CHAPTER - III

MATERIALS AND METHODS
3. MATERIALS AND METHODS

The study was conducted in the districts of Dhubri, Golaghat, Dibrugarh and Karimganj in Assam. Standard Methodologies have been followed for the following aspects of the study. Research designs have been evolved whenever necessary.

a. Locations of the study sites
b. Land and the people
c. Methods of data collection
d. Procedure of selection of respondents
e. Application of statistical methodology
f. Operationalization of variables and their measurement
g. Statistical analysis of data

a. Locations of the study site

The study was conducted in Talu Malu Beel (22.0 ha) in Dhubri district; Amuguri Basapathar Beel (49.80 ha) in Golaghat district; Kutuha Bar Beel (16.0 ha) in Dibrugarh district and Bhitorkuri Beel (20.0 ha) (chotto Beel) within Sone Beel (3458.12-409.37 ha) of Karimganj district of Assam. Bhitorkuri Beel is taken as control Beel to get some comparable views with respect to impact of development and management of Beels through community-based fisheries management and without community-based fisheries management (Islam et.al, 2006, Chapagain, 2007).

b. Land and the people

The province of Assam is located (25°29'7.27 to 27°23'37.43''N and 90°1'50.21" to 96°21'28.44"E) covering an area of 78,434 sq.km. The province of Manipur and the neighbouring country Myanmar are situated to its East; Bangladesh to its West; Arunachal Pradesh to its North and Mizoram to its South. Assam has 27 districts which are enriched with both biotic and abiotic resources representing numerous wetlands and intricate networking of rivers forming the Brahmaputra-Barak-Meghna drainage system. The prolific fish diversity sustains a rich diversity of fisherfolk in this region represented by professional, occasional and part-time fishermen (FAO, 1979; Kar, 2007).

c. Methods of data collection

In the study, basic socio-economic data were collected through Participatory Rural Appraisal (PRA) method by applying PRA tools, viz. community meeting and small focus group discussion, direct observation, participatory mapping, wealth ranking with the help of Key Informants'/Knowledgeable Individual (KI) Technique
Semi-structured interviews were also conducted with *Beel* users (stakeholders) using Annexure-III and IV. Before final data collection, the schedule was pre-tested with non-sample respondents of the area. Data were collected during 2007-08 to 2009-10 in local language and replies have been recorded in English (Barman, 2004; Dana *et al.* 2005; Kar *et al.*, 2009).

PRA team consisted of Technical Officers of Fisheries Department, NGO representatives, local Knowledgeable Individuals (KIs).

Data were also collected from the offices of the concerned district Nodal NGOs, District Fisheries Development Officers, Directorate of Fisheries, Assam and Assam Rural Infrastructural and Agricultural Service Society (ARIAS), Assam.

**Community meeting and small focus group discussion**

Community meeting and small focus group discussion are the two basic important techniques of community information gathering and dissemination, and it is a cooperative approach to decision making through discussion (Pomeroy and Rivera, 2006).

In the present study, several such meetings were held with the stakeholders, KIs and some active general BDC members to collect first-hand information on the involvement of community members including women in all the stages of *Beel* development.

**Direct Observation**

Direct observations on *Beel* development activities, physical status of the *Beels*, distribution of incomes of the *Beel* users and management of the *Beel* by the BDC were done (Ray, 1999).

**Knowledgeable Individual interview**

KIs are the Knowledgeable Individuals who are considered as local experts because of their knowledge about the community and its resources. The KIs were interviewed to know about the problems and need of the community at large (Townsley, 1996; McCaslin and Tibezinda, 1997; Pomeroy and Rivera, 2006).

Local Fishery Demonstrators, Fishery Extension Officers, NGO Coordinators, Village Head Men (*Gaon Burhas*), local school teachers were considered and engaged as the KIs in the present study.
Wealth Ranking

It is a participatory analytical exercise carried out by a few KIs based on certain socio-economic parameters viz. income, land holding, employment, etc in order to reveal the socio-economic status of the Beel users and classify them into different wealth classes viz., Rank A (Rich), Rank B (Medium), Rank C (Poor) and Rank D (Very Poor). Chapagain (2007).

Rich (Rank A)
Those people who have the land holding measuring >2.0 ha; annual income > Rs. 1,10,000.00 and have Government/non-Government job. They generally have concrete house.

Medium rich (Rank B)
Those people who have the land holding measuring >1.0 ha and up to 2.0 ha; annual income ranges from Rs. 55001.00 and up to Rs. 1,10,000.00 and have no Government/non-Government job. They usually do not have concrete house.

Poor (Rank C)
Those people who have the land holding > 0.40 ha and up to 1.0 ha; annual income ranges from Rs. 22001.00 and up to Rs. 55000.00 and work as laborers. They generally have thatched houses.

Very Poor (Rank D)
Those people who have the land holding up to 0.40 ha; annual income up to Rs. 22000.00 and work as labourers. They generally have thatched house.

d. Procedure of selection of respondents:
Out of the total of 1023 households of Beel users, 200 households surrounding the Beel (consisting of both males and females) were selected through random sampling. Random sampling of 50 households of Beel users were chosen from each of the four selected Beels. As such, the total numbering households of Beel users surveyed were 200, which were considered as the respondents for the study.

e. Application of statistical methodology:

Independent variables: Total 21 (Twenty One) variable.

Personal Characteristics: (a) age, (b) education and (c) family size.

Socio-Economic Characteristics: (a) type of constructed house (b) caste, (c) land holding, (d) occupation, (e) income (annual, pre CBFM and post CBFM), (f) social participation, (g) community-based physical asset and (h) socio-political empowerment
Psychological Characteristics: (a) Beel users’ participation in development program (b) Beel users’ decision making ability, (c) women empowerment, (d) community-based fishery organization, (e) Management capabilities of BDC and (f) involvement of NGOs.

Situational characteristics: (a) Availability of critical aquaculture inputs (b) community managed markets.

Dependent variables (a) Knowledge level of Beel users on community-based fisheries management, (b) Sustainable development and management of Beel fisheries, (c) community’s livelihood for sustenance.

f. Operationalisation of the variables and their measurement

Independent variables

Personal characteristics

Age:

It refers to the chronological age of the Beel users and consist of the following three categories (Goswami, 2003, Barman, et al., 2006):

Young Beel users – It refers to those Beel users whose age is up to 30 years.

Middle-aged Beel users – It refers to those Beel users whose age ranges from 31-50 years.

Old aged Beel users – It refers to those Beel users whose age is > 50 years.

Education:

It refers to the academic qualification acquired by the Beel users through formal schooling (Dana, 1987, Goswami, 2003, Barman, et al., 2006). The formal educational levels, which were used in this study, are as follows:

Illiterate – It refers to those Beel users who are not educated at all.

Primary – It refers to those Beel users whose education is up to primary and can read and write Assamese/ Bengali.

Middle – It refers to those Beel users whose education is up to middle school (Class-V to VIII) where English is one of the subjects of study.

High school – It refers to those Beel users whose education is up to High /Higher Secondary (H.S.) level where English is one of the subjects in the curriculum.

Graduate and above – It refers to those Beel users whose education is up to graduation and above.
The education of the respondents was measured with the help of the classification and scoring was done as – primary: 1; middle: 2; high school: 3; graduate: 4.

**Family size:** It refers to the total number of members in a family.

**Nuclear family:** It refers to total number of persons in the family of a *Beel* user, which includes his wife, sons, daughters etc., irrespective of their age.

**Joint family:** In addition to the family members mentioned above in a nuclear family, it further includes the *Beel* users, father, mother, sisters, brothers and grand parents.

The total family sizes were categorized as (a) small-sized family (1-4 members); (b) medium-sized family (5-7 members) and (c) large-sized family (>7 members).

**Socio-Economic Characteristics**

**Type of constructed house:**

It refers to the condition of the house of the *Beel* users, whether it is concrete, semi concrete and thatched house. Pattern of house indicates the socio economic condition of the *Beel* users (Kar 2000b, Maiti, 2003, Goswami, 2003, Barman, 2004).

The variable was categorized with the scoring of (a) concrete: 3; (b) semi-concrete: 2 and (c) Thatched: 1.

**Caste**

It refers to the caste of the *Beel* users. Three categories of the caste were considered in this study namely scheduled caste, scheduled tribe and general caste.

**Land holding**

It refers to the total land areas (cultivated and household) possessed by the *Beel* users. *Beel* users were categorized into four groups viz. (a) very poor land holding (up to 0.40 ha); (b) poor land holding (ranges from 0.40 ha and up to 1.0 ha); (c) medium land holding (ranges from 1 ha to 2.0 ha) and (d) rich land holding (>2.0 ha).

**Occupation**

This variable was divided into five categories with the scores of (a) service-5; (b) agriculture-4; (c) business-3; (d) labour-2; and (e) fisheries-1.

**Income**

It refers to the total annual income of *Beel* user’s family earned through aquaculture, fishery and agriculture. Some non-fishermen *Beel* users’ also earn through jobs, trade, day labourers, etc. Based on annual income, *Beel* users were
categorized into (a) very poor (up to Rs. 22000.00); (b) poor (ranges from Rs. 22000.00 to Rs. 55000.00); (c) medium rich (ranging from Rs. 55000.00 up to Rs. 110000.00) and (d) rich (> Rs. 110000.00) income groups (Anon, 2004; 2008).

Social participation

It refers to the degree to which Beel users are associated with different organizations like village-Panchayat, Panchayat Samity, Fish Farmers Club, Rural Development Club, Zila Parishad, Fishermens’ Co-operative societies, etc. This variable was divided into four categories and scores were allotted as (a) member of one organization-1; (b) member of more than one organization-2; office bearer-3 and (c) office bearer and members of another organization-4; (d) not a member of any organization-0.

Community-based physical asset

It refers to the common infrastructure available to the Beel users’ group. These include common cultivable fish pond, common model fish farm with or without eco-hatchery, common crafts and gears used in harvesting, common institutes like schools, libraries, etc. The variable was quantified by allotting the score of (a) strong infrastructure (5-6 out of 6); (b) medium infrastructure (3-4 out of 6); (c) poor infrastructure (2 out of 6) and (d) very poor infrastructure (<2 out of 6).

Socio-political empowerment

It refers to the simple average (Hiremanth, 2008) of the following areas viz. (a) control/influence over resources (i.e. here it is Beel); (b) participation in policy making and (c) participation in law/policy implementation and enforcement and it was applied to measure the extent of Beel users’ participation in the aforesaid areas. The variable was quantified after adding the total scores (in a scale of 1-50) and categorized as (a) high socio-political empowerment (>40 out of 50); (b) medium socio-political empowerment (30-40 out of 50) and (c) low socio-political empowerment (<30 out of 50). A short description of the sub-areas under the socio-political empowerment is stated below:

(a) Control/influence over resources

It refers to pattern of using the Beel resources. It also includes how the Beel users obtain lease and their management norms for conservation, rational harvest of Beel resources.
(b) **Participation in policy making**

This refers means the Beel users are involved in making policy, decision for effective development and management of the Beel.

Responses from the respondents were taken against the above two areas after framing a dichotomous type of questions (Annexure–III). Respondents were awarded with the score of ‘1’ and ‘0’ based on their response of ‘yes’ and ‘no’.

(c) **Participation in law/policy implementation and enforcement**

This reveals how the Beel users are involved in BDC’s law/policy implementation and enforcement for effective development and management of the Beel.

(d) **Conflict resolution / management**

Conflict may arise due to different causes viz. sharing the benefit of projects, choices in the allocation of the resources or the functioning of the external cost at different levels which may suggest a certain approach to management and this type of conflict is the focus in most of the conflict management (Pomeroy and Rivera-Guieb, 2006).

Responses from the respondents were taken against the above two areas i.e. ‘Participation in law/policy implementation and enforcement’ and ‘Conflict resolution / management’ after framing a dichotomous type of questions (Annexure–III). Respondents were awarded with the score of ‘3’, ‘2’, ‘1’and ‘0’ based on their response of ‘Fully Agreed’, ‘Agreed’, ‘Disagreed’ and ‘No Decision’.

**Psychological Characteristics:**

Six independent (psychological) variables namely (a) Beel users’ participation in the Beel development program; (b) Beel users’ decision making ability; (c) Woman empowerment under BDC; (d) Community-based Organization; (e) BDC’s Management capabilities and (f) Involvement of NGOs, were measured by developing schedules (Annexure–III) and awarded with the score of ‘1’ and ‘0’ based on their response of ‘yes’ and ‘no’ for this purpose (Barman et.al., 2006, Barman and Dana, 2009). Afterwards, respondents were grouped into three categories namely (a) ‘low’; (b) ‘medium’ and (c) ‘high’ for each of the aforesaid variable. For finding out the total scores against each variable, the scores for each item were added. A short description of the variables is given below:
(a) *Beel* users’ participation in the development program under BDC:

It refers to the degree to which a *Beel* user is associated with different stages of the *Beel* development programme.

(b) *Beel* users’ decision making ability:

Decision-making is the process of consciously choosing courses of action from available alternatives and integrating them for the purpose of achieving a desired activities (Ray, 1999).

(c) Woman empowerment under BDC

The concept of empowerment is related to the concept of freedom (Srinath and Thangamani, 1993). Empowering equips one to improve his / her living condition (Devadas et al., 1988). Here, the concept of women empowerment is related to involvement of women *Beel* users in each stage of *Beel* development programme (Braman et al., 2007).

(d) Community-based Organization

Here, community-based organization is refers to *Beel* Development Committee (BDC) which is a group of 20-500 individuals living in the adjacent villages of a *Beel*. The *Beel* users come together to work hand in hand for effective utilization of the *Beel* and thereby to ensure enhancement of livelihood in a sustainable manner (Anon, 2004,2011).

(e) BDC’s Management capabilities

This portrays to the efficiency of a BDC in respect of (a) management of the BDC ; (b) effective record keeping for the BDC; (c) mobilization and effective utilization of BDC fund and (d) capacity building of the BDC members. Success or failure of a community-based *Beel* development depends on how the management of the BDC is carried out. Depending upon the management efficiency of a BDC , the productivity of the *Beel* may be enhanced to a desirable level.

(f) Involvement of NGOs

‘Hedge (1993) stated that NGOs are primarily service organizations; they are generally hard working and efficient in comparison to Government extension agencies when it comes to promoting development programs in rural areas. NGOs are
generally strong in program management and hence able to organize and monitor the program more efficiently (World Bank source, 2004).

Situational characteristics

Two independent (situational) variables namely (a) availability of critical aquaculture inputs and (b) community managed market were measured by developing schedules (Annexure–III). Accordingly, responses from the respondents were taken (Dana, 1987; Goswami, 2003; Barman, 2008; Barman et al., 2008). Respondents were awarded with the score of ‘3’, ‘2’, ‘1’and ‘0’ based on their responses of ‘Fully Agreed’, ‘Agreed’, ‘Disagreed’ and ‘No Decision’. A short description of the aforesaid variables is given below:

(a) Availability of critical aquaculture inputs

This refers to the availability of crucial and decisive inputs for sustainable development of fisheries which include availability of quality fish seeds for composite culture practice, inputs like lime, organic and inorganic fertilizers, prophylactic and therapeutic drugs, fishing and harvesting equipments, other important aquaculture and animal husbandry inputs (Barman et al., 2008).

(b) Community managed Marketing:

This reflects to the selling and purchasing of aquaculture and fisheries inputs and produces by the Beel users. As a general norm, the marketing facility should be well developed whenever sustainability is concerned (Barman et al., 2008).

Afterwards, respondents were grouped into three categories viz. (a) ‘low’; (b) ‘medium’ and (c) ‘high’. For finding out the total scores against each variable, the scores for each item were added.

Dependent variable

(a) Knowledge level of Beel users on community-based fisheries management

Here, knowledge refers to the information and understanding of Beel users on community-based fisheries management. In this study, their knowledge was measured with the help of “KNOWLEDGE TEST” scale developed by Dana (1987), Shaikh et al. (1993), Barman (2004), Barman et al. (2007) with slight modification done for the present study. For each of the correct answer, a score ‘X’ was given and for the incorrect answer, ‘O’ was assigned. Then such scores were finally added to yield a knowledge score out of 100 for them. Afterwards, respondents were grouped into three categories viz. (a) low knowledge score: < 75 out of 100; (b) medium knowledge score: 75-85 out of 100 and (c) high knowledge score: > 85 for each of
the aforesaid variable. For finding out the total scores against each variable, the scores for each item were added.

Procedure followed in developing knowledge test

Firstly, after detailed review of literature and discussion with the fishery officers and scientists of the State, Government fishery extension specialists, the major items and sub items of knowledge with their definite correct answers (of major items and sub-items) were collected.

The selected items and sub-items of ‘knowledge test’ (Annexure-I) were given to 20 judges. The judges consisted of scientists, extension specialist and fishery officers. Each of the 20 judges were asked to distribute the weights (marks) to each of the four major items and the sub-items under the major items, considering relative importance to community-based fisheries management, so that, the total marks become 100. Final score for each of the items and sub-items were finalized (Annexure II ) by calculating arithmetic means of the scores given to the items and sub-items by the experts (Dana 1987; Shaikh et al. ,1993; Barman 2004; Barman et al. 2007)

(b) Sustainable development and management of Beel fisheries

Sustainable development and management of Beel fisheries is not a concept only but also a process of enhancing and ensuring fish production in a systematic way without destroying the existing fish production potentialities, so that, the level of production could be continued and enjoyed by the Beel users at the same rate years after year (Barman et al, 2006). Here, this refers to the activities and achievement related to the areas of (a) profit sharing plan, (b) adoption & replication of the package of practice, (c) transparency/accountability maintenance for Beel fishery development.

This variable was analyzed by taking responses from the respondents on schedule (Annexure-III) . Respondents were awarded with the score of ‘1’ and ‘0’ based on their response of ‘yes’ and ‘no’. The variable was quantified after adding the total scores ( in a scale of 1-15) and categorized as (a) high sustainability (12-15 out of 15) ; (b) medium sustainability (9-11 out of 15) and (c) low sustainability (6-8 out of 15) and (d) very low sustainability (< 9 out of 15) .
(c) Community's livelihood for sustenance:

It is a fact that household sustainable livelihood is ensured when they can cope up with and recover from shock and stress and can maintain their capabilities and assets without undermining the natural base (Hiremanth, 2008).

This variable was analyzed by taking responses from the respondents on questionnaire schedule (Annexure-III). Respondents were awarded with the score of '1' and '0' based on their response of 'yes' and 'no'. The variable was quantified and categorized as after adding the total scores (in a scale of 1-15) for those aforesaid areas as (a) high sustainable livelihood (5-6 out of 6); (b) medium sustainable livelihood (3-4 out of 6) and (c) low sustainable livelihood (< 3 out of 6).

g. Statistical analysis of data

The collected data were checked and put in proper format for coding in I.B.M. sheets. For making simple comparisons, the frequency tables were constructed and percentages were calculated. The data were also fed to the computer and the following statistical techniques were used to analyze the data using the “Software Statistical Package for Social Sciences” (SPSS).

i. **Descriptive statistics:** Descriptive statistics are used to describe the basic features on the data in a study. They provide simple summaries about the sample and measures. Together with simple graphics analysis, they form the basis of virtually every quantitative analysis of data. Through the descriptive analysis, we can simply describe what is or what the data shows or in other words, we use descriptive statistics simply to describe what is going on in our study. It is used to present quantities descriptions in a manageable form. In a research study, we may have lots of measures. Descriptive statistics help us to simply large amount of data into a simpler summery (source: [http://www.socialresearchmethods.net/kb/sttdesc.php](http://www.socialresearchmethods.net/kb/sttdesc.php)).

Hence, this technique of statistical analysis was carried out in the present study.

ii. **Mean Comparison:** This analysis was done to see the effect of different independent variables on other independent and dependent variables. During mean comparison, we use for those comparisons where significant value is less than 0.05. In the current study, effect of education, family size, type of constructed house, occupation, social Participation,
Community-based physical assets, Beel users' participation in development program, Beel users' decision making ability, women empowerment, community-based fisheries organization, involvement of NGO, availability of critical aquaculture inputs, caste on mean scores of dependent variable like land holding, income, socio political empowerment, management capabilities of BDCs, community managed marketing, pre CBFM income, post CBFM income, knowledge scores of Beel users on community-based fisheries management, sustainable development and management of Beel fisheries and community's livelihood for sustenance were calculated and tested by non-parametric tests like Kruskal Wallis Chi square test for those independent variables which have more than two levels and accordingly effects are shown in the Table 24-36.

iii. Correlation coefficient: analysis was done in order to study the relationship among dependent and independent variables for which correlation matrix was prepared. The correlation is one of the most common and most useful statistics.

A correlation is a simple number that describe the degree of relationship between dependent and independent variables (source: http://www.socialresearchmethods.net/kb/ststdesc.php). The significance of the estimated correlation co-efficient was tested at 5% and 1% level of significance (by using the statistical table for biological, agricultural and medical research of Fisher and Yates, 1975). The formula used for estimating the co-efficient of correlation was as follows: Correlation coefficient (r) between X and Y

\[ r = \frac{\text{Cor}(X,Y)}{\sqrt{V(X) \cdot V(Y)}} \]

iv. Regression analysis: Analysis was done in order to study the effect or influence of independent variables on dependent variables. Variables were selected on the basis of 'F' values and R^2 values, following stepwise regression analysis. Such, stepwise multiple regression analysis was done to study the predictor variables for selecting the best predictor (the independent variables having maximum contribution to the character expression of the dependent variable) (Ray and Mondal, 2000).
v. **Factor analysis:** This technique was carried out in order to obtain scientific parsimony or economy of description. It is used to make a group of variables into a single factor (based on correlation between variables), which, however, can convey all the essential information of the original set of variables. Here, factor analysis was extracted by Equamax with Kaiser Normalization method of Principal Component Analysis on the basis of eigen values more than 1 with Rotation converged in 18 iterations.

The main applications of factor analytic techniques are: (1) to reduce the number of variables and (2) to detect structure in the relationships between variables, that is to classify variables. Therefore, factor analysis is applied as a data reduction or structure detection method. Thus, basic idea of Factor Analysis is to reduce the Data into the group that can describe the relationship between the variables (Kothari, 1996; Ray and Mondal, 2000). After we have found the line on which the variance is maximal, there remains some variability around this line. In principal components analysis, after the first factor has been extracted, that is, after the first line has been drawn through the data, we continue and define another line that maximizes the remaining variability, and so on. In this manner, consecutive factors are extracted. Because each consecutive factor is defined to maximize the variability that is not captured by the preceding factor, consecutive factors are independent of each other. Put another way, consecutive factors are uncorrelated or orthogonal to each other (source: http://www.stasoft.com/textbook).

vi. **Path analysis:** This technique was carried out to get a clear picture of the direct and indirect effects of the independent (causal) variables on dependent (effect) variable. Through this analysis, variables, which have higher direct and indirect effects on dependent variable, can easily be understood. Basically, the objective of doing Path Analysis is to get a clear picture of the direct and indirect effect of the independent variables on the Dependent variables. Variables, through which substantial indirect effects are channelled, are also found out (Ray and Mondal, 2000).