CHAPTER 3

METHODOLOGY

3.1. INTSITUTION VISITS

During the recce visits, both primary and secondary data were collected which helped in finalizing the research methodology for each of these six questions. For the secondary data collection, following institutions were visited for library browsing and personal interviews with senior researchers –

3.1.1. Assam Institute of Research for Tribals and Scheduled Castes (AIRTSC)

Assam Institute of Research for Tribals and Scheduled Castes (AIRTSC) is also known as Tribal Research Institution. It is located in Guwahati and was established in 1963. It is a Government Institution and has carried out several authentic research on tribes and castes in Assam. AIRTSC has published several books in the past five decades on different tribes and their culture. It also has a good collection books that can be accessed for research purpose. Hence, AIRTSC was selected as one of the institutions to visit.

3.1.2. Assam Remote Sensing Application Centre (ARSAC)

Assam Remote Sensing Application Centre (ARSAC) is the Government Institutions hosted by the Assam Science Technology and Environment Council (ASTEC). In collaboration with Space Application Centre, it prepares maps with geotagged information. It played an important role in preparing the National Wetlands Atlas by Space Application Centre. All the wetlands maps and geomorphological maps of Assam are prepared by ARSAC. Hence, Scientists in ARSAC were contacted for help in mapping.

3.1.3. Assam Science, Technology and Environment Council (ASTEC)

Assam Science, Technology and Environment Council (ASTEC) is a Government Institution located at Guwahati. ASTEC was the nodal agency for developing the Management Action Plan of Deepor beel wetland. During this management plan development process, ASTEC carried out studies on fish diversity of Deeporbeel and socio-economy of the fringe villages. Hence, ASTEC was visited to study the management action plan of Deeporbeel and interactions with scientists.

3.1.4. Block Development Offices

Block Development Offices have demographic details of respective Development Blocks. It also have records about the vocations of people. Hence, Block Development Offices were visited to understand the demographic patterns of the blocks and to know the locations of people who are involved in fishing.

3.1.5. Centre for Environment Education, North East Regional Office (CEE NE)

Centre for Environment Education, North East Regional Office (CEE NE) is a Centre of Excellence under the Ministry of Environment, Forests and Climate Change (MoECC), Govt of India. It has been implementing several projects in Kamrup, Kamrup Metro and Goalpara Districts in the past one decade. The Programme Director of CEE did PhD on fishes in Protected areas that covered Deeporbeel Sanctuary area. To understand and get secondary information about the communities in the study area, CEE NE was visited.

3.1.6. Gauhati University (GU)

Several researchers from Gauhati University, especially Zoology Department have done PhD research work on the fishes, fishermen communities and wetlands. To discuss with the Research guides and to browse the PhD Thesis, GU was visited.

3.1.7. North East Social Research Centre (NESRC)

North East Social Research Centre (NESRC) has a good collection of books in its library that included books on tribes and castes of Assam. Hence, NESRC was visited to do literature review.

3.1.8. North Eastern Hill University (NEHU) and Indian Council of Social Science Research (ICSSR)

North Eastern Hill University (NEHU) and Indian Council of Social Science Research (ICSSR) North Eastern Centre are located in the same campus. Both the institutions have good collection of reference books in their libraries. Hence, these two institutions were visited.

Following methodologies were adopted to find answers to the 5 research questions.

3.2. METHODS FOR STUDY OF THE WATER SPREAD AREAS AND MAPPING

3.2.1. Geomorphology

- The geomorphological map of Assam prepared by Assam Remote Sensing Application Centre (ARSAC) using **LANDSAT – 5 TM** and **IRS - IA LISS II** satellite imageries have been referred for studying the geomorphological characteristic.

3.2.2. District maps

- District maps have been prepared using the online internet tool of Google map at 5 km scale (Goalpara and Kamrup Metro districts) and 10 km scale (Kamrup district)

3.2.3. Major rivers

- All the major rivers in the study area were visited. Origin/ entry point to Assam and the confluence with river Brahmaputra has been traced through site visits. GPS readings were taken at the origin/entry point, confluence and at the transit point of the river with any major Highway. All these points are described in CHAPTER 3 in the Water Spread Area description

- Following southern tributaries of Brahmaputra were studied –
  .1. Jinjiram
  .2. Jinari
  .3. Krishnai
  .4. Dudhnai
  .5. Singra
  .6. Chaygaon
  .7. Kulsi
  .8. Bharalu
  .9. Digaru
  .10. Kopili
- Studies on the bank of river Brahmaputra was limited to the following sites and the confluence points of the Southern tributaries –
  .1. Chandrapur
  .2. Kachari ghat, Guwahati
  .3. Sadilapura
  .4. Nagarbera
  .5. Simlitola
  .6. Dalgoma
  .7. Mornoi

.8. Guwaltuli

.9. Goalpara

.10. Pancharatna

3.2.4. Geographical coordinates (GPS points)

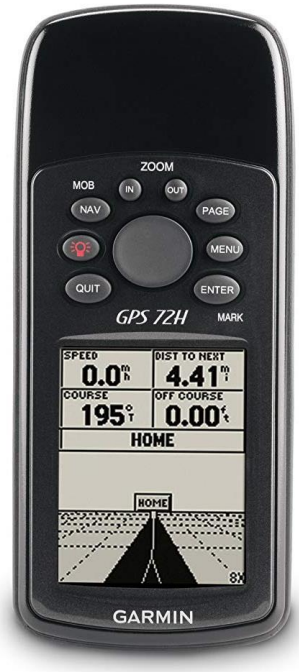

Fig. 3.1. Garmin GPS 72H

- All geographical coordinates (GPS points) of the wetlands, study villages and sampling sites were taken using **Garmin** make portable **GPS 72 H instrument** (Fig. 2.1)
- For calibration, the GPS instrument was switched on and left on standby for about 10 min under open sky before taking any reading.
- Care was taken to avoid any place under the canopy of a large tree or any kind of obstruction between the Garmin handset and the satellites.
- While noting the GPS coordinates, it was ensured that the reading was taken only when a minimum of 4 satellite connections were getting good signal. On cloudy days, readings were taken when atleast 5 satellites were connecting.

3.2.5. Major beels

- High resolution Wetland maps of the following beel eco-system were prepared using Google Earth Pro app. The image stock of the areas are given below –
  - Kumri beel – 2 km scale – (Image 2019 – Digital Globe, 2018 - Google) and Makri beel – 2 km scale - (Image 2019 – Digital Globe, 2018 - Google)
  - Hasila beel – 1 km scale - (Image 2019 – Digital Globe, 2018 - Google)
  - Urpad beel – 3 km scale - (Image 2019 – CNES / Airbus, Digital Globe; 2018 - Google)
  - Chandubi beel – 2 km scale - (Image 2019 – CNES / Airbus; 2018 - Google)
  - Deepor beel – 3 km scale - (Image 2019 – Digital Globe, 2018 - Google)

3.2.6. Cross referencing:

- Wetland maps were cross referenced with National Wetlands Atlas: Assam, 2010 maps of **IRS P6 LISS III** satellite

3.3. METHODS FOR COLLECTION AND PRESERVATION OF FISHES:

3.3.1. COLLECTION OF FISHES

The study area has the major rivers and beels mentioned above. Fishes from both lentic and lotic water bodies were collected, preserved and identified. Pre, during and post monsoon sampling were done in major water bodies. Some common species like *Labeo rohita, Gibelion catla* were not killed and preserved as these are common and could be identified on the spot using the taxonomic key given below. Confusing specimens i.e. *Puntius, Channa* were preserved and studied in detail. Relevant literature and equipments for identification were carried to the field for the study.

Fig: 3.2: Collection of fish using a cast net

Some external morphological studies and morphometrics were done on the site with live specimens and some were done with preserved specimens in Centre for Environment Education. Extensive collections were made during the rainy season, particularly during floods. For all collections, help of local fishermen was taken and they used their own gears as per the need of the eco-systems. Different types of gears were used in different type of habitat. Collection gears also varied with the fish species. Collection gears included hook and line, cast nets, gill nets of different mesh sizes, scoop nets, sepa, jakoi, jaati jaal, thoha, jakra, porongi jaal, dheki jaal, katal, ghoka jaal and kharband. For taxonomic studies, external morphology of the fish needs to be in good condition. Hence, only such gears were selected which can catch the fish live or with minimum distortion to the external morphology. For Deepor beel, collection was done outside the Wildlife Sanctuary boundary where fishing is allowed.

3.3.2. PRESERVATION OF THE FISH SPECIMENS:

Fishes caught for taxonomic study were initially preserved in 10% formaldehyde solution in a wide-mouthed glass jar in the collection site itself (Jayaram, 1999). Later these were transferred to large sized bucket so that the body doesn't bend or distort. Fishes smaller than 10 cm length were dipped in formaldehyde without incision in the abdomen and medium sized fishes of 10 to 30 cm length were dipped with an incision in the abdomen on the mid-ventral line. Fishes longer than 30 cm were injected with 10% formaldehyde through a hypodermic syringe. In the process of preservation, every individual fish was tagged and details of the specimen including location, date of collection, local name, colouration, special features etc. were recorded. The preserved fishes were taken to the laboratory for detailed morphometric and anatomical investigations.

3.4. METHODS FOR IDENTIFICATION OF FISHES

3.4.1. Identification of the fishes:

The identification of fishes were done based on the published works of –

- Beavan (1877),

- Day (1889),
- Talwar and Jhingran (1991),
- Nelson (1994),
- Jayaram (1999) and
- Nath and Dey (2000),

For confirmation of specific groups, following literatures were followed –

- For Siluroid fishes - Hamilton, Menon (1964)
- For genus *Puntius* - Jayaram (1991)
- For Cobitidae and Botinae - Menon (1992)

Unpublished PhD thesis of Kalita (2011) was referred for confirmation of the fishes from Deepor beel area.

3.4.2. Classifications of the fishes:

Classifications of the identified fishes were done after –

- Talwar and Jhingran (1991),
- Nelson (1994) and
- Jayaram (1999)
- Jayaram (2010)

For the latest binomial nomenclature, website www.fishbase.org was followed.

3.4.3. Comparison:

Wherever necessary, the morphometric data of the fishes were compared with the specimen at the fish section of Bio-diversity Museum of the Zoology Department, Gauhati University and Zoological Survey of India, Shillong office

3.5. TAXONOMIC KEY FOLLOWED FOR IDENTIFICATION OF THE FISHES

Table: 2.1: Key for classification upto Sub Division level:

Taxonomic level	Characteristic observed	Inference
Grade	Aquatic Gnathostomata having gills in adult state. Paired limbs in form of fin when present are not of pentadactylous type. Median fins supported by a special skeleton. An internal ear only.	**PISCES**
Class	Skeleton contain bone. A single gill opening on each side of the head.	**Osteichthyes** (boney fishes)
Subclass:	Fins with rays, two paired fins, one or more median dorsal fin, one median anal fin, the internal skeletal support of median fin don't extend to fins, gills covered by bony operculum	**Actinopterygii** (ray fin fishes)
Subdivision:	True boney fishes with true endoskeleton, 4 pairs of gill arches, air bladder	**TELEOSTEI** (Teleosts)

Source: Talwar & Jhingran (1991)

Table: 2.2: Key to the orders (*Source: Talwar & Jhingran (1991)*

1. (a) Body bilaterally symmetrical --- 2
2. Body not oddly shaped; without bony scutes or rings; upper jaw protractile --- 3
3. (a) Body eel-like, and rounded in cross section, Gill openings narrow, on side of head; no Spinous ray in fins; pelvic fins absent --- **Anguilliformes**

   (b) Body not eel-like; if eel-like, gill openings

	are not separate but confluent on ventral side of body near the throat, pelvic fins present, or spinous rays in dorsal and/or anal fin	--- 4
4.	(a) Form of body eel-like	--- 5
	(b) Form of body not eel-like	--- 6
5.	(a) One gill opening on the ventral surface, as a slit or pore; pectoral fin absent	**Synbranchiformes**
	(b) Two gill openings; pectoral fins present	--- Perciformes (Suborder: Mastacembeloidei)
6.	Pectoral fin with one base, the lower rays often markedly modified as compared with upper rays but there is no gap between the base of the two groups	--- 7
7.	(a) Weberian apparatus present; head without scales; often no teeth on jaw	--- 8
	(b) Weberian apparatus absent; head usually with scales; jaws toothed	--- 9
8.	(a) Body either naked or covered with bony Plates; jaws with teeth; outermost ray of pectoral fin modified into an osseous spine or thick ray	--- **Siluriformes**
	(b) Body generally with scales, devoid of bony Plates; no teeth on jaws; pectoral fin devoid of an osseous spine	--- **Cypriniformes**
9.	(a) Mesocoracoid present	--- 10
	(b) Mesocoracoid absent	--- 12
10.	(a) Anal fin very long, confluent with the reduced caudal fin, with more than 100 rays; pelvic fins rudimentary	**Osteoglossiformes**
	(b) Anal fin moderate, not confluent with caudal fin	--- 11
11.	Lateral line absent; body compressed and	

with keeled scutes on abdomen; branchiostegal rays 4 to 8 --- **Clupeiformes**

12. No adipose dorsal fin; caudal fin bilobed/ rounded --- 13

13. (a) Pelvic fin absent or reduced to one strong spine; mouth small; gill openings restricted to lateral slits **Tetraodontiformes**

    (b) Pelvic fin present and normal --- 14

14. Pelvic fins thoracic or abdominal; body with scales; single lateral line --- 15

15. (a) Dorsal and anal finds very long; no fin spine; suprabranchial organ present **Perciformes** (Suborder: Channoidei)

    (b) Dorsal and anal fins short to moderate; suprabranchial organ generally absent --- 16

16. Gill openings normal; body with scales --- 17

17. (a) Single dorsal fin, with or without spine --- 18

    (b) Two dorsal fins (continuous, but with a notch between the spinous and soft parts --- 20

18. (a) Suprabranchial organ present; dorsal and anal fins with spines; gill membranes scaly and broadly united --- **Perciformes** (Suborder: Anabantoidei)

    (b) No suprabranchial organ --- 19

19. No fin spine **Cyprinodontiformes (Beloniformes)**

20. Suborbital stay absent --- 21

21. (a) Dorsal fins with a small gap or notch between spinous and soft rayed parts --- **Perciformes**

    (b) Dorsal fins wide apart --- 22

22. Dorsal fin with four spines; lateral line absent

or very faint; jaw teeth small or absent	--- **Perciformes** (Subordr: Mugiloidei)

Sample size for fish identification – a minimum of 4-8 individuals of each species have been verified depending on the availability

3.6. METHODS FOR STUDY OF THE FISHING GEARS:

It was mostly an exploratory work to identify the fishing gears in the study area being used by different communities. Direct field surveys were conducted in the localities as described in CHAPTER 3 Gears used in all types of lotic and lentic water bodies were studied. 120 fishermen fishing in different types of water bodies were interviewed. Manufacturer of fishing net, bamboo gears and fishing boat in the study area were interviewed. The processes of weaving of caste net, preparation of bamboo gears and making of boat were observed live and photo-documented. Raw materials as described by them were noted and verified with the actual gear. A semi-structured questionnaire was integrated in the main survey format (Section B of the format attached as *Annexure 1*).

For measuring length and diameter of gears, meter tap and 12 inches ruler scale was used. For measuring girth of bamboo sticks, screw gauge was used and for measuring mesh size of nets, Vernier callipers was used.

For studying the modus operandi of the gears, observation trips were made with the fishermen to the waterbody where they demonstrated the operation of the gears. Seasonal variations if any were first recorded from the interviews and subsequently in all necessary cases verified through field observations.

The detailed designs of the gears were documented with help of digital SLR Nikon D7000 or drawings prepared based on the FAO catalogue of small-scale fishing gear (FAO, Nedelec, 1975). Most of the gears were digitally photographed. Only in case of some gears, due to rains, camera couldn't be operated. In such cases, line drawings have been made.

3.7. METHODS FOR DEMOGRAPHIC STUDIES INCLUDING CULTURAL LINKAGES AND INDEGENOUS TRADITIONAL KNOWLEDGE

Basic secondary information about the communities in the districts were collected from the Government offices of the study districts. For demographic data, 2011 Census of India data has been referred from Census of India website (www.censusindia.gov.in). Secondary information were also collected from published papers/ thesis. Following line Departments were visited for secondary data on demography –

1. Block Development offices
2. Directorate of Research on Schedule Tribe and Schedule Caste
3. Fisheries Department
4. Guwahati Metropolitan Development Authority
5. Centre for Environment Education

Primary data on the communities and their engagement in fishing were collected through –

1. Key informer interaction
2. Focus group discussions
3. Semi structured questionnaire survey of fishermen, fish vendors, fish whole seller, Mahaldar, family members of fishing communities

3.7.1. Key Informer Interaction

Discussions with the key informers were kept organic without keeping a pre-drafted questionnaire. But, a checklist of key information to be derived was prepared beforehand and probing questions were asked to lead to the desired answers. The Check list had the following questions:

- Which localities should be visited?
- Who can be the knowledgeable fishermen in the community for interviews and group discussions?
- Where can the photo documentation be done?

- What will be the best season for sampling of fishes?
- What can be the best season to document the Modus operandi of the fishing gears?
- What are the communities living in the area who are engaged in fishing?

Following key informers from different locations were met and interacted with – (listed in alphabetic order)

1. Md. Inamul H Ahmed, Community leader, Suwalkuchi
2. Md. Rofikul Islam, Pancharatna, Goalpara
3. Mr. Polsing Momin, Baida, Agia, Goalpara
4. Ms. Lilimai Das, Chandrapur, Kamrup
5. Smt Dayabati Rabha, Rajapara, Kamrup
6. Smt. Padumi Rabha, Community leader, Baripara, Singra
7. Sri Ajanta Barman, Youth leader, Urpad beel, Goalpara
8. Sri Amiya Roy, Head Teacher and In-charge of the Baripara LP School Mini Museum, Singra
9. Sri Boloram Rabha, Dudhnai, Goalpara
10. Sri Dhananjay Barman, Budhipara, Goalpara
11. Sri Jayanta Kalita, Community leader, Goalpara
12. Sri Jogesh Barman, Fisherman, Jungle para, Nichinta, Goalpara
13. Sri Gayanath Barman, Treasurer, Urpad beel Ganga Puja committee
14. Sri Khagen Das, Secretary, Deepor beel Pachpara Committee, Azara
15. Sri Lakkhan Teron, Community leader, Chakardo
16. Sri Madan Das, Mahaldar, Bongolaghuli, Kamrup
17. Sri Mahesh Kalita, Chakardo, Boatman
18. Sri Manoj Patgiri, Community leader, Matia
19. Sri Purna Das, President, Deepor beel Pachpara Committee Hira para
20. Sri Sankar Patgiri, Owner of Fish Hatchery and Fishery trainer, Matia, Goalpara

3.7.2. Focus Group Discussion

Focus group discussion were done with community leaders, fishermen and fishing community women at the following grassroot institutions. Discussion was kept organic without keeping a pre-drafted questionnaire. But, a checklist of key information to be derived was prepared beforehand and probing questions were asked to prompt them to lead to the desired answers. FGDs were organized at the following 14 locations (in alphabetic order) -

1. Azara Keotpara Boys Club, Azara, Kamrup Metro – With fishing community leaders
2. Azara Keotpara Lower Primary School, Azara Kamrup Metro – With Manasa temple committee, women of the village
3. Baripara LP School Mini Museum, Singra – With Rabha community leaders and women of the community
4. Bolbola fish market, Bolbola, Goalpara – with fishermen and fish sellers
5. Chandubi beel, Kamrup – With fisher men and women
6. Dalgoma Jaluapara, Dalgoma, Goalpara – Fishermen and fish sellers
7. Domani, near Mornoi, Goalpara – fishermen and women
8. Dubapara, Goalpara – fishermen and women
9. Forest Watch tower, Chakardo, (Deeporbeel) Kamrup Metro – With fishermen, forest Dept staff
10. Goalpara New Market Fish market – with fish retailers and whole sellers
11. Gobardhan Fish market, near Chandrapur – With fishermen and fish sellers
12. Junglepara Self Help Group, Urpad beel – with fishermen & ladies of fishing families
13. Pancharatna market, Pancharatna, Goalpara – with fish retailers
14. Uzan bazar fish market, Guwahati – Fish Mahaldars, whole sellers and retailers
15. Gobardhana village, near Boko, Kamrup – with fishing ladies

The Check list had the following questions:

- What are the communities living in the area who are engaged in fishing?
- What are the fishing gears used in the area?
- What are the cultural links of the communities with fish and fishing?
- If there is any traditional knowledge specifically linked to fish and fishing?

- What are problems/ threats to fishery in the area?
- What are the alternative livelihood choices of the people?

For problem prioritization and livelihood discussions, Participatory Rural Appraisal (PRA) techniques were used. PRA methodology and techniques were followed after Narayanasamy (2009) as given in his book *Participatory rural appraisal: Principles, methods and application*

3.7.3. Questionnaire survey

Stratified proportionate random sample survey through semi structured questionnaire has been carried out.

3.7.3.1. Sample design:

- **Type of universe:** finite sample as per 2011 Census records has been considered

.1. Population of Goalpara district - 1,008,183
.2. Population of Kamrup district - 1,517,542
.3. Population of Kamrup Metro district - 1,253,938

Therefore, the total population is = 37,79,663

Total number of household is = 5,39,952

As per information gathered from the Block Offices and key informers, out of these, approximately 55,000 households are involved in commercial or artisanal fishing having a population of about 3,85,000. This is the total number of fishing population in the area to be studied

- **Sampling units:** Fishing villages and fish markets as mentioned in the Water spread areas described under CHAPTER 3.

- **Source List:** prepared based on discussion with Block offices and local key informers

- **Sample size:** Considering the population of fishing families to be approximately 3,85,000, If we take 95% confidence level at 5% margin of error, a total of 384 persons have been considered for the questionnaire survey.

3.7.3.2. Tools of data collection for community surveys: Semi- structured questionnaire as given in *annexure 1*

3.7.3.3. Sources of data:

- **Primary**- Fishermen, Fish seller (including Mahaldar, Whole seller, retailers and house to house selling vendors), Community Leaders

3.7.3.4. Collection of data:

- Personal interviews using the semi structured questionnaire: 384 individuals were interviewed using the semi-structured questionnaire

3.7.3.5. Locations of the survey:

Locations of the surveys are elaborately mentioned with GPS Locations in CHAPTER 3.

3.7.3.6. Analysis of community data:

- Data entered in excel spread sheet.
- Classified and graphical analysis done using excel.

3.8. METHODS FOR DIGITAL PHOTODOCUMENTATION:

All the important waterbodies, fish species, fishing gears and some cultural elements were digitally photographed using a Nikon make D 7000 DSLR camera and a 18-105 / 18-200 mm VR lens. Raw photographs were processed in Adobe Photoshop Version CC 2017 with help from experts.

Fig: 3.3. Nikon D 7000

Plate 3.1 : Some scenes from the field works

Fig: 3.4. Fishermen at Brahmaputra, Goalpara

Fig: 3.5. Visiting Urpad beel, Goalpara

Fig: 3.6. Interviewing Women at Dalgoma

Fig: 3.7. Visiting field with fisherwomen

Fig: 3.8. Visiting Rabha museum in Baripara LP School, Singra

Fig: 3.9. Interviewing women at Jungle para

Fig: 3.10. Interviewing fishermen at Urpad

Fig: 3.11. Got love & affection from community