over it and then the paste of mud is put to make it air tight. The fishermen keep on regular checking if any crack is there, if seen, it is repaired soon. The gunny bags are spread surrounding the neck of the pot to prevent from any contamination. The pot is then taken out from the pit using the cross ropes (Plate-41) and kept in shelter for 3-6 months (plate-42). After which, the first layer is removed and the final product is ready to serve.

This fish product is preferred by almost all the people of Manipur and it is one of the items which is consumed almost daily. It is taken along with boiled rice as well as along with other curry. Now-a-days, its price rises upto Rs. 200/Kg because of increase in price of *Puntius sp.* and transportation charges.

Thapa *et al.* (2004) reported about the microbial diversity of the fermented fish products *Ngari, hentak* and *tungtap* of the North-East India. And at present study it is mentioned about method of preparation for *Ngari and Hentak* and its importance.

Plate 35: Turning up and down of fish (A) and Spreading (B)

Plate 36: Pressing of fish by stone roller

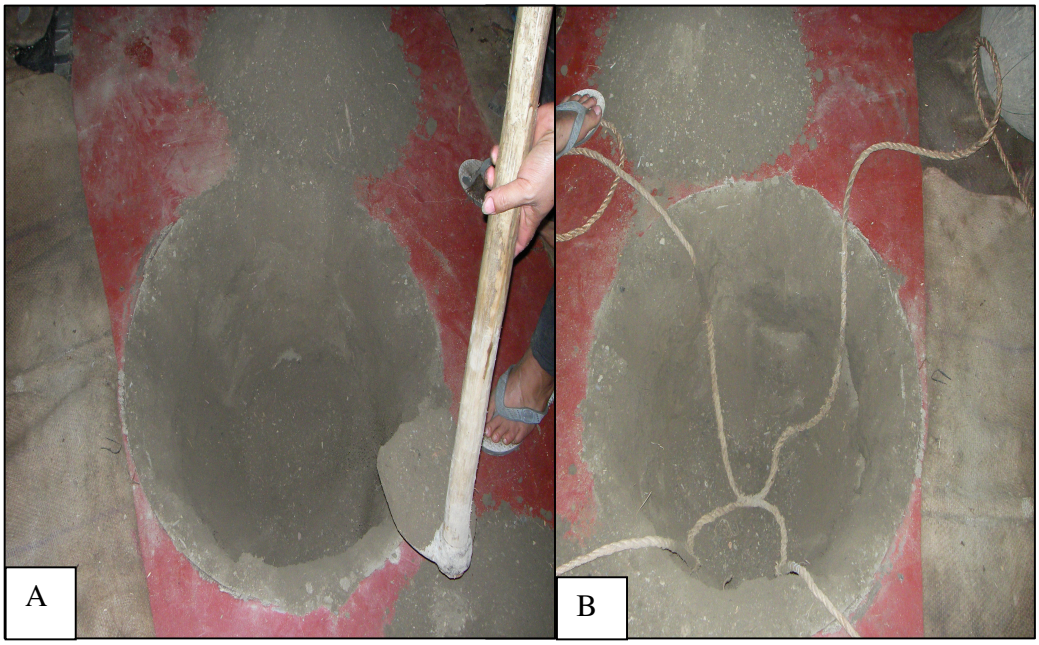


Plate 37: (A) Making of pit (B) Placing the rope to support the earthen pot

Plate 38: Fixing the earthen pot inside the pit

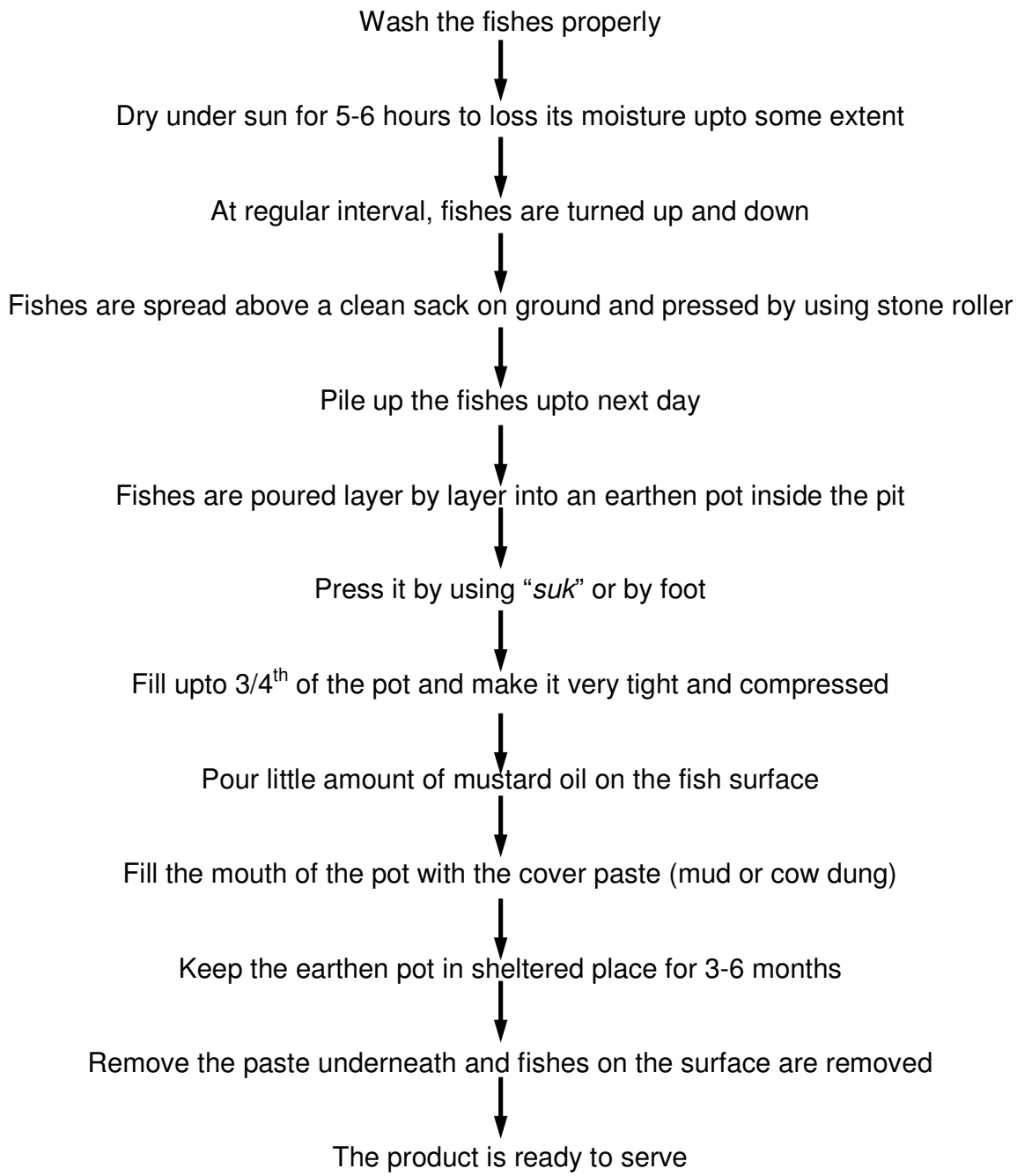
Plate 39: Filling the earthen pot with fish

Plate 40: Pressing the fish using (A) wooden log, (B) by Feet

Plate 41: Lifting up the filled earthen pot

Plate 42: Covered-up earthen pot (A), and Earthen pot in sheltered area (B)

Flow Chart: Preparation of *Ngari*



4.2.4.3. *Nganam* – Steamed Fish

Nganam is prepared from the weed fishes along with prawns especially from very small size fishes which are difficult to segregate. In this process, steam of turmeric leaves are allowed to pass through the fishes which give peculiar taste as well as smell to the product. This is not produced commercially, but prepared in small amount and can be stored for a month.

Raw materials required

a) Small weed fishes – mainly caught from pond and lake or are remains from other catches. These are caught by using dip nets or by scoop nets. The species used are mainly comprised of *Amblypharyngodon mola, Puntius sp., Chanda nama,* prawns, etc.

b) Banana leaves – mainly the old banana leaves are used for covering whole ingredients;

c) Turmeric leaves – mainly for smell and wrapping the fishes;

d) Spices and Condiment - Chilli powder, turmeric powder and salt, etc.

Plate 43: Weed fishes (A) Ingredients for *Nganam* (B)

Procedure for preparation of *Nganam*

The small fishes are washed properly and if any bigger size fish is there then its gut is removed and cleaned (Plate 43A). Turmeric leaves are arranged above the banana leaves (Plate 43B). The mixture of chilli powder, turmeric powder and salt are thoroughly mixed with the fishes. This fish mixture is spread uniformly above the turmeric leaves and wrapped it properly along with the banana leaves (Plate 44). This is kept above the traditional "*chulla*' (Plate 45). And after short interval of time, it is turned up and down and continued for around 30 minutes. When banana leaves is burned and the colour of turmeric leaves turns into yellowish, the product is ready (Plate 46).

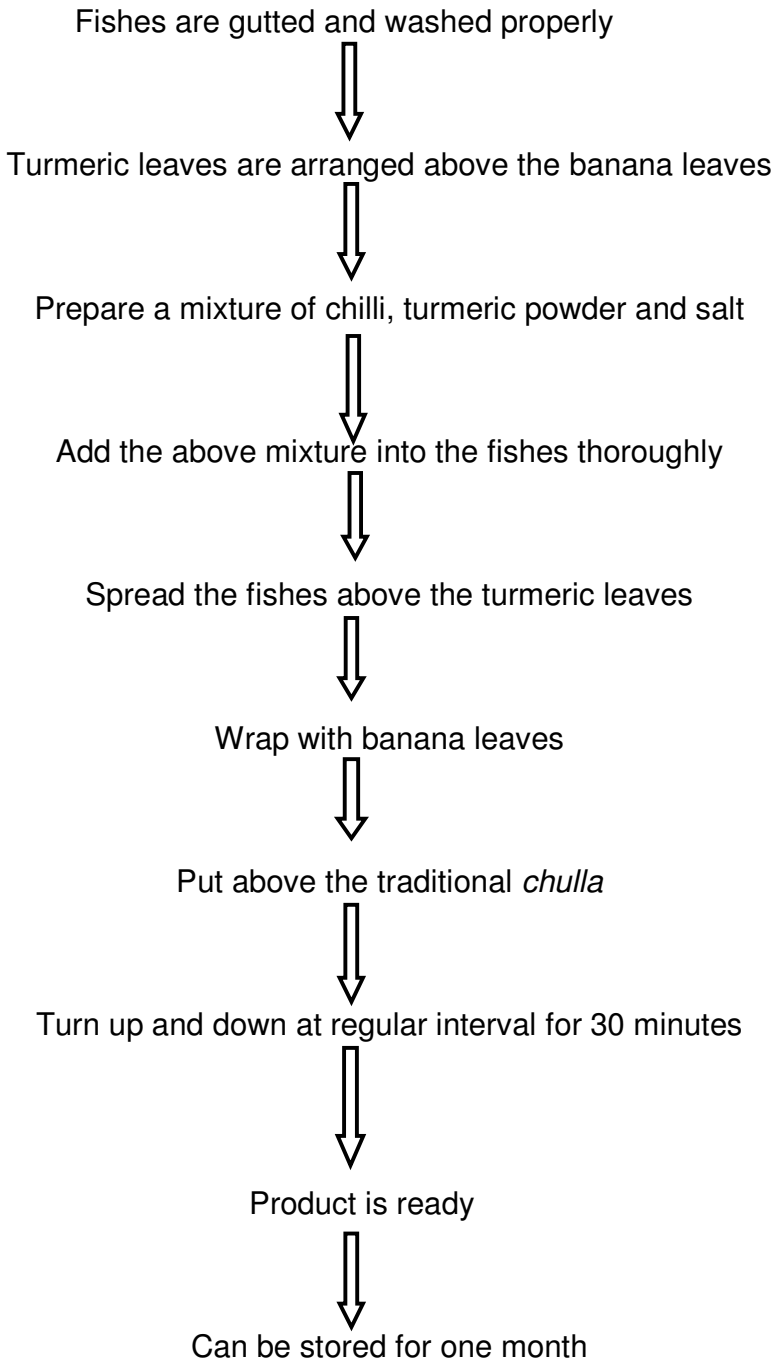
It is taken as a side dish and its taste is different from other products. It is preferred by *Meitei community* of the state. It can be kept for one month at warm temperature or nearer to flame. The advantage of this indigenous method is that it makes use of small fishes which are discarded during catch. It is regarded as a simple fish product which is good for sick people also.

Plate 44: Spreading of fish on turmeric leaves

Plate 45: Fish above the traditional *"chulla"* for steaming

Plate 46: Finished product of *"Nganam"*

Flow Chart: Preparation of *Nganam*



4.2.4.4. *Nga-yaiba* – Smoked fish

'Nga-yaiba' is the process of smoking of fishes, which is practiced and very common in the state of Manipur. Different types of fish can be used for smoking as a preservation method. Not only the fresh fishes are used for making smoked fish but also the fishes which are not able to be sold in the market are prepared for smoked fishes. It can be kept for longer duration. In this practice, smokes of husk, straws and wood are allowed to pass through the fishes under the indigenous *chullas.* There are different types of *chullas* which are made according to the condition of the region (plate 47 & 48). They maintain the *chulla* in rake system so that the finished smoked fish can be kept above it to retain its original texture and crispiness.

Procedure for Preparation of *Nga-yaiba*

The fishes to be smoked are cleaned and prepared into different shapes and sizes according to the sizes of fish. If it is a bigger fish then its viscera, guts and sometimes the head part is removed. Then the fishes are arranged above the iron made tray and covered. The smoke of husks and straws are made to pass through the fishes by keeping the tray above the *chulla.* It is kept for few minutes and the fishes are turned up and down with care otherwise its shape would break. When the fish turns into yellowish color, its process is over. Golden shining color is regarded as the best color for smoked fish.

Different types of smoked fishes are available in market (Plate 50) and it is one of the item which is consumed daily as side dish or along with other vegetables. Its price differs from species to species and it is sold on number basis instead in weights.

Plate 47: Smoking kiln

Plate 48: smoking of fish

4.2.4.5. Enhancement of the color of smoked fish

The color of the smoked product shows the quality of the product as well as it enhances the acceptability by the people. The most favorable color of the smoked fish is golden yellow. So in order to acquire this color, the traditional people use smoke of fern (*Microlepia strigosa*) (Plate 49). The fume or the smoke of this fern is passed through the finished smoked fish for few minutes and spread it. The resultant color is very good. This is mainly practiced by Thanga village of Bishnupur District.

4.2.4.6. Traditional storage system

The *Meitei* community has the habit of buying huge quantity of fish and fish product and keeping stored for daily uses. The storage container is locally known as "*Ngarubak".* Therefore, it is important to have good storage facilities and materials which are favorable to all conditions, otherwise the product would spoil due to various factor such as fungus, bad odour, ants, mice, etc. Some of the traditional methods for keeping the fish and fish products are (i) they used to keep above the bamboo-made plate and kept hanging over *chullas* (Plate 52), so that it can get the heat all the time and allow the product remain fresh, (ii) Others storage boxes are mainly made from bamboo strips, iron wire and sometime aluminum (Plate 51). The containers can be kept exposed to sunlight as and when required.

After fishing, in order to keep the fishes fresh and alive, they store the fishes inside big box traps which are put inside the water anchoring at dyke (Plate 53).

At the time of fish catch, especially during hand picking method, they put the fishes inside *tengol* which is kept hanging from the waist (plate 54) of the fishermen. During fishing operation in lake, the fishers use boat as storing device for fish.

Plate 49: **Fern (*Microlepia strigosa)* – used in smoking of fishes**

Plate 50: Different types of smoked fishes

Plate 51: Different fish storage containers -*"Ngarubak"*

Plate 52: Fish in hanging bamboo-made plate

Plate 53: Fish storage container during the catch

Plate 54: *"Tengol"*- fish storage container after hand picking

4.2.5. Fish Health Management

The traditional fishermen of the study area knew and had the techniques to control as well as prevent some of the commonly occurred diseases from locally available materials. In most of the fish ponds, the most commonly and frequently occurred disease was that of Epizootic Ulcerative Syndrome (EUS) due to poor water quality. Some of the techniques and practices used by the fishermen to prevent this disease are discussed below.

4.2.5.1. Turmeric powder with salt to prevent EUS

The turmeric powder and salt are mixed together with water and then it is sprinkled in the fish pond. It serves as a preventive measure for Epizootic Ulcerative Syndrome. It is a well known fact that turmeric has remedial property of healing abrasion. Now-a-days, fishermen have become very conscious about fish health, therefore, they sprinkle the mixture even if the disease is not seen as a preventive step in fish culture.

This practice is very close to the findings as reported by Goswami *et. al.* (2006), where they reported the use of garlic in place of turmeric along with salt for controlling EUS of fishes.

4.2.5.2. Ash for treatment of EUS

Use of ash for treatment of EUS is very familiar and used by more or less all the respondent fishermen who culture fish in their ponds. Ash produced through the burning of fuel wood materials and any other watse material produced in the family is used for aquaculture. But some fishermen use and consider the ash of paddy straw as the best, for the treatment of EUS.

4.2.5.3. Use of banana stem to improve water quality

The stems of banana are cut into pieces longitudinally and added into the pond by the fishermen to improve the water quality by increasing the dissolve

oxygen and helps in maintaining the pH of the pond. Also, the fishermen believe that it purifies the water and makes it clean which is good to prevent from any kind of diseases and helps in increasing the fish yield. As it involves low cost, it is being followed by most of the fish farmers. This result is in consonance with the findings of Mishra (2003), where the pseudo stems of banana, after harvesting the bunch, are added to the pond by cutting longitudinally, which increases the pH of pond water and oxygenation in water and it results in increase in fish yield by the farmers in the Basta village of Balasore district in Orissa.

4.2.5.4. Removal of Aquatic Weeds

Massive proliferations of aquatic macrophytes are one of the major problems, if it is grown in vast, in the culture pond. Sometimes, they also harbor insects and micro-organisms which can cause disease to fishes. The dense growth of weeds in water pollutes the water because they deoxygenate the water and kill the fishes. Water hyacinth (*Eichhornia sp.*) is the weed which grows in vast, in short period of time. The indigenous way of removing this weed is through manual weeding only (Plate 55). Similar findings have been reported by Goswami *et. al.*, 2006.

Plate 55: Removing aquatic weeds from pond

4.2.6. Construction of Gears and Crafts

4.2.6.1. Making of Traps

Traps are the most common gear used by all the fishermen as it is easy to use at anytime. Traps are mostly constructed by fishermen themselves for their own use and almost every fisherman possesses that skill. It is mainly carried out in the Thanga village in Bishnupur District.

Materials required: Bamboo splits, cone / polythene strap.

Method of Making: The bamboos are made into several splits of desired shapes and sizes depending on the types of the traps to be prepared (Plate 56). These bamboo strips are then heavily smoked by burning of vehicle tyre (locally available) for increasing its strength and also they believe that black color can increase the efficiency of the gear. Then bamboo strips are tightened together by using polythene strap maintaining a gap of 0.5-1cm between the splits. The strips are tightened longitudinally as well as horizontally by using polythene strap maintaining its valve opening of 4 to 5 cm.

Plate 56: Making of trap from bamboo splits

4.2.6.2. Making of Fishing Crafts

The crafts operated by the fishermen in lakes, rivers and wetlands were mainly of plank-built type. The fishing crafts were of small and medium size, plank-built type, which is primitive in nature. The fishing crafts are operated more in Bishnupur District. This is locally known as *"hi-nao".* It is constructed by joining the planks (Plate 57). A hole is made in the front side (aft portion) which is used for anchoring at the shore when not in use. This is operated by using a "*pou" (bamboo* pole). This can be used for 2-3 years after which they go for repairing as leakage in joints is a common problem.

Plate 57: Plank Built Canoe

Some timbers which are used for construction of crafts are given below:

1. Cham (*Artocarpus chaplash*)
2. Heinou (*Magnifera indica*)
3. Chingsu (*Tectona grandis*)
4. Tolhoo (*Terminalis myriocarpa*)
5. Uningthou (*Phoeba bensiana*)
6. Tairel (*Corolla teena*)
7. Pareng (*Alnus nepalensis*)
8. Uthum naraobi (*Bischofia javanica*)

Among these, fisherman preferred Cham (*Artocarpus chaplash*) and Uningthou (*Phoeba bensiana*) for the construction of the crafts.

4.2.6.3. Making of nets

Making of nets is done both by the fishermen as well as fisherwomen, but this activity is mostly perceived as an additional occupation for the women in fishing villages. The locally made nets are similar to the mosquito nets which are used for dip nets and drag nets. The materials required for making nets are monofilament nylon, cotton, jute or polyethylene (Plate 58) for frame head and foot rope. These are made either by using wooden frame/ loom or without using loom, in which some equipments are installed on the floor and the threads are held in the waist. Loom is a wooden made structure locally known as *"kon"* (Plate 59). This is available in almost all the houses of selected fishing villages.

4.2.6.4. Floats and sinkers

Floats and sinkers are managed from the locally available materials such as cut pieces of wooden as floats for gillnets. Floats are also made from plastic bottles, rectangular pieces of flexible rubber, from sole of sandal, hollow bamboo and sometimes pipes. Sinkers are mostly iron pieces and stones, where stones are

wrapped in a piece of cloth (Plate 60). Locally made burnt clay sinkers are also used for the gillnets.

Plate 58: Netting material (nylon thread) soaking in water

Plate 59: Making of net by using *Loom (Kon)*

4.2.7. Preservation of Gears and Nets

4.2.7.1. Traps preservation

Traps are used for longer duration and during the off season these are kept stored for future use. Fish farmers use some preservative measures like burning of the bamboo splits before making which serves as a good means for preservation as it protects from fungal and insect infestation.

For storage of traps, a unique method locally called as *"Leikang okpa"* is commonly practiced commonly for preservation of traps during off season. Here traps are kept either on bamboo/ wooden made rack or kept hanging underneath, above a firing place which expose them to the smoke (Plate 61). It helps in maintaining the strength of the gear by preventing them from fungal infection and attack by harmful insects and termites without being disturbed in its structure. Fishermen believed that the black colour also helps to increase the efficiency of the gear.

Also, the traps are also kept immersed in a thick liquid mixture of "*leikang"* (dusty particles from smoked areas) and cow dung for about one and half hours. It also helps in maintaining in strength of the traps.

Plate 60: Sinker - stone wrapped in cloth

Plate 61: Traps kept in rack and hanging to avoid from damage

4.2.7.2. Nets preservation

After fishing, nets are treated with various types of locally available preservatives. Barks and leaves of various trees such as *Kuhi* (*O. serrata*) and *Heikru* (*Phyllanthus emblica)* are extensively used as preservatives (Plate 62). The barks and leaves are properly crushed and soaked in water for 2-3 days until the water is turned into black colour. Then, the nets are dipped into this liquid for a day and exposed to the sunlight for proper drying before storage.

4.2.7.3. Crafts preservation / Caulking

Coal is applied on all surfaces of boats after construction. The leakage in the seam or any joint is filled up with the mixture of kerosene, resin (local name *Mekruk*) and jute fibres along with brick powder and ash powder to make it water tight.

Plate 62: Barks and leaves of *Phyllanthus emblica* for net preservation

4.2.8. Paddy-cum-Fish culture

Paddy-cum-fish culture system is practiced in different region of Manipur using different techniques.

4.2.8.1. Paddy-cum-Fish culture in *Sagol Tongba* village

The existing Paddy-cum-fish culture system in *Sagol tongba* village is different from the practices of other areas. They make a channel around the paddy field with depth ranging from 2-3 ft and width of 8-15 ft and ring bundh of 5-6 ft height around the field (Plate 63). The fingerlings of Rohu, Catla, Mrigal, Silver Carp and Common Carp are released in the channel during the month of December. The practices for paddy cultivation start from November and complete with harvesting process by the end of May, or latest by the end of June. Then with the rainfall, the water level is raised up to full capacity of the field. The harvesting of fish is carried out during November to December, when water level comes down.

4.2.8.2. Paddy-cum-Fish culture in *Thanga Village*

In *Thanga village* of Bishnupur District, the paddy field is used mainly for raising the Grass carp. They use paddy for feeding the fish. It is more economical and profit come from fish is more than that of paddy field. The advantage in this practiced is no need for supplementary feed (Plate 64)

4.2.8.3. Paddy-cum-Fish culture in Hill Terrace

In hilly terrace, the fish farmers grow both fish as well as paddy in the paddy field simultaneously. The peculiarity in this method is that, in central part of the field, they make little deeper. During rainy season, fishes move all around the paddy field, but when the water level reduces, paddy is harvested and the fishes will congregate in deeper portion. They let them grow there for few more month= till water level comes down much lower and after which they harvest the fishes (Plate 65).

Plate 63: Paddy-cum-Fish culture

Plate 64: Paddy grown with Grass carp

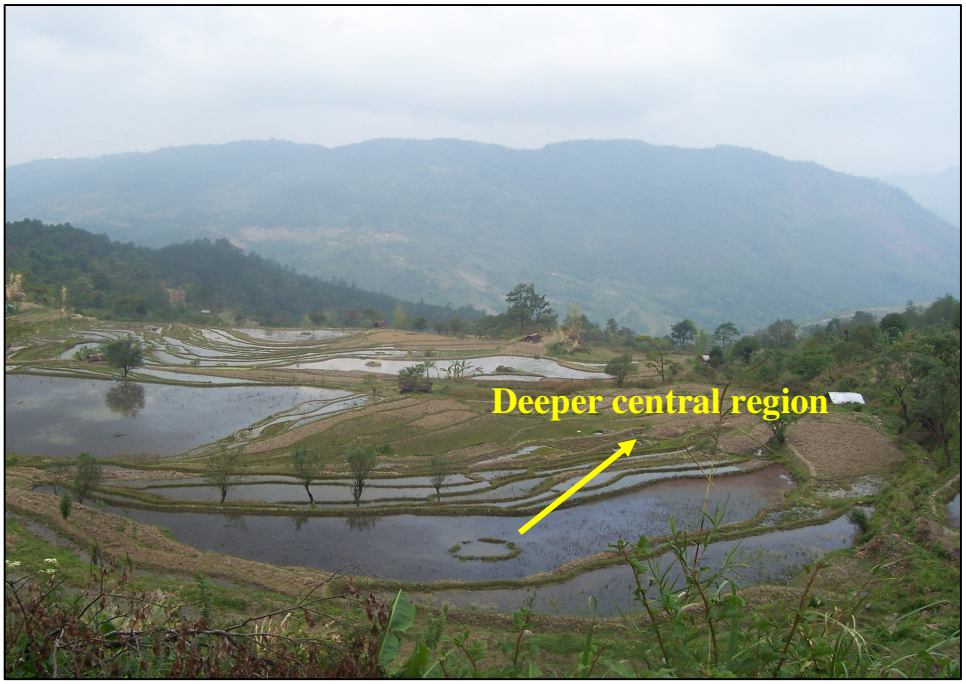


Plate 65: Paddy-cum-fish in hilly terrace

4.2.9. Fish- based Customs and Beliefs

In Manipur, fish constitutes an important part not only in dietary aspect but also considered as an important component for different rituals and customs of the *Meitei* community. The fish based rituals and customs documented during field survey are discussed below.

4.2.9.1. *"Meitei Ngamu thaba"* in wedding ceremony

This custom is part of the wedding ceremony of the *Meitei* community. During the period of marriage, two women from both bride and groom sides hold a healthy pair of fishes, *Channa orientalis* and release into the pond simultaneously (Plate 66A). By seeing the movement of fish into the water, they predict the future of the couple. If the fishes move together, then it is believed that the couple will live happily throughout the life and vice-versa.

4.2.9.2. "*Nganap thongba pijaba"* - Feeding of *Nganap* to new couple

The fish *Acanthophthalmus pangia* is locally known as *"Nganap"*. As this fish is sticky in nature, it is considered as important food item to feed to the newly married couple on the first night of marriage. The fishing people believe that feeding of this fish will keep the new couple together for the lifetime. After five days of marriage, both the bride and groom are served with a feast where *Wallago attu* is regarded as compulsory food item for the day (Plate 68).

4.2.9.3. "*Epaan- thaba"* – Fish in the name of new born baby

On the sixth day of child born, there is a ritual conducted in the name of welcoming the new born baby. On this day, seven different smoked fishes, seven different flowers and seven different fruits are offered to the God for the good health and welfare of the child. In this, *Channa orientalis* is considered as one of the important fish and must be there. They also offer a garland of *Ngakha* fish *(Puntius ticto)* and one full basket of paddy to pray for the welfare of the child.

Plate 66: (A) *"Meitei Ngamu"* (*Channa orientalis*) used in different customs

Plate 66: (B) *Monopterus cuchia* used in "*Lamta Thangja"*

4.2.9.4. "*Lamta-thangja*" / First Saturday of March month

"Lamta-thangja" means the first Saturday of the March. There is a ritual performed every month on this day by the whole fishing community by offering different food items including the smoked fishes, vegetables, flowers, fruits etc, collected from every house of the community to their God to protect themselves away from evil spirits for the years to come.. On this day, children are made to bathe their heads using the water which contains the slime from the skin of eel (*Monopterus cuchia*) (Plate 66B).

4.2.9.5. *Maning-Kunba* / confinement after child birth

After the child birth, the mother is offered to eat *Meitei Ngamu (Channa orientalis)* for one month. It is believed that it strengthens the immunity systems of the body as well as purifies the blood.

The same finding about the fish-based rituals and customs in the State of Manipur among the *Meitei community* has also been reported by Gurumayum *et al* (2006).

Plate 67: *Osteobrama belangirii* – offered to *"Ema Emoinu*

Plate 68: *Wallago attu*

4.2.10. Others (Unclassified)

4.2.10.1. Indigenous breeding and spawning Hapa

In order to enhance smooth progress of breeding of fishes in hapa, wooden-made frames are constructed over the pond (Plate 69). Fish farmers can walk above these frames and fix the hapa(s) without disturbing the water. As the collections of spawns from hapa(s) are carried from the wooden frames, it reduces the mortality rate because the water remains undisturbed. It makes easy in fixing of hapa(s) and requires less labour and time. Wooden framed hapa and aluminum container with holes are some of the components used for segregation of the fishes during breeding season.

4.2.10.2. Catching Fish by Dewatering

During the dry season i.e. when water level reduces almost to bottom, in order to fully dewater the pond and catch all the fishes inside the mud, the fishermen used a long iron pipe like electric post, for dragging the water into one region (Plate 70). During this process, the fishes come up and can be seen easily with bubbles in the mud. In this practice, they catch the fishes as well as complete the dewatering process. Thereafter, they let the pond as such for drying for one month or so and make ready for the next season.

4.2.10.3. Fish Wastes as Manure for Fruit Plants

The intestine and other discarded parts of fishes which are not used for eating are used as manure for the fruits plant (mainly grapes), flowers. The fishermen dump the wastes of the fishes near the roots of the plants (Plate 71). They said that, it increases the fruit-bearing of plants and also prevents from insects infestation by increasing their insect resistance.

4.2.10.4. Use of Bamboo to Prevent from Soil Erosion and Poaching

In order to prevent from erosion of the pond dyke, bamboo poles and bamboo frames are installed by the fishermen on the dykes of the pond (Plate 72). In some cases, the fishermen throw the branches of the bamboos to the water to protect from poaching. Also the periphyton grows on bamboo poles served as feed for the fishes and provide shelter for the catfishes.

Similar practice had been reported by Goswami *et. al.* (2006), where he mentioned the fishermen's rationale for putting bamboos inside ponds was to control the lice problem of fishes.

4.2.10.5. Aquatic Vegetation as Human Food and Medicine

Various aquatic vegetations are used both for consumption as well as medicine purposes for human being. Commonly used aquatic macrophyes were *Thangjing (Euryale ferox), Heikak (Trapa natan), Kolamani (Ipomea aquatica), Thambal (Nelumbo nucifera), Singju pan (Calocasia sp) and Terapaibi (Cynara cusimbua)* (Plate 73). The fishermen use *Terapaibi* for the treatment of *"*pile*"* and also use for healing the wound by putting on it. *Phachet* is used to cure the mouth ulcer; it is also used along with *Tulsi* for reducing fever. This macrophyte also serves as important means for generating income as it provides side income to the fishermen during the off season.

Plate 69: Wooden frame for fixing Hapa

Plate 70: Dewatering using iron pipe

Plate 71: Fish waste as manure for fruit crops

Plate 72: Bamboo poles to prevent from erosion

Plate 73: Some consumable aquatic vegetation and also used for various purposes

Table 16: Assessment of Appropriateness of ITKs in Fisheries

Distribution of average Score of Experts on the Appropiateness of Selected ITKs in Fisheries									
SN	**ITK Methods and Practices**	**Average scores of the Parameters for the Assessment of Appropitaeness**						**Overall Appropiate-ness (n=30)**	**Percentage**
1	**FADs**	Cost effectiveness	Materials availability	Social Acceptibility	Cultural appropriateness	Environmental soundness	Scientific value		
a	*Phoom-namba* - Transplantation of *Phoom* (aquatic plants) for FAD in lake	3.53	4.07	3.93	**4.20**	**3.00**	3.80	**22.53**	**75.10**
b	*Kao* - branches,twigs in bamboo-made triangular-shaped structured in river	**4.47**	4.33	3.87	4.00	3.87	**3.47**	**24.00**	**80.00**
c	FAD for grass Carp - Putting of grasses in selected area before catching the fish	4.07	4.20	4.07	**3.93**	**3.93**	**4.33**	**24.53**	**81.77**
d	Use of lsing kambong *(Hygoryza sp.)* as FAD for air-breathing fishes in low-lying areas	**3.93**	**3.93**	3.53	**3.40**	3.80	3.80	**22.40**	**74.67**
2	**Traps**								
a	Operation of Box Traps (*Taijeps*) with identification marks in Ponds as well in Lakes	**4.53**	4.33	3.60	4.13	**3.27**	4.27	**24.14**	**80.47**
b	Splits of bamboo are heavily smoked before making traps	**4.60**	4.33	4.20	4.20	**3.93**	4.33	**25.60**	**85.33**
3	**Health management**								
a	Turmeric powder and lime are put in pond as prophylactic measures to prevent from EUS	4.33	4.13	3.93	**3.73**	4.13	**4.87**	**25.13**	**83.77**
b	Banana stem are used in pond to improve water quality	3.73	3.67	**3.40**	3.53	**3.80**	3.53	**21.67**	**72.23**
4	**Processing**								
a	*Hentak* - (fermented fish paste) - *Alocasia micrrohiza* is used to accelerates fermentation	4.27	**4.60**	4.27	4.53	4.47	**4.13**	**26.27**	**87.57**
b	*Ngari* - (semi fermented fish)- earthen pot is used as container for fermentation process	4.60	4.33	**4.13**	**4.80**	4.53	4.47	**26.87**	**89.57**
c	*Nganam* - (fish steamed product) - turmeric leaves is used as preservative	4.33	4.47	**4.60**	4.53	4.40	**4.20**	**26.53**	**88.43**
d	Fern *(Microlepia strigosa)* gives golden yellow color when its fumes is passed through smoked fish	4.20	**4.07**	4.20	**4.53**	4.27	**4.07**	**25.33**	**84.43**

4.3. Assessment of Appropriateness of ITKs in Fisheries

Finding in the Table 16 revealed the appropriateness of twelve selected ITKs as assessed by fisheries experts from different organizations. As mentioned in the methodology, six parameters were identified to assess the appropriateness of the ITKs and the experts assessed each ITK on the basis of these parameters by scoring in a 5-point continuum scale, i.e., 1,2,3,4 and 5. The values in the table show the average score of all the 22 experts who responded.

According to the experts, "*Phoom namba"* as a FAD, very appropriately fits (4.20/5) to the cultural aspects of fishing community, whereas, they perceived, it is moderately compatible (3.00/5) with the environment. This might be due to the fact that "*Phoom namba"* being a transplantation of *phoomdis* may results in the depletion of water resources and may cause different water polluting factors and create environmental problem.

They gave comments that considering the condition of the Loktak Lake today, this method of FAD is environmentally and socially not sound and the Loktak Development Authority is spending crores of Rupees annually as compensation to farmers for removing these *phoomdis* from the lake.

As per the table 12 "*Kao"* as a FAD in riverine system was rated as a highly cost-effective (4.47/5) indigenous method. Materials for preparing *Kao* are also easily available (4.33/5). As per the experts, it possesses a moderate scientific value (3.47/5). As a FAD for Grass carp i.e. "Bunch of Grass" is concerned, it was adjusted as having very high scientific value (4.33)/5 as it is taking the advantage of the feeding habit of the Grass carp and also the materials are very easily available (4.20/5).

The materials for *Hygoryza sp.* as FAD for air breathing fishes are also easily available (3.93/5) and cost-effective (3.93/5), but might not culturally very appropriate (3.40/5) and it is limited to only some places of Nambol Thiyam pat under the Bishnupur district.

The results in the table 16 also reveal that 'operation of Box traps (*Taijep*) in ponds and lakes' as fishing traps is very cost effective (4.53/5) and also possesses a very good scientific value (4.27/5). But, the experts felt that this traps might not be so environmental friendly (3.27/5) and the social acceptability might also be moderate (3.60/5). The ITK practice of 'Heavy smoking' of bamboo splits" before making traps was assesses as very cost-effective (4.60/5) as well as having very high scientific value (4.33/5). However, the environmental compatibility got less score of 3.93/5.

The expert gave a viewed that keeping the bamboo splits over traditional fireplace accelerates drying by reducing moisture content thereby enhancing longetivity.

Two ITKs relating to fish health management practices were also assessed. The scores in the table 16 indicates that 'application of turmeric powder and lime in ponds to prevent EUS disease of fish' was adjudged by experts as having very high scientific value (4.87/5) as well as a highly cost effective practice (4.33/5). The social acceptability of the ITK practice of 'using banana stems in ponds to improve water quality' was assessed by experts as moderate (3.40/5) as compared to other practices, with having moderate scientific value (3.53/5) and it needs to be validated by scientific findings.

According to the table, all the parameters for assessing the appropriateness of the four indigenous practices of fish processing were given very good scores, which means that they are all very cheap, raw materials are also easily available with very high social as well as cultural compatibility, highly environmentally friendly and having a very high scientific value and rationality. The experts suggested that it needs to be investigate and validate about how *Alocasia micrrohiza* helps to preserve *Hentak.* And turmeric used in the preparation of *Nganam* imparts a typical flavor to the products and also preservation may be due to reduction in moisture while baking over the *chulla* and continued keeping near it.

A critical analysis of the findings in the table 12 also enlightened the overall appropriatness of these selected ITK practices. It is noteworthy to mention here that all the twelve ITKs were assessed as above 72 percent appropriate" lowest being 72.23 percent appropriate for "use of banana stems in pond to improve water quality" and as high as 89.57 percent appropriate for semi fermented fish product *Ngari*. This is really a good indication that the ITK practices being followed in the Central valley region of Manipur are not only having scientific basis but also they are highly sustainable. The fish farmers had taken quite good considerations of the environment, the culture, the society, the locally available raw, while evolving these indigenous methods, practices and products in their efforts to achieve sustainable livelihood options.

SUMMARY AND CONCLUSIONS

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In this chapter, the findings of the study are summarized in the same order as have been in 'Results and Discussion' chapter.

Indian fisheries sector plays an important role in the national economy. Local knowledge system of fishermen, fisherwomen and fish farmers gain prominence over the conventional technology based knowledge system. Therefore, there is an urgent need to identify, document, validate and blend the fishers' local knowledge system popularly known as Indigenous Technical Knowledge (ITK) System. In realization of this need, the present study was directed towards the survey of the indigenous technical knowledge in fisheries prevailing in the central valley of Manipur with the following objectives:

1. To study the socio-economic profile of the respondents of the study area.
2. To collect and document the Indigenous Technical Knowledge relating to different aspects of fisheries available in the study area
3. To study the rationale behind the use of the Indigenous Technical Knowledge by the respondents.
4. To assess the appropriateness of some most widely used Indigenous Technical Knowledge in Fisheries of Manipur.

Manipur was purposively selected for the study as it is very rich in fisheries as well as natural resources and popular in its fisheries related activities among the northeastern states of India. Both primary and secondary data served as major means for the collection of data. The study was restricted to the central valley of the state which comprises of four districts, namely, Imphal West, Imphal East, Bihsnupur and Thoubal district. From each district, two fishing villages were selected and from each village ten respondents were selected randomly for the collection of information by personal interview, field observations and focus group discussions.

The socio-economic parameters of the sample respondent fishermen included the age, sex, marital status, size of the family, type of house, educational status, experience in fishing, annual family income pattern, source of fisheries information and expenditure pattern.

The indigenous technical knowledge related to fisheries activities in the central valley of the state were collected and documented. The indigenous technical knowledge which were collected and documented included different fishing methods, fishing traps, FADs, fish processing and storage practices, fish health management practices, construction of gears and crafts and their preservation, different methods of paddy- cum-fish culture, rituals, beliefs and customs based on fish and some others like indigenous breeding facility.

The results and findings of the study are summarized below as per the objectives of the study.

Socio-economic Profile of the Respondents

In the study area, 57.5 percent of the respondent fishermen belonged to the age group of 31-50 years which shows the active involvement of the middle age fishers in the fishing activities and the young age group of less than 30 years constituted 22.5 percent of the total respondents. Most of the farmers were male which constitutes 73.75 percent and only 26.25 percent were female which shows that male fishers' engagement in fishing activities was higher than the female in the fishing villages. The survey in marital status shows that majority of the fishers, i.e. 71.25 percent were married. Analysis of the family size revealed that 47.5 % of the fishers' family were large families, i.e., members of more than seven numbers. Only 10% of the sample fishermen had *pucca* houses and 50 percent of the fishermen had *kutcha* houses and 25 percent were living in the thatched houses which show lack in well-being of the community. The educational status of the respondents in the study area was quite good in which 75 percent were literates and most of them acquired education upto high school. And it was found that some of the extension workers were also involved in their own fishing activity. Most of the fishermen, i.e., 58.75% had a

fishing experience of more than 20 years. The analysis of the income of the respondents revealed that 50 percent of fish farmers had an annual income between the range of Rs. 10,000-20,000. This reflects their poor economic condition and insufficiency to maintain their livelihood. And 25 percent had average annual income of Rs. 20,000-30,000, 17.5 percent had average annual of less than Rs 10,000 and very few, i.e., 7.5 percent of the respondents had average annual income of more than Rs. 30,000. The different sources of information in the study areas were recognized as Fisheries Department/ Extension Officers (43.75 %), NGOs (25.0%), Radio/Television (18.75 %) and other sources (12.5 %) such as neighbors, friends and relatives. On analysis of the average annual expenditure of the respondents, it was found that 55 percent of the income was spent for their food. This was followed by the expenditure on education (18%) and cloths (15%). On an average they spent 8 percent of their income on medical treatment.

Documentation of Indigenous Technical Knowledge in Fisheries

The fishermen of central valley of Manipur used various indigenous technical knowledges in different aspects of fisheries activities starting from a range of fish catching methods to the processing and importance of fish in rituals, customs and beliefs of the community. The documentation of the different fisheries related indigenous technical knowledge of Manipur are summarized as follows:

a) Fishing Methods

The fishing methods followed by the fishermen of central valley of Manipur are very unique in nature having their individual uniqueness. The fishing methods can be broadly classified into minor fishing methods and major fishing mehods. The *Nupi-il, Il – Jao, Lang, Khoisang thakpa, Moirang lang* and *Moo-namba* come under the major fishing methods and *Lonthrai, Long-oop, long* and *khoi choppa* come in category of minor fishing methods. Majority of the fishing methods are widely distributed and common in every area but some of the methods such as *Khoisang thakpa* and *Moirang lang* are exclusive in practice in Loktak lake of Bishnupur district.

b) Fishing Traps

The use of traps for catching fishes in rivers. lakes, streams, marshes etc is a longstanding and wide practice throughout the valley. Varieties of traps are used in the study area which differ in their shape, size, and types of operation. Most widely used traps are *Taijep* and *Kabo-lu*. In rainy season, when water level and current is high, the *Sora-lu* is used in river. Less time is required in setting and hauling of traps. Apart from this, other advantages are, it can be left in water both in favorable and unfavorable condition and the fish caught in the traps can be retrieved alive in an undamaged condition.

c) Fish Aggregating Devices (FADs)

A peculiar type of FAD is made by the fishermen using the *'Phoomdis'* (the floating mat) in the Loktak Lake. In this practice, the *phoomdis* are transplanted into the productive region and created an environment where the fish can aggregate, which is locally known as *Phoom namba*. It is carried out by a group of fishermen together. Another FAD for catching catfishes by using *Phoomdis* is known as *Phumdao thumba* where traps are set into the cut out *phoomdis* in different regions and the catfishes are caught when come up for breathing. Taking the advantage of feeding habit of grass carp, the fishermen used grasses as FAD for catching the fish. Besides this, the *Meitei* community makes use of the branches, twigs in making the FAD locally known as "*Kao"*. This is used in the river system where there is good water current. Another FAD is used of macrophytes (*Hygoryza sp.*) in lowlying area. While harvesting the macrophytes, the fishermen catch the catfishes those sheltered in the macrophytes.

d) Fish Processing and Storage

Fish is the most perishable commodity; therefore, it requires a special technique for the preservation after the catch and for the surplus which remain unsold in the market. Manipur is well-known for its unique fermentation techniques. *Hentak* is a fermented fish paste which is prepared in every house throughout the study area.

Ngari is a fermented fish product which is commercially produced. Both *Hentak* and *Ngari* can be kept stored for more than one year. Turmeric leaf is used for the preparation of *Nganam* which serves as preservative as well as increases the flavour of the product. Smoking of different types of fishes ranging from small to large size is another common processing method which is practiced in every house of the study area. The smoked fish can be kept for longer duration. In order to acquire the most favorable golden yellow color in smoked fish, the smoke of fern (*Microlepia strigosa*) is passed through the fishes. The containers for storing the fishes are made from different materials such as bamboo splits, aluminum tin and iron wire. After the catching, the fishes are kept stored either in boat or in bamboo-made basket. During hand pick fish catching method, the fishes are stored in the ”*tengol’* which is kept hanging from the waist of the fisherwomen.

e) Fish Health Management

For the control of diseases and improvement in water quality, the fishermen have appropriate indigenous knowledges which are used whenever necessary. The fishermen used the mixture of turmeric powder and salt in culture pond as preventive measure for Epizootic Ulcerative Syndrome (EUS). And, for the treatment of EUS, ash is spread into the disease affected pond. For increasing the water pH, fresh banana stems are put into the water.

f) Construction of Gears and Crafts

Traps are made using seasoned bamboo splits depending on desired shape and size by the fishermen themselves. It is most extensively used gear throughout the study area. Crafts used are of plank-built and the fishermen preferred logs of *Cham* (*Artocarpus chaplash*) and *Uningthou* (*Phoeba bensiana*) for the construction of these crafts. It is operated by using a single bamboo pole. Interestingly, most of the nets used by the fishermen are made locally in *loom* by the fisherwomen. Floats are prepared from locally available materials such as hollow bamboo, pipes, rubber and plastic bottles and sinkers by using iron and stone

wrapped in a piece of cloth. It makes the fishermen economical and avoid from additional expenses.

g) Preservation of Gears and Crafts

"Leikang okpa" is the indigenous technique for preservation of traps where the traps are kept on a rack and hanging above a firing place which exposed them to the smoke. It prevents from fungal attack and harmful insects and termites without being disturbed in its structure. Another technique is, traps are kept immersed in thick liquid mixture of "*leikang"* (dusty particles collected from smoked areas) and cowdung which they believed increase in its strength. Barks and leaves of various trees are extensively used as preservatives for the nets. For crafts, coal is used as preservative and mixture of kerosene, resin (local name *Mekruk*) and jute fibres with brick powder and ash powder are used for the leakage problem.

h) Paddy-cum-Fish Culture

Different types of paddy-cum-fish culture technique are carried out in various regions of the study area. Most interestingly, in Thanga village of Bishnupur district, paddy is grown along with the grass carp where it serves as feed for the fish. In *Mayang Imphal*, fishes are cultured in paddy field by making a partition between them. The peculiar technique in hill terrace is that they make deeper portion in central part of the field. In this, the fishes aggregate into the deeper portion during the dry season.

i) Fish- Based Customs and Beliefs

Fish is considered as an unavoidable component related to rituals, beliefs and customs of the *Meitei* community. *Channa orientalis* is used compulsorily in wedding ceremony, child birth and also during confinement of pregnancy. The state fish *Pengba (Osteobrama belangirii)* is offered to God of rice *"Ema Emoinu"* which indicates richness in its value. Besides this, on the first Saturday of the March, children are made to bathe their head using the water which contains the slime from

skin of eel (*Monopterus cuchia*), as they believe that it will protect from evil. Some of the most widely used fishes in important occasions of the state are *Channa orientalis, Wallago attu, Acanthophthalmus pangia, Osteobrama belangirii, and Monopterus cuchia.*

j) Others (Unclassified)

The fishermen of Manipur use different other techniques to facilitate both culture as well as capture fisheries. The FFDA of Imphal West adopts a new technique for fixing the breeding hapa in the pond. Wooden-made frames are constructed over the pond where the fishermen can walk above these frames and fix the hapa (s) without disturbing the water and also they can easily collect the seed / spawn which increases its survivality also.

For dewatering of pond and catching the fishes during the dry season, the fishermen used a long iron pipe/ old electric pole to drag the water to one region which forces the fishes to come up. The fishermen catch the fishes as well as complete the dewatering process simultaneously in short duration.

The people of Manipur recognize the importance of left out fish waste from kitchen as important manure for the plants, fruits, and flowers crops. They pour the waste of the fishes into the roots of the plants. It enhances in enrichment of nutrients in fruits as well as they believe that it increases in bearing of fruits in the next season.

The fishermen install a frame of bamboo split or bamboo pole, as guard over the dyke of the pond to prevent from erosion. And in some places, the fishermen simply throw the branches of the bamboos into the water to protect from poaching.

Various aquatic macrophytes are used for consumption purposes as well as for treating different human diseases. It also serves as important means for generation of day-to-day income for the fishermen.

Assessment of Appropriateness of selected ITKs in Fisheries

For knowing the appropriateness of the indigenous technical knowledges practiced in the state, an assessment study was made, using six parameters, namely, cost-effectiveness, materials availability, social acceptability, cultural appropriateness, environmental soundness and scientific value, with twelve most commonly practiced ITKs through experts from different organizations. From the assessment, it was found that all the ITKs have some rationality and scientific value behind the practice, and on an average all the twelve ITKs were assessed above 72 percent appropriate " lowest being 72.23 percent appropriate for "use of banana stems in pond to improve water quality" and as high as 89.57 percent appropriate for semi-fermented fish product *Ngari*. This is really a good indication that the ITK practices being followed in the central valley region of Manipur are not only having scientific basis but also they are highly sustainable. Also, many experts gave their comments and suggestions about the needs for further validation and investigation for some practices.

Conclusions

The present investigation was a pioneer attempt to study different indigenous technical knowledges relating to fisheries and their systematic documentation, collected from the central valley of Manipur, which comprises of four districts. It is observed that each and every fisherman and fisherwoman possesses some kind of ITK practices & methods or the other, starting from 'when and how to catch the fish' to 'fish processing and preservation methods' and uses them both individually and co-operatively for their livelihood. They have built up an intimate knowledge of how different components of the environment operate around them. Accordingly the evolved ITKs are having great potential value and well-suited to their localities. Therefore, this documentation will provide a platform to the policy makers and planners to understand the value and potentialities of the local and Indigenous knowledge systems in sustaining the fisheries and can activate the integration of the system in the development process.

The indigenous knowledges could serve as entry points into the sustainable utilization and management of natural resources. This could be achieved through the exploration of the indigenous technical knowledge of the local people and integrating useful aspects into the modern technologies. And also, welcoming the indigenous experts to collective problem-solving endeavors will be a good step towards successful sustainability planning

Moreover, many past researches have reported that there are no readymade technical solutions to the problems faced by farming communities by the modern scientific knowledge system, which can be diffused to and adopted by the poor farmers. On the other hand, solutions for many such problems come from the people themselves over a period of time. Therefore, we need to encourage such a mechanism where the knowledge base of the indigenous people would improve and subsequently use them along with the scientific knowledge. It is noteworthy to mention here that the present attitude of the educated and scientific masses needs a one-eighty degree turn to realize the potentialities and rationalities of ITKs. If this happens, the major common problem of the world, i.e., poverty, can be addressed in a sustainable manner.

Also, the documented indigenous technologies are not made available throughout to fishing community in a form they can make use to improve their production due to lack in linkage between the fishermen, researchers, scientists, policy makers and government functionaries. Therefore, a suitable linkage mechanism is required between documentation and proper utilization of ITKs to extend the benefits to all needy.

Some of the most widely practiced indigenous technical knowledges, which were assessed for their appropriateness, need to be further refined and upgraded by scientific validation in laboratories. Their applicability in other parts of the country is also to be tested and analyzed. As the indigenous knowledge is cost effective and environmental friendly, it would be easy for the fishermen to adopt these technologies.

The effective way to achieve sustainable development in fisheries is to utilize the indigenous knowledge.

There are numerous indigenous knowledges related to fisheries activities in India, but unfortunately this vast local knowledge system is dying out because of the official bias towards large infrastructural based systems and centralized bureaucracies. It is imperative that we collect, document and analyze these technologies, so that the scientific value behind them could be understood properly. Based on the findings of the study, few measures are suggested and recommended as given below.

Suggestions and Recommendations

Based on the findings of the study, following suggestions and recommendations are being made for use by researchers, academicians, officers of fisheries departments of different states, policy makers and students for taking further course of actions.

1. **Exhaustive Studies on Collection and Documentation of ITKs:** The present study was carried out only in four districts Manipur. Therefore, it is suggested to carry out both extensive as well as intensive studies on ITKs in agriculture in general and fisheries in particular, in the entire north-eastern region, and even the covering the entire nation, as there exist vast indigenous knowledge resources of worth among the rural masses. The preliminary studies may include (a) collection, (b) systematic documentation, (c) prioritization and then (d) scientific validation. ITKS can be collected either from the primary As well as secondary sources.

2. **Scientific Validation of ITKs:** Inventories of ITKs alone will carry no meaning and solve any problem, unless they properly used (once the knowledges are systematically documented, they should be prioritized by experts in consultation with the potential users and subject to scientific validation to see

their rationality this will provide a platform for further scientific research). Present day scientists have hardly given due recognition to this knowledge system, although these were evolved based on field experimentations of their users/ possessors since time immemorial. Scientists, researchers and extension workers should conduct systematic, multi-location, field as well as laboratory experiments to find out the rationality and scientific validity of these ITKs.

3. **Suitable Incorporation of ITK System with Modern Knowledge System:** The ITKs evolved in a particular agro-climatic zone or region may not be suitable and adaptable to other zones or regions across different states. Similarly, the scientific knowledges are mostly cost intensive and not very popular among the resource-poor farmers. Therefore, there is a dire need for suitable blending of these two knowledge systems to come out with more sustainable, cost-effective, profitable and environmental-friendly technologies to suit wider agro-climatic conditions and to suit both resource-rich and recourses-poor farmers.

4. **Popularization of Tested and Validated ITKs:** In order to popularize the proven and validated ITKs, adequate steps should be taken by different NGOs and GO departments to distribute the fruits of benefits to all farmers and individuals. Different mass media, like electronic and print media, and focus group discussions at village level can be arranged for this purposes.

5. **Organizing Trainings, Workshops & Seminars on ITKs:** Workshops and seminars at sate, regional and national level are good platforms to document ITKs and share ITK related issues among different stakeholders, starting from farmers to policy planners. Similarly, trainings on ITKs should be conducted to educate and train the field functionaries of different development departments.

6. **Encouraging Involvement of NGOs in ITK Studies:** Non-governmental Organizations (NGOs) and Community Based Organizations (CBOs) mostly work with the rural populations who virtually possess the indigenous

knowledge. Therefore, the employees of such organizations should be made aware of the importance of ITKs in the sustainable development process and should be made parts in the documentation, validation and utilization process of the ITKs.

7. **ITK Possessors-Scientists-Extensionists-Development Planners Linkage:** The present linkages among the ITK Possessors, Scientists, Extensionists and Development Planners are very weak. Therefore, there is an urgent need to link these vital components ands pillars of development, if development is to be sustainable. Suitable linkage modalities for the same may be framed.

8. **Creation of IK Centres at State level:** indigenous Knowledge Centres at state level should be created, preferably at State Agricultural Universities linking all stakeholders of the state. One such initiative has been made with the formation of Centre for Indigenous Knowledge in Agriculture (CIKA) in Tamil Nadu. All the state level centres may interconnected with link to a central hub.

9. **Developing a Central ITK Portal System:** Even though, many scattered studies have been conducted on different disciplines of agriculture, they have not yet been made available to all due to lack of further initiatives. Of course, ICAR had taken an initiative in this regard under National Agricultural Technology Project (NATP) during 2000 in a mission mode to collect, document and validate different ITKs in agriculture. Therefore, a “Central ITK Portal System” may be developed by ICAR to make those ITKs available to all concerned for research studies as well as general use.

10. **Compulsory Curricular Sanction in Educational System:** The present education al system is biased towards ITK system in the name of traditional and obsolete, so with the students. Therefore, in order to increase the affinity of the new generation towards the traditional knowledge system, there should be compulsory course curricular sanction on ‘ITK as a course’ starting from school education to university education.

11. **Efforts to put ITK System in International Agenda:** Due to growing importance of indigenous knowledge system, efforts may be made to keep it in international agenda to solve many international problems, mostly relating to livelihood aspects of developing and underdeveloped countries, within a consensual framework.

12. **Awareness Camps for ITKs and IPR Issues:** As per the Aarticle-29 of the Convention on Biological Diversity (CBD), 'Indigenous peoples are entitled to the recognition of the full ownership, control and protection of their cultural and intellectual property. They have the right to special measures to control, develop and protect their sciences, technologies and cultural manifestations, including human and other genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs and visual and performing arts'. But, neither the field functionaries nor the ITK holders are hardly aware of these rights. Therefore, extensive efforts should be made to protect theses intellectual property of the poor illiterate masses, before they are perpetrated by others.

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APPENDICES

ANNEXURE-I

Central Institute of Fisheries Education
(Deemed University-ICAR)
Versova, Mumbai

Project: Indigenous Technical Knowledge in Fisheries of Manipur

Interview Schedule

Part - A : Socio-Economic Profile

1. Name: **Respondent No:**
Address: **Date:**

2. Details about the Respondent

a. Age (years) -
b. Sex - Male/Female
c. Caste -
d. Marital Status - Married/Unmarried

3. Educational Qualification –

i. Illiterate
ii. Upto Primary level
iii. Upto High school
iv. Above High school

4. Size of Family

i. Small (upto 4 member) -
ii. Medium (5-7 members) -
iii. Large (above 7 members) -

5. Type of Family - Nuclear / Joint

6. Housing Pattern

iv. Thatched
v. Kutcha house
vi. Pacca house

7. Distance to the nearest Educational Institute (in kms)

i. Primary school -
ii. High school -
iii. College -

8. Income (Rupees Per Annum)

i. On season -
ii. Off season -
iii. Total -

9. Expenditure Pattern

i. Food -
ii. Clothing -
iii. Education -
iv. Medical -
v. Entertainment-
vi. Others -

10. Is fishing a traditional occupation of the household? Yes/No

11. Fishing Experience

i. Upto 10 years
ii. 10-20 years
iii. Above 20 years

12. Source of information - Information regarding credit, marketing and fish processing are obtained from

i. Extension Officer
ii. Government
iii. NGOs
iv. Head fisherman
v. Others (friends/relatives/ neighbours)

13. Attendance / Participation in voluntary organization

i. Regular
ii. Irregular
iii. Occasional

Part - B : INDIGENOUS TECHNICAL KNOWLEDGE IN FISHERIES

A) INFORMATION ABOUT GEARS AND CRAFTS

1. Type of the gear and craft used and how long?
2. Operational details:
    a. Size of the craft:
    b. Manpower requirement (Number of Fishermen per trip):
    c. Fishing time:
    d. Usual landing time:
    e. Quality and Quantity of Catch:
    f. Total operating time per day:
    g. Frequency of operation per day:
    h. Total number of fishing days per year
    i. Cost of craft:

B) SELECTION OF FISHING METHODS

- Methods practiced:
- Reasons for opting this particular method
- Advantage/disadvantage
- Years of Practice

C) INFORMATION TO BE GATHERED ABOUT GEARS

1. Type of gear used and how long:

2. Selective/non-selective:

3. Name of the net/nets:

4. Materials used for its fabrication and why:

5. Method used for its fabrication:

6. Parts of the net
   i. Specification –
   Length
   Breath
   Height
   ii. Mesh Size

7. Types of floats used and why?

8. Types of sinkers used and why?

9. Types of colour used in net and why?

10. Method of operation

11. Methods adopted for preservation against wear and tear of the gear and why?

i. Materials used :

ii. Purpose of use:

iii. How many years you are using it?

D. INFORMATION ABOUT FISH PRESERVATION AND PROCESSING

1. Where the fish is stored after catching and after landing?

2. Method of preservation adopted, specify:

3. Why this particular method is adopted?

4. Who taught this method?

5. What indigenous method you adopt for processing the fish?

6. Why do you adopt this method?

7. Whether any by products are prepared?

8. For what purpose the fishery by-products are used?

9. How many years you are using this method?

E) METHODS OF FISH STORAGE

1. Fresh fish:

2. Processed fish:

3. How many years you are practicing this method?

4. Cost of processing

5. Shelf-life of the processed product

F) MEANS OF TRANSPROTATION AND MARKETING

1. Harvested fish is used for marketing or for self consumption:

2. Fresh fish marketing:

3. Fish seed marketing

4. Why the particular method is adopted

5. Marketing channels

6. How many years you are practicing the method

G) PREFERENCE TIME AND FISHING GROUND

1. Whether the fishing is carried out during specific time in a day and why?

2. Whether fishing is carried in a particular locationfishing ground?

3. How do you know about the resources availability in a particular location?

H) SEASONAL AND MONSOON EFFECT ON THE AVAILABILITY OF FISH

I) THE SIGNIFICANCE OF PARTICULAR COLOUR IN GETTING THE PARTICULAR FISH SHOAL/CATCH

Sl. no.	*Colour*	*Particular catch*	*Rationality*
1	Brown		
2	Green		
3	Bluish		
4	Muddy		
5	Clear		

J) SIGNIFICANCE OF PARTICULAR MACROPHYTE VEGETATION IN GETTING A PARTICULAR FISH CATCH AND ITS USES

K) WHAT METHOD USED FOR THE FISH SEED COLLECTION?

L) INFORMATION REGARDING FISH CULTURE

M) INFORMATION REGARDING FISH HEALTH MANAGEMENT

N) INFORMATION REGARDING FISH FEED AND NUTRITION

O) OBSERVATION OF CLOSED SEASON

1. **Do you observe the closed season? Why?**

2. **What is the extent of closed season?**

3. **When do you start the fishing? Why?**

P) OTHER INFORMATION:

ANNEXURE-II

ASSESSMENT OF INDIGENOUS TECHNICAL KNOWLEDGE IN MANIPUR

SL.NO.	NAME OF ITKs	RESPONSE OF THE EXPERTS *					
1	**Fish Aggregating Device (FAD)**	**Cost Effectiveness**	**Materials Availability**	**Acceptability by others**	**Cultural Appropriateness**	**Environmental Soundness**	**Scientific Value**
a	***Phoom-namba*** - Transplantation of *Phoom* (aquatic plants) for FAD in lake						
b	***Kao*** - branches, twigs in bamboo-made triangular-shaped structured as FAD in river						
c	FAD for Grass carp - Putting of grasses in selected area before catching the fish						
d	Use of "**Ising kambong**" (*Hygoryza sp.)* as FAD for air-breathing fishes in low-lying areas						
2	**Fishing Traps**						
a	Operation of Box Traps (Taijeps) with identification marks in Ponds as well in Lakes						
b	Splits of bamboo are heavily smoked before making traps						
3	**Fish Health Management**						
a	Turmeric powder and lime are put in pond as prophylactic measures to prevent from EUS						
b	Banana stem are used in pond to improve water quality						
4	**Fish Preservation**						
a	***Hentak*** - *(*fermented fish paste) - *Alocasia micrrohiza* is used to accelerates fermentation						
b	***Ngari*** - *(*semi fermented fish)- earthen pot is used as container for fermentation process						
c	***Nganam*** - (fish steamed product) - turmeric leaves is used as preservative						
d	**Fern** *(Microlepia strigosa)*gives golden yellow color when its fumes is passed through smoked fish						

***Please give your responses in a 5-point scale (5** for **Fully Agree, 4** for **Agree, 3** for **Neutral, 2** for **Disagree and 1** for **Fully Disagree)**