

## Indigenous technical knowledge associated with disaster management and fisheries related activities in the highest flood affected district (Dhemaji) of Assam, India

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Indigenous Technical Knowledge has been the key rescuer of the fishers and common people of Dhemaji district of Assam, India from frequent floods in the region every year. They utilize the existing resources with a sustainable eco-friendly approach towards disaster management and exploration of fisheries resources and co-exist with the usual floods in the region. This study was conducted in the region through PRA after interviewing 110 fishers of three most flood-prone development blocks of the district with the help of an interview questionnaire. ITKs associated with the early warning of flood, construction of flood-safe fish ponds for flooded regions and post flood situation, modified fishing methods, fishing gear and fish preservation methods best suited to the flood situation developed by the people of the district are compiled and documented. People of the region traditionally use different meteorological signs, weather status along with animal behavior as early signal of flood and heavy rain. In order to face devastating floods which occur 2-3 times a year, the farmers constructed smaller ponds (<0.2 ha) for facilitating easy maintenance against flood inundation with tall and wide dykes and strengthening them with turfing and plantation. Fish harvesting techniques were modified in several occasions and preservation of bulk catch was done with innovative techniques for future consumption including combination of drying and smoking in household oven and development of products in combination with vegetables.

**Keywords:** Dhemaji, Disaster management, Flood, Pond construction, Fisheries, Fish preservation

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Assam is located in the North-eastern part of India (24°-28° N latitude and 89° 50'-97° 4' E longitude). There are several great river systems including Brahmaputra and Barak rivers which are the cause of frequent floods in the region. Among 27 districts, Dhemaji is the most flood hit district of Assam (Fig. 1) and its 69% population depends on agriculture and aquaculture or related activities. However, all the farming activities are the most vulnerable to flood which has severe impact on the livelihood of people resulting in heavy economic loss. The loss of crops, live-stock, properties, land due to

erosion and deposition of sand and silt are quite evident. In order to cope up with flood, Government and many organizations have been trying to help the farmers, but the initiatives have been more relief oriented or with temporary solutions. On the other hand, over centuries, local people developed their own ways and means to deal with floods. These measures and techniques are location specific. The district Dhemaji is one of such locations and it is one of the most backward and remotest districts of eastern-most part of Assam. The population of the district comprises of 98.15 % rural and only 1.85% urban with 47.29% Scheduled Tribe (ST). These STs are the indigenous tribes of Assam including *Mising, Bodo, Rabha, Lalung, Sonowal, Garo, Deori, Hazong,*

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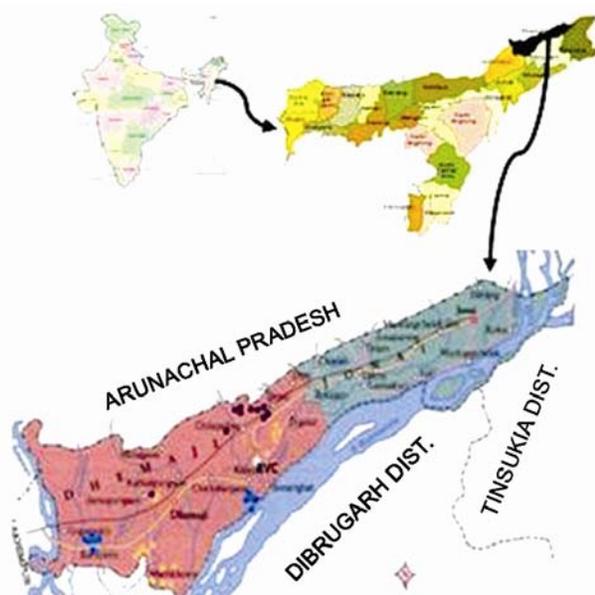


Fig. 1—Map of the study area

*ST Nepalis* and some tribes of foothills of Arunachal Pradesh. Along with the STs, there is Scheduled Castes (SC) about 5.33% of the total population. The average literacy levels of the Dhemaji is 44.65%, of this 49.34 % comprised male and 38.36% by the females.

The historical tract of the district reveals that the entire population of the district had been concentrated along the river banks and the waterways in the rivers were the main communication mode for the people. The economy of Dhemaji is generally agro-based. Sericulture, fishing and driftwood business are practiced in smaller scale. Numerous drainage systems originating from the hills of Arunachal Pradesh flow through this narrow valley ending at the mighty river Brahmaputra. It is highly flood prone district where almost every year flood causes immense loss to the people of the region since time immemorial. The term flood is used sometime rather loosely to indicate two types of situations. Firstly, the water from rains and the runoff from the surrounding areas start entering the low lying areas in the month of May and June and remain accumulated till the month of October/November. Depending on the situation, such areas may remain submerged under 1 to 5 meters of water. Such shallow or deep water areas are also called flooded areas. In other cases the water from the

over flowing rivers and rains enters the inhabited areas and fields causing damage to lives, properties, crops and roads etc. The first wave of flood usually comes in the first week of June although occasionally floods may also occur in May, depending on the rainfall. There may be several intermittent spells of flood depending again on precipitation. The plain fields of Dhemaji is predominantly crop fields and livelihood of people is mainly dependent on land based agriculture, aquaculture and livestock rearing. However, due to onset of flood the livelihood of people is immensely affected. Apart from the loss of agricultural crops, the houses in the villages get inundated, health problems arise and finally due to the water logging, the next cropping is seriously delayed. Consequently, options and opportunities for works and labour decrease and the multi-pronged problems make the communities extremely vulnerable and on an average the crop loss alone accounts for nearly 75% of the total damage caused by flood.

The people of Dhemaji are intimately associated with fish culture and capture for their livelihood. Due to lack of technology intervention the production rate is very low. However, sand deposition and other adverse effects of chronic floods on fertile agricultural land have made even affluent farmers land-less. Therefore, a large number of such people shift to greener pastures within the district to carry out horticultural practices.

Studies on the prediction and management of natural disasters through indigenous technical knowledge in relation to fisheries and agriculture in Orissa and Andaman and Nicobar were carried out in recent years and many interesting natural signs which red by fishers to predict disasters were recorded<sup>1</sup>. Indigenous techniques related to fishing and fish harvesting gears have been documented and discussed by many researchers in the recent past<sup>2-5</sup>. However, there is scanty of documents in indigenous knowledge and techniques of the fishers associated with flood related activities including early warning and weather prediction, etc. The present study is aimed at collection and compilation relevant information and documentation of indigenous technical knowledge and technologies in order to help refining and extend the same to other similar flood affected areas.

Over centuries, local people of Dhemaji have developed their own ways and means to deal with floods based on their experience and observations. These measures and techniques are locality specific, require no external help or support and are inherently scientific. The indigenous technical knowledge developed by the fishers of the district related to early warning of flood, pond construction and protection, on and post flood fishing techniques and preservation of abundantly available fish during flood are discussed below:

### Methodology

Three Development Blocks namely Maskhwa, Dhemaji and Bordoloni were selected for survey, because these three blocks experience frequent floods among the total five blocks in Dhemaji district. Total 16 villages were selected from these blocks randomly and total 110 active fisher households were selected randomly for the study. Adopting PRA (Participatory Rural Appraisal) method, primary data were recorded by interviewing and filling a questionnaire prepared for the purpose. Two PRA methods including Visualization and Semi-Structured-Interviews<sup>6</sup> were carried out in the specified area. The average family

size of the sample was around 5. Nearly 25.7% of the respondents in the selected farms belonged to the age group of 31 to 45 yrs and 28% belonged to 45 to 55 yrs in all the clusters.

### Results and discussion

The frequency of flood and average pond size Machkhowa, Dhemaji and Bordoloni blocks are given in Table 1. The people face frequent floods, 2-3 times a year and they excavate smaller ponds for convenient flood management. The average size of the ponds ranges from 0.5 to 0.17 ha and an ideal pond should be 0.2 ha in size in the areas where flood occurs rarely.

### ITK related to early warning of flood of the people of Dhemaji

Different traditional knowledge systems that are used as early warning of flood by the local communities play an important role in traditional disaster management resulting in saving hundreds of lives from sudden flood inundation (Fig. 2). In absence of scientific and proven early warning system in the regions these are playing a very important role in preparedness for flood. Some of the helpful indications are described.

Table 1—Frequency of flood (number of occurrence in last five years) in Machkhowa, Dhemaji and Bordoloni blocks in the household ponds with average size of the ponds

Sl no.	Name of village	Total number of House	No. of pond surveyed	Avg. size of ponds (in hectares)	Frequency of flood in last five years
1	Seujiyapathar	73	7	0.15	2
2	Chawaria	70	7	0.10	2
3	1 No Khuhimari	56	5	0.11	2
4	2 No Khuhimari	21	4	0.09	2
5	3 No Khuhimari	22	4	0.095	2
6	Bordoloipa	73	8	0.17	3
7	Chakaladoloni	64	5	0.12	3
8	Changmaibari	41	7	0.12	3
9	Harudhekera	32	7	0.10	3
10	Baruapathar	29	6	0.11	3
11	Bahokotika	90	9	0.080	3
12	Digingia gaon	215	10	0.088	3
13	Auniaeti	216	12	0.092	3
14	Kochgaon	62	6	0.077	3
15	Sarokham	87	5	0.052	3
16	Kalitagaon	180	6	0.081	3



Fig. 2—Sudden Flood inundation in Dhemaji district

**Early prediction of flood and rain based on Ethology (animal behavior)**

- i. In the morning of the very last day Assamese month *Powsh* (Mid of January), i.e. the eve of *Magh bihu* (Local crop harvest festival of Assam), if the cattle are found to stay standing under their shed this indicates a forthcoming flood.
- ii. If the cattle behave abnormally and furiously when they are brought for bath during the morning of *Goru Bihu* (Assamese New Year festival) it is believed that the flood is ahead.
- iii. When insects like locust, grasshopper, etc. come out from their hide and fly randomly and enter houses, this situation suggests a sudden change in the weather condition, more occasionally a flood with heavy rain.
- iv. Ants shift their shelter to higher places with their eggs and food stuff; it indicates a definite forthcoming flood.
- v. When fox howls irritably at higher place it indicates a forthcoming prolong drier season and when it howls from a low lying location it indicates a probability of high flood.
- vi. Doves cry monotonously before a forthcoming flood.
- vii. A mysterious bird locally known as *Melong* cries before a devastating flood.

viii. A bird having local name *Chatok* cries mournfully before flood.

ix. Toads and frogs make continuous sounds before torrential rain and devastating flood.

**Early prediction of flood and rain based on the observations of celestial bodies, nature and meteorology**

- i. If the moon inclines towards South it implies a forthcoming devastating flood.
- ii. If the cloud gathers in the South west direction it indicates a probable storm, in South-east direction indicates a rain and flood and in North west indicates normal rain.
- iii. A species of grass locally know as *Torapat* (a plant of ginger family) when its new buds come out with tints of silt, it indicates a forthcoming devastating flood.
- iv. When rain starts on –
  - o Wednesdays and Thursdays, it indicates a torrential rainfall in next 22 days.
  - o Saturdays, it indicates continuous raining in next three consecutive days.
  - o Mondays, it indicates continuous raining in next 8 consecutive days.
  - o Tuesdays, it will rain continuously for next few days
  - o Sundays, it will rain for longer duration in hours.
- v. When rainbow extends from North east to South west sky and if its full half is clearly visible, it indicates a devastating flood ahead.
- vi. Massive bamboo flowering before the summer season indicates an upcoming devastating flood.
- vii. When cloud floats from North east towards southwest, it indicates a forthcoming flood.
- viii. If mango trees bear more flower than the flowers of jackfruits, it indicates that there will be more rain and flood.
- ix. If it rains continuously for three to four days in the adjacent hills of Arunachal Pradesh, water will reach the low lying areas within 6 to 10 hrs.

**Some popular beliefs on the possible causes of flood in Dhemaji district**

- i. Villagers believe that during 1950's devastating earth quake and the big dam construction in

Arunachal Pradesh, a substantially big numbers of big stones/boulders were either broken or dislodged which had been working as the natural speed breakers of the water current of river Brahmaputra. Thus, it resulted in uninterrupted flow of the river water without sand filtration system. So, now flood brings more sand instead of silt.

- ii. The construction of river embankments without any scientific knowledge of the hydro-dynamics of river water has been creating major problems.
- iii. Construction of roads without providing sufficient numbers of culverts increases the speed of water current which results in destruction of agricultural fields and fish ponds.

### **ITK related to pond construction and protection of pond from inundation**

#### ***Construction of pond***

It is an irony that the flood causes massive economic loss in rainy season and oppositely there is

always a deficiency of water in the ponds and other water bodies in winter season in Dhemaji. Keeping this in view, the fishers generally construct ponds in low laying areas with minimum earth excavation, but with tall embankments. This reduces the pond construction cost, protects them from inundation and also ensures greater possibility of retaining water even in the winter season. The sizes, depths and pond dike dimensions of the ponds depend on the nature of soil. Areas having clay loom soil, the size of ponds were larger whereas the sizes were smaller in areas which have sandy loom soil (Table 2). The present technique employed in plain area, whereas different other techniques of pond construction was reported in hill district of Assam<sup>7</sup>.

#### ***Protection from seepage***

Seepage is a major problem in certain parts of the district where sand was deposited on the soils during floods. In those areas people use raw cow dung mixed with water and overlay a layer of it on the bottom of

Table 2—Normal Morpho-edaphic parameters of the ponds in Dhemaji district with common fish species reared (values are mean, n=5-12)

Sl. No	Name of village	*Avg. Height of pond dyke (In meters)	*Avg. maximum water depth (In meters)	Avg. freeboard (in meters)	Avg. size of crest of dike (in meters)	Major fish species reared
1	Seujiyapathar#	1.87	1.44	0.43	1.22	Rohu, Catla, Mrigal, Common carp, Grass carp, Silver carp, Bighead carp
2	Chawaria#	2.03	1.50	0.53	1.33	Same as above
3	1 No Khuhimari#	1.81	1.26	0.55	1.14	Same as above
4	2 No Khuhimari#	2.00	1.68	0.32	1.31	Same as above
5	3 No Khuhimari#	1.90	1.44	0.46	1.28	Same as above
6	Bordoloipa#	1.80	1.39	0.41	1.25	Same as above
7	Chakaladoloni#	1.88	1.41	0.47	1.21	Same as above
8	Changmaibari#	1.76	1.31	0.45	1.32	Same as above
9	Harudheker#	1.82	1.29	0.53	1.19	Same as above
10	Baruapathar#	1.90	1.35	0.55	1.14	Same as above
11	Bahokotika^	1.44	1.12	0.32	0.86	Same as above
12	Digingia gaon^	1.19	0.93	0.26	0.81	Same as above
13	Auniaeti^	1.27	1.03	0.24	0.87	Same as above
14	Kochgaon#	1.37	1.07	0.30	1.10	Same as above
15	Sarokham^	1.11	0.89	0.22	0.62	Same as above
16	Kalitagaon^	1.26	0.40	0.36	0.93	Same as above

\*The measured maximum water depth of the pond and freeboard of dikes are cumulative average of data obtain from two years survey.

#Clayey loamy soil

the pond. This works as an excellent sealing of bottom increasing water retention capacity of the pond. Farmers also use clay soil for dike construction which they bring from neighboring areas having clayey soil and this protects the dikes from soil erosions.

#### ***Protection of pond dike***

The dikes of the ponds are usually constructed very tall and wide so that they become strong enough to protect the pond from speedy water currents during flood (Fig. 3). The land erosion of the pond dike is minimized by turfing on the sides of the embankment immediately after construction and further protection through the plantation of plants including plantain, pulses, betel-nut, lemon etc. on the dikes to prevent soil erosion (Fig. 4). If the height of the dikes is not sufficient to protect inundation, people use fine-meshed plastic nets to fence the pond in order to prevent escaping of fish from pond.

#### **ITK related to modification of fishing gear and harvesting technique**

Artisanal fishing gears including lift net, cast net, pole and line, gill net, traps, fish aggregating devices



Fig. 3—Construction of tall and wide dyke for protection of pond from flood

are very common in the region. Some of these gears are modified for catching fish during flood and post-flood periods. This results in better catching efficiency of the gear both on flood and post flood situation. These modifications are either in general structure or in mode of operation of the gear. Gears used at Dhemaji with modified form are discussed below:

#### ***Large Pole and line (Bor boroxi)***

Use of pole and line is a common traditional method of capturing fish. In this technique, a line with a single hook containing bait is attached to a bamboo pole. Generally, small pole and line and with small hooks are used to catch small variety of fish in Assam. Locally this gear is called as *boroxi*. Fishers of Dhemaji use pole which is made up of a longer line attaching with heavy and stronger pole and also larger hook is used. This type of pole and line is locally called *bor boroxi* to catch the fish including *Wallago attu (borali)*, a highly predatory large cat fish. Small fish or frogs are used as the bait. During operation, the hooks with baits are simply laid on the water surface with repeated lifting and dropping and the baits are not allowed to sink completely in water. When the fish is attracted towards the bait, it tries to engulf the bait and jumps out of water and in the very



Fig. 4—Strengthening of pond dyke by turfing and plantation above the dyke

moment fishers pull the pole with a forceful and sudden jerk and fish gets hooked. This needs special skill and an experienced fisher does the operation tactfully.

#### ***Modified aerial trap***

Normally aerial traps are used to catch the migratory fish. But the people of Dhemaji make use of the aerial trap to catch any species of fast swimming fish by taking the advantage of fast current of flood water. In the operation, they make fish channels with nylon nets or *bana* (split bamboo straps are woven with jute ropes, keeping 1-2 cm gap between the straps to make a folding fence) and the fish are guided by the channel to move along with water current. Thereafter, obstacles usually a *bana* with lower height, are kept transversely in the way. A long aerial trap is constructed with small meshed net or cloth just outward the obstacle fence which is fitted to bamboo poles lifting it out of water at a certain height. When fish come across the obstacle, they try to jump over the obstacle fence and fall in the trap.

#### ***Use of specially designed harpoons***

Harpoons are devices with sharp pointed iron spears which are used to catch fish by sudden stabbing. The harpoons are generally modified by fishers of Dhemaji with long spears and handle. The fishers operate this gear during night hours while traveling in boats with torches in hand. Fish are hooked directly with the harpoons and lifted out of water. The entire process is locally known as *Jur kata*.

#### ***Fishing by using Fish Aggregating Devices (FAD)***

Fish Aggregating Devices (FAD), locally known as *Jeng fishing* is generally practiced in post flood situation particularly in the beels and small water bodies attached to a paddy field. The FAD is made by putting fresh tree branches including small bamboo branches in the deeper areas of water bodies during rainy season. Sometimes water hyacinth is placed over the surface. Some fishers often apply rice bran and slaughter house wastes to the aggregates. Fish are attracted to this device as they get shelter and easy source of food because many insects, worms,

zooplanktons and phytoplankton accumulate in these areas. When water starts receding, fish are caught by surrounding the FAD with a *bana* or nylon net. There is report that the branches of tree such as *hajol* (*Barringtonia acutnagula*) were used traditionally by the fishers in wetlands of Cachar district of Assam<sup>8</sup>.

#### ***Fishing without gear during 'masor ujan utha'***

Fish like *Anabus testudinious* (*Kawoi*), *Clarius batrachus* (*magur*) and *Heteropneustes fossilis* (*singi*) have a natural tendency to swim against the water current, especially during the breeding period. This phenomenon is locally known as *masor ujan utha*. Taking advantage of this, many fishers make shallow channels in the edges of natural water bodies and artificial water current is created using slanting contours and gravity. Fish when try to swim against the current and reach the channels, the experienced fishers tactfully catch them by grasping with hand from the channels which have very shallow waters.

#### **Fish preservation related ITKs**

During flood and post-flood, fish become abundantly available and the market prize of fish becomes too low, whereas the same fish become scarce and highly priced in the off seasons. Therefore, the fishers, particularly belonging to the tribes have special preservation methods of fish so that there is a sustained supply of fish, may it be in processed form, throughout the year. These preserved fish plays an important role as a low-cost protein source to overcome protein malnutrition for the poorer section of people who cannot afford costly fresh fish in the off seasons. Moreover, in due course of time these processed fish have become ethnic delicacies giving them a reliable food security. Hence, the processed and preserved fish are often termed as poor men's diet/protein, even though these are equally preferred by richer ones.

The most common preservation and processing methods of fish are drying, smoking and fermentation which are also practiced in other regions. However, fishers in Dhemaji district have brought about some innovations according to their need and available resources. The modified preservation techniques are discussed below:

Table 3—The significance of flood prediction ITKs to the farmers

Early prediction ITKs of flood in	Significances
Agriculture	Future planning for cropping cycle, timing for sowing and harvesting , utilization of flood deposited humus as natural fertilizer
Animal husbandry	Shifting of live-stock to safer places in time, arrangement of fodder and feeds, disposal/sale of older beasts, arrangement of floating rafts
Aquaculture	Protection of ponds with net barriers or with high earthen dykes, disposal/sale of fish
Harvest and Post-Harvest Technology	Surviving in the flood affected areas by utilizing the available resources; judicial utilization of resources, harvesting and curing/preservation for future use

### ***Drying of fish by heating with fire***

Although sun drying is the most common method of preservation of fish in Assam, fishers in the district have developed fish drying method wherein they use a bamboo rack to place the fish and heating by fire from firewood beneath the rack in order to tackle the inconveniences created by frequent rain fall and consistent cloudy weather, especially during bulk harvest of fish which happens to be post-flood season (July to September). The fishers house the bamboo rack under a shed made of corrugated iron sheet that is normally raised about 1 – 1.5 m above ground. The shed protects fish from rains. Besides, they often apply salt and turmeric powder to extend the self life as well as to reduce the off-smell of drying fish. Interestingly, it was also observed that a particular herb, locally called *bihlongoni* (species of fern) was used to repel the insects from the drying fish. In this process the rate of drying is faster and the product quality is also very good.

The huge economic loss due to insect infestation in dry fish has been a very difficult and persistent problem for the dry fish merchants all over the world. Such innovations may be a potential research topic for the scientists that might open a path to invent a herbal insect repellent for food that would be low-cost, environment friendly, non-toxic and with no health hazard.

### ***Smoking of fish simultaneously with cooking food***

Smoked fish is an ethnic delicacy in households of tribal people particularly among the *mising* community. Smoking and drying has been a convenient method of processing and preservation because the smoke repels insects, reduces smell, provides extra flavor and most importantly the method is not dependent on sunlight. Going one step

ahead, the fishers of this flood prone area make use of their traditional mud-oven simultaneously with their day-to-day cooking for smoking their fish. Many fishers including the tribes generally cook their food by burning firewood in mud-ovens. They make flat bamboo baskets, locally called *dola* or *saloni* which is used as a hanging rack over the mud-oven for fish smoking. Small fish (whole) and large fish (filleted) are arranged on the *dola* and hung just above the mud-oven in such a manner that the smoke created in the oven directly reaches the baskets. Apart from smoking, the heat from the oven imparts drying too which is an added benefit. However, due to intermittent smoking and heating, the process becomes comparatively longer than the other method and it is applicable only for small scale operation. Nevertheless, this process signifies judicial use of energy from firewood saves working hours of the fishers and does away with the expenditure incurred in the construction of drying shed and bamboo racks as well as the cost of firewood.

The scientific bases of the ITKs related to disaster prediction may be understood through organized studies. Some significances of flood prediction ITKs have been summarized in Table 3. If scientifically understood refined and devised, these ITKs may be awesome tools for disaster management. Further, the ITKs associated with fish harvesting and preservation may taken up for refinement and scale-up.

### **Conclusion**

Signs and abnormal behavior of animals before natural calamities are being studied in many countries for their scientific base and thus acceptability. It is no wonder that the technical knowledge of the people of Dhemaji in reading the animal behavior including other natural signs may be usefully utilized for early

prediction of flood in other places as well. Besides the knowledge associated with pond construction, protection of fishery from inundation, tactful utilization of fisheries resources etc. are some of the topics on which organized research may be conducted for bringing out probable cost effective measures of disaster management. The research outcome may be of great help for the poor farmers who have faced the problems of land erosion, water seepage etc. Different fish harvesting methods were found to be fishing devices that were cost effective and efficient with cultural appropriateness and environmental soundness. It is imperative to analyze these technologies so that the scientific principles/basis behind them can be properly understood. Once this is done, the techniques can be further refined and improved by blending them with modern scientific knowledge, leading to easier extension of them to the places with similar problems.

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