COMMUNITY-BASED FISHERIES MANAGEMENT WITH PEOPLE'S PARTICIPATION FOR SUSTAINABLE DEVELOPMENT OF *BEEL* FISHERIES

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in

FISHERY EXTENSION

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CERTIFICATE

This is to certify that the work embodied in the thesis entitled "COMMUNITY-BASED FISHERIES MANAGEMENT WITH PEOPLE'S PARTICIPATION FOR SUSTAINABLE DEVELOPMENT OF *BEEL* FISHERIES" submitted by MR. RAMENDRA CH. BARMAN in partial fulfillment of requirement for the Degree of Master of Fishery Science (Fishery Extension) in the Faculty of Fishery Science, West Bengal University of Animal and Fishery Sciences, is the faithful and bonafide research work carried out under my supervision and guidance. The results of the investigation reported in this thesis have not so far been submitted for any other Degree or Diploma. The assistance and help received during the course of investigation have been duly acknowledged.

Date : The 20th Aug. 2004.
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We, the undersigned having satisfied with the performance of **Mr. Ramendra Ch. Barman**, in the Viva-voce Examination, conducted today, the 27th Sept., 2004 recommend that the thesis be accepted for the award of the degree.

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(Ramendra Ch. Barman)

DEDICATED TO THEM

THEY ARE THE CENTER OF ALL DEVELOPMENT APPROACH

CONTENTS

LIST OF ABBREVIATIONS

AFDC	Assam Fisheries Development Corporation Ltd.
ARIASP	Assam Rural Infrastructure and Agricultural Service Project
BCC	*Beel* Cornodhar Committee
CBFM	Community-Based Fisheries Management
CIFRI	Central Inland Fisheries Research Institute
DBMMC	Dek *Beel* Milanjyoti Meen Mahal Committee
DRDA	District Rural Development Agency
FAO	Food and Agricultural Organization
Ft	Feet
HS	Higher Secondary
ICAR	Indian Council of Agricultural Research
MOC	Mustard Oil Cake
NATP	National Agricultural Technological Project
NERC	North Eastern Regional Centre
SHGs	Self Help Groups (s)
SPSS	Statistical Package for Social Sciences
SSP	Single Super Phosphate
UNDP	United Nations Development Programme
USDD	United States Development Department

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CHAPTER – I

INTRODUCTION

1. INTRODUCTION

India has extensive wetlands (low-lying areas) mainly associated with the Brahmaputra and Ganga river basins, which are collectively termed as floodplain wetlands (Shrivastava and Bhattacharjya, 2003). These wetlands together cover an area of 0.2 million hectares (ha.) and constitute important fishery resources in the states of Assam, West Bengal, Bihar, Manipur, Arunachal Pradesh, Tripura and Meghalaya (Sugunan *et al.*, 2000). Wetland is a broad term, which encompasses a wide range of inland, coastal and marine habitats sharing the common feature of temporary or permanent freshwater or shallow coastal waters. The Ramsar Convention (1971) defined wetlands as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters". Maltby (1991) gave a more precise definition and according to him "wetlands occupy the transitional zone between permanently wet and generally dry environments. They share characteristics of both environments, yet cannot be classified exclusively as either aquatic or terrestrial".

Since the wetlands of India are mostly situated on floodplains of major rivers, which form a rich and varied inland fishery resource, they are better designated as floodplain wetlands or floodplain lakes (Sugunan, 1997). The lands along both sides of a river channel formed by layers of river alluvium, containing the meanders or braided reaches of a river and periodically inundated at times of high river discharge, constitute its floodplain (ICLARM, 1999). According to Maltby (1991), "floodplains are the flat land bordering rivers that is subject to periodic flooding, which tend to be most expansive along the lower reaches of rivers".

Floodplains can be classified in several ways, *e.g.*, into permanently or seasonally flooded ones (ICLARM, 1999). Based on the flow of water, these can be divided into two broad groups: the plains and the standing waters (Welcomme, 1979). The plain (lotic component) includes the river channel, the levee region (more or less follows the river channel course) and the flats (extending from the levees to the terrace or plateau delimiting the plain). The standing waters are the lentic components of

floodplains. Receding floods leave permanent or semi-permanent standing waters in the form of sloughs, meander scroll depressions, back swamps and residual channels (oxbow lakes). These water bodies expand or contract in area according to annual flood cycle and tend to merge into a continuous sheet of water covering the whole plain during the highest floods. Floodplain wetlands (locally known as *beel* in India) usually represent the lentic component of floodplains and exclude the lotic component. These vary widely in area, shape, depth, extent of riverine connection, etc. and have tremendous potential for development of capture, culture and culture-based fisheries in them. The characteristic ecological features binding these wetlands together are their periodic inundation by floodwaters (or by surface run-off from the catchments, if separated from the adjacent rivers by flood control embankments), and infestation with aquatic macrophytes.

Since time immemorial, the floodplains and their associated wetlands have been utilized for sustenance and well being of human societies. No where is this truer than in Asia, where high population densities are exerting huge pressures on all natural resources in general and floodplain wetlands in particular. In many areas, wetlands are the critical resource for the survival of both rural and urban communities. They are a source of protein and other nutrients required for human health (fish, birds, edible plants, reptiles, etc.), water (for drinking and irrigation), building materials (reeds and timber), transport and communication routes, effective sewerage treatment systems, fertile soils for agriculture, and buffers against flooding, erosion and nutrient loss (Howes, 1995). In addition, floodplain wetlands present diverse aquatic habitats from deep lakes to shallow marshes and from lotic (open *beel*s retaining riverine connection)) to lentic (closed *beel*s that have lost riverine connection) environments, which support rich faunistic biodiversity including fishes and waterfowl. Thus, conservation of these diverse habitats is necessary for *in situ* conservation of aquatic biodiversity.

The floodplain wetlands are locally known as *beel*s (in most states), *maun*s, *chaur*s and *dhar*s (Bihar), *pat*s (Manipur), *charha*s, *baors/haor*s and *anoa*s (parts of West Bengal and Assam bordering Bangladesh). *Beel*s constitute an important fishery

resource contributing significantly to the fish production of these states apart from providing livelihood to thousands of poor fishers.

Among the Indian states, Assam has the maximum number and the largest water area under floodplain wetlands (*beels*), mainly associated with the Brahmaputra and Barak river systems (Sugunan and Bhattacharjya, 2000). This northeastern state has 1392 *beels* covering 100,000 ha, which is 49.5% of the total area under floodplain wetlands in India. *Beels* constitute 28.9% of the total fishery resources (347,000 ha) and as much as 70.4% of lentic water bodies (142,000 ha) of Assam (Bhattacharjya, 2002). Thus, they are the second largest and the most potential fishery resource of the state. Though precise data on fish yield from *beels* are not available, they reportedly contribute @ 12.5% of the total fish production from Assam (Shrivastava and Bhattacharjya, 2003). These wetlands generally possess high potential for *in situ* fish production and where the topography allows, provide a 'collection sink' for the fish produced in the flooded catchments areas. Further, most of the riverine fishes are harvested from the adjoining *beels*, since operation of most fishing gear is difficult in the main river. The open *beels* act as breeding and nursery grounds for a number of riverine fishes including Indian major carps. The registered *beels* (numbering 423) that are under the administrative control of the Revenue Department and the Assam Fisheries Development Corporation (AFDC) generate considerable revenue for these government establishments. However, a combination of the natural processes of river-bed evolution and anthropogenic changes (*e.g.*, extensive flood control/irrigation works and overexploitation) have reduced fish production of many *beels* through reduced autostocking from rivers, depletion of fish stocks, siltation, habitat destruction and heavy macrophyte infestation.

The average fish yield of Assam *beels* is 173 kg $ha^{-1}yr^{-1}$ (Sugunan and Bhattacharjya, 2000). It is somewhat higher than the average yield of other open waters of India like rivers, reservoirs and lakes, however can be increased significantly through scientific management including fisheries enhancements. For example, studies conducted by the Central Inland Capture Fisheries Research Institute (CIFRI), Barrackpore, for the past 15 years have shown that fish yield from West

Bengal *beels* can be raised to 1,000-1,500 kg $ha^{-1}yr^{-1}$ (Sugunan *et al.*, 2000). Thus, there is an urgent need to formulate sound management norms for sustainable development and optimal utilization of the *beels* of Assam to increase their fish production. Such a step is urgently required considering the facts that the state produced only 159,768 t of fish during 1999-2000, which could meet only 60.6% of the requirement (263,720 t) resulting in draining out about Rs. 300 million from the state every year (Anon, 2002) and that the *beels* are the most potential resource of the state, which will have to account for most of the additional fish production.

Community-based fisheries management (CBFM) with people's participation in the development process is an essential pre-requisite for sustainable development of *beel* fisheries. Thus, CBFM approach can be regarded as the most potential and effective management approach for sustainable development of *beel* fisheries Mazumdar (1998), Bhattacharjya (2001). Again **Sustainable development** is the management and conservation of natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such development conserves land, water, plants and animal genetic resources are environmentally non-degrading, technologically appropriate, economically viable and socially acceptable (FAO, 1988). However, sustainable development is not a concept that can be implemented through a "top-down" approach unlike high technologies, which can be required, put to use and maintained without much public participation (Paul and Paul, 2003). They argued that any development strategy must be environmentally sound with active people's participation for its sustainability. Citing the example of sustainable rural development they mentioned that people participation in the development process should be always community driven, community led and community owned. More over, sustainable development on fisheries emphasize five main components the multiple *resource* in its *environment*; social and economic *human needs;* the *technology* and *institution.* While resource and environment must be conserved, the other needs to be respectively satisfied, controlled and established through the general management process (Ayyappan and Jena, 2004).

Community-based fisheries management is being as the most potential and viable alternative approach to the conventional centralized fishery management system, because it allows greater stake holders participation in decision making process, creates more transparent management system, enhances competence with rules and regulations, greater co-operation between stakeholders, strengthening management efficiency, reduce government cost, minimizing fishing conflict and promotes sustainable development and management (Salim 1998).

It is worth while to mention here that people's participation include people's involvement in decision making process, in implementing programmes, their sharing in the benefits of development programs and their involvement in efforts to evaluate such programs (World Bank, 1996).

Though few investigators have made strong attempt to study limnology and fishery aspect of selected *beel*s of Assam, systematic studies on role of people's participation on sustainable development of *beel* fisheries of Assam are lacking. Because, importance of community participation in *beel* development program is yet to be fully examined.

- But who cares ?
- What is the role of *beel* fisheries for uplifting the socio-economic status of *beel* users in the state ?
- Is the community participation in the *beel* development program is truly a pointer of sustainable development of *beel* ?
- Have the community members i.e. *beel* users have sufficient knowledge on sustainable development of *beel* ?
- What are the factors/parameters affecting *beel* users knowledge on sustainable development of *beel* ?
- How community members including woman can be mobilized and organized for their effective empowerment through *beel* fisheries ?

- How confidence and capacity of the *beel* users can be accelerated towards the *beel* activities ?
- What are the most significantly contributing variables for *beel* users knowledge level on sustainable development of *beel* ?
- What are the suggestive measures for getting immense feed back from the *beel* development programe initiated by the government, non-government or voluntary organizations ?

In order to seek answers to these quarries, an attempt was made to study *beel*s aspect in DEK *BEEL* under Kamalpur development block of Kamrup district, Assam with the following **objectives**

- To study the socio-economic profile of *beel* users.
- To find out the existing knowledge of *beel* users about sustainable development of *beel.*
- To find out the different factors associated with sustainable development of *beel.*
- To identify the variables contributing most significantly to the *beel* users knowledge level on sustainable development of *beel.*
- To mobilize and organize the community member (i.e. respondent) to participate in the fishery development program.
- To conduct a case study on pen culture through Community-Based Fisheries Management approach.

1.1 NEED OF THE STUDY

Most of the flood plain wetlands of the country are not effectively utilized till today. This may be due to the fact that most people think it as a **common property resource**, the tragedy of common (Hardin, 1968). Thus, most of the flood plain wetlands development projects as initiated by different funding agencies are being futile or continued with little and/or without any feedback. Therefore, it was felt to study whether there may have any impact of people's participation on sustainable

development of fisheries of flood plain wetlands/*beel*s or not. The need of the study can be justified as follows:

- Most of the studies indicated that people are not aware of regarding values and importance of *beel*s. Hence, there are no short cut management, conservation and development approaches without active people's participation for its sustainable development. It is hope that by incorporating the participatory management approach to the clientele system, there may have occurred an appreciable change for knowledge, attitudes, and considerations of the stakeholder in regards to value and importance of these potential resources. So this study may give new direction in regards to sustainable development of *beel* or other such type of common property resources.
- The traditional objective of extension work was just to transfer of technology through scientist led top down approach of communication and getting feed back (Singh, 1984; Dahama and Bhatnagar, 1985), but applied sociologists were not convinced at all; as they thought there would not have enough guarantee for its prolonged benefit (Ross and Lappin, 1967; Gangrade, 1971). Hence they advocated merging extension work with community organization. Thus this study may help to explore the possibilities of merging extension work with community organization as an effective method of transfer of technology with sufficient feed back (Veeranna, 1997).
- The researcher hails from the state of Assam. Being an in-service candidate from the state Department of Fisheries, Assam, the study may help the development planners, project executors, to think for viable cost effective alternatives as mentioned here for sustainable development of *beel*s or such type of common property resources.
- The traditional extension is a scientist led top down approach of communication with little and delayed feedback. However with the passage of time, the extension approaches are being metamorphosis. Today it is revealed that people's participation is the center for any kind of development. Hence the study may be helpful for indicating the significance of participatory bottom up

approach for sustainable development of *beels* as well as other natural resources in the country.

- The *beels* of Assam are the prime inland water bodies of the state, with lucrative production potentials. But due to lack of public awareness, strong community participation as well as political commitment, it is not effectively managed for its sustainable development. Hope, the study will help in enhancing the public awareness among the fishermen communities of these *beel* fisheries resources in the state.

1.2 LIMITATION OF THE STUDY

The limitations of the study are

- The findings of the study can not be generalized to the other areas for development of flood plain wet lands/ *beel* in the country, since the nature of the people and their mode of use of these resources, intervention of development agencies will be obviously differ place to place.
- There is a limitation of time, fund and resources, which are generally faced by student researchers. However proper care and sincerity were exercised in making the study as scientific and systematic.
- The responses given by the respondents are based on their memory, which may differ from time to time. On the other hand one cannot ignore the possibility of biasness on the part of respondents, which may affect the findings.

CHAPTER – II

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Community-based fisheries management with people's participation for sustainable development of *beel* fisheries is an emerging concept. Literatures in this aspect are also scanty. However, some literatures having indirect relevance to the present research work is being reviewed here. For the sake of convenience, the available literature has been discussed under the following **sub - headings**:

2.1 Community-based fisheries management.

2.2 People's participation

2.3 Some definitions and concepts

2.4 Sustainable development with people's participation.

2.5 Sustainable development of fisheries including *beel* fisheries.

2.6 *Beel* fisheries of Assam.

2.7 Socio – economic profile of fishers.

2.1 COMMUNITY-BASED FISHERIES MANAGEMENT (C.B.F.M.)

White (1989) opined that education and community organization have a great positive impact on marine conservation and development, when community-based marine management approach was taken into account.

Mills (1994), from his study of community development and fish farming in Malawi, observed that traditional community culture and success of community development method within agriculture and fisheries extension service have proved key elements in fish farming development. Results revealed that community development strategies have encouraged autonomous activities such as farmers clubs, which was one of the main reasons for success of fish farming.

Chong and Kurien (1997) stated that the unresolved issues such as effective enforcement of regulation and conservation measures in coastal waters, proper resource allocation and right of access in coastal waters, effective enforcement of right over Exclusive Economic Zone (EEZ) can be solved through community participatory

management; however, sustained and responsible fisheries may be achieved by building consensus among different users and stake-holder's groups in the fishery; working out agreement among them as these are the parts and parcels of responsible fisheries.

Madhu (1997) from his study on community-based fisheries management in Pang Naga Bay, Thailand opined that villagers of Ban Hin Rome were extremely benefited from such ventures and the spirit of the fishermen was up beat because villagers liked the concept of CBFM as an effective development approach.

Sen (1997) mentioned that community-based management; co-management and co-operative management are some of many terms used to describe management systems that involve the participation of both users and the state in fisheries management. She argued that through co-management, it is possible to bring government and resource users to a closer contact which enhances participation of resource users in the management process especially in resources conservation and compliance with fisheries management rules and regulations, because co-management involves sharing of knowledge, mutual understanding of problems and joint formulation of solutions that prevents over-exploitation and conflicts within the fishery or between the fisheries. She firmly believed that co-management could succeed only when considered as legitimate by those who designed and implemented it, those who were directly involved and those who authorized it.

Salim (1998) mentioned some basic prerequisites of CBFM. These are:

- It requires a clear and defined fishery boundary.
- It requires an effective information gathering mechanism through the involvement of local people.
- It must have an effective local institutional set up to promote greater participation of all the stakeholders.
- It requires some forms of control mechanism to reward and punishment.

Kuperan *et al.* (1999) after conducting a study on fisheries co-management in Sansalvador Island, Phillippines, mentioned that fisheries co-management have better cost effectiveness than that of centrally or government managed system of fisheries.

Baruah *et al.* (2000) mentioned that for sustainable development of *beel* fisheries in Assam, India, a community-based co-management model is quite necessary like those applied in reservoir fisheries in Northern Brazil.

Bhaumik (2001) defined co-management as the sharing of authority and responsibility among government and stakeholders, a decentralized approach of decision-making that involves user groups in regards to multiple uses of natural resources.

Sultan *et al.* (2002) after conducting a case study on *Goakhola Hatiara Beel*, South Bangladesh for CBFM, revealed that under the leadership of women through community-based approach, the socio-economic condition have changed and the social capital has increased to a substantial level; because through this approach local people participation was enhanced, over fishing was restricted, decision making was prompted, woman empowerment was raised. Thus, they argued that local communities involvement in development and management process is very important for sustaining the development activities in the *beel*.

Das (2003) mentioned that due to successful implementation of participatory approach for management of ox-bow lakes in Bangladesh, fish production was boosted up and conservation of resource was witnessed. He promptly argued that such success story of Bangladesh and elsewhere might be useful for future *beel* management program in Assam. For that purpose the concern governmental organization must take help of local NGOs to organize and motivate the riparian farming communities through participatory approach and provide necessary technical, managerial and financial support for sustainable development of *beel*s with active participation of local community

2.2 PEOPLES PARTICIPATION

"To develop a nation – its people – must be developed. The purpose of the development is to create an enabling environment for people to enjoy long, healthy and creative lives"

– **UNDP** (1995): Human Development Report.

The term **'people's participation'** consists of two words viz. '**people**' and '**participation**'. It is used to connote different things by different authors in different contexts.

Ramakrishnan (1992) from his study on shifting agriculture (*Jhum*) and sustainable development for Northeastern India mentioned that people are the pivot for strengthens conservation measures based upon traditional knowledge of local tribal communities who can identify the measures to protect the natural forest in the entire region.

Singh (1993) argued that people are the causes and consequences of development. It is the human factor that is pivot of the process of development. It is inexhaustible, renewable and the only resource which can sustain development forever with no adverse effect on environment. Thus people are the center of all development.

According to Sen (2002), the term 'people' may mean the target population, the beneficiaries, the men and women, the old and young, the formal and informal leaders, people of different segments and strata of the community, depending upon the mandate of specific development programmes and activities initiated by the development agencies. Achieving a healthy social change in the forms of economic and social development with social justice is possible - only when there exist a strong and conscious participation of target population.

On the other hand the term '**participation**', as a concept has been referred to time and again since early age of modern civilization. Even the great Greek scholar, Aristotle, conceived participation as an essential element in the development process.

Cohen and Uphoff (1977) mentioned that participation includes peoples involvement in decision making process, in implementing programmes, their sharing

in benefits of development of programmes and their involvement in efforts to evaluate such programmes.

FAO Council (1982) emphasized participation in all decision making process but by the people's own organization and through self-organization.

According to Paul (1987), the ultimate objective of participation is to enhance the well being in terms of income, personal growth, self-reliance or other values they cherish. According to Ray (1999) participation is a learning process through which people can develop their capabilities in respect to individual and collective decision-making and problem solving.

Kumar (2002) termed participation as the process of empowering the local people. Its focus is on transfer of power and change in the power structure. He strongly advocated that interactive participation and participation through self-mobilization are critical for participation to become a progress of empowering the people, so that they gain more control over their own resources and lives.

United States Development Department (1973) defined the **people's participation** as a process of activities. It mentioned that when the decision making dimension combined with equitable sharing of benefit from development programmes, it constitutes people's participation. Similarly according to the World Bank: (1996) peoples participation includes people's involvement in decision making process, in implementing programmes, their sharing in the benefits of development programmes and their involvement in efforts to evaluate such programmes.

Rietdergen *et al.* (1998) defined people participation as a process where the stakeholders share, control, influence the development decisions, resources and initiatives that affect them. Thus, today there is wide consensus that development cannot be sustained and effective unless people's participation is made central to the development process.

Mazumdar (1998) mentioned that *Velacoba Fisheries Project* of Bangladesh was succeeded because it was truly a self-help project. It was implemented by the people of the area using their own resources with their own leadership and for their

benefit. Ray (1999) also mentioned that any development program with people's participation are always likely to be sustained after outside funding and support are reduced or even withdrawn.

According to Sen (2002) people's participation is the involvement of people in the programme of directed social changes, initiated by the development agencies by away of analyzing the situations, deciding on the problems to be tackled, fixing up priorities, drawing plans of action, taking initiatives in implementing activities of the project as partners through contributing their ideas, materials, resources, labour and time etc. and finally evaluating the results thus accrued to themselves. The whole purpose and process of people's participation in the context of directed social change is human resource development, the development of human and inner material resources, with stimulus and support external to the community.

Mukundan (2004) mentioned that people's participation plays an implicit and inevitable role in deriving the fruits of development schemes. It is an effective instrument to monitor the officials and contractors on the one hand and augment the empowerment of local bodies on the other hand. Thus, it increases the worthiness of the projects by means of achieving a steady and balanced growth from within the best use of natural resources. It ensures the involvement of deprived people to uplift the level of their life style.

2.3 SOME DEFINITIONS AND CONCEPTS

2.3.1 Development and management

Sehgal (1993) mentioned that fisheries management involves judicious application of all available scientific data and of all other facts and knowledge to produce, support and yield a maximum sustained crop of usable aquatic life from the water bodies, which is, of course, possible through effective utilization and conservation of the resources with due enforcement of fisheries legislative measures, as deemed fit.

Bhattacharjya (2001) argued that the two concepts of development and management are closely related. According to him development always implies some

form of improvement in a fishery. On the other hand, management is often called upon only after fisheries become over-exploited. Development measures should be adopted when a fishery is under exploited. Thus, he concluded that fisheries management without elements of development is impossible and vice-versa.

Bhattacharjya *et al.* (2003c) gave a detail account on flood plain wet lands management. Based on size and case of management, they divided the flood plain wet lands into very small (effective water spread area <20 ha), small (20-99 ha), medium (100-499) and large *beel* (500 ha and above) and stated that management options suitable for different types of *beel*s (e.g. open/close, large/small, etc.) can be broadly grouped under capture fisheries and various forms of fisheries enhancements (including culture-based fisheries and aquaculture) depending upon the extent of human intervention in the management process.

Yadava (2004) mentioned that management is often perceived as a response to the development when fisheries is concerned. Thus, the aim of both development and management is to achieve the optimum use of resources.

2.3.2 Conservation

Gulland (1974) mentioned that conservation could be defined as the aggregate of measures designed to bring about the maximum sustainable yield.

Bhaumik (2002) indicated that conservation as the management of human use of biosphere, so that it may yield the greater sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirations of future generations. Thus, conservation embraces preservation, maintenance, sustainable utilization and restoration of natural environment. He further argued that by creating mass awareness campaign and empowering the people in the conservation of aquatic environments, such as *beel*s, the fish production can be enhanced to a desired level.

Hussain (1996) stated that by arousing public awareness about the value and importance of the wetlands and their effective conservation, the fish production could be increased to a congenial level. He further mentioned that by introducing environmental education at primary and school level, by seeking helping hand from

the reputed NGOs, schools and colleges, local woman and youth organizations for their active participation with the local people in the conservation movement, the enhanced productivity of the wetlands could be ascertained. In this context, seminars, workshops, *jatras*, *folk dances*, etc. are the potential instruments to educate the target clientele.

Bhattacharjya *et al.* (2003) gave a detail account on conservation on habitats and conservation of fish stocks for effective utilization of flood plain wetlands. They argued that following steps are very much important for effective conservation of flood plain wetlands. These are :

2.3.2.1 Conservation of habitat

The suggested steps for conservation of the habitats are:

- Clearing/controlling infestation of aquatic macrophytes by suitable means.
- De-silting the connecting channels and marginal shallow areas of the *beel.*
- Retention of sufficient water levels during dry season (by minimizing water outflow and abstraction).
- Prevention and control of aquatic pollution.

2.3.1.2 Conservation of fish stocks

Measures suggested for ensuring recruitment of natural fish stocks are:

- Allowing free migration of brooders and juveniles of major fishes from the *beel* to the parent river and *vice versa.*
- Identification and protection of breeding grounds of commercially important fishes (e.g., closed regions).
- Conservation measures suggested for the protection of brood stock and juveniles are :
    - ➢ Strict adherence to restrictions on minimum landing size for different commercial fish species.

- Increasing or decreasing the fishing-effort for optimizing fish production or to prevent over-fishing.
- Observing fishing holidays during the monsoon season to ensure spawning success.
- Banning or phasing out destructive-fishing methods like mosquito nets, dewatering, fishing with explosives/pesticides etc.
- Diversification of fishing methods to avoid selective over-fishing.

Community-enforced regulation is more effective than government enforcement.

2.3.3 Empowerment

Ramakrishnan (1993) mentioned that empowerment of a society, to take decisions, execute them and share the benefit in an equitable manner, is difficult to quantify, but is the key to evaluating sustainable development with people's participation.

Bautliwala (1994) mentioned that empowerment is the process by which the powerless gain greater control over the circumstances of their lives. It includes both controls over the resources (physical, human, intellectual and financial) and over ideology (beliefs, values).

Lalitha (1996) advocated that one side of empowerment includes resources, skills, training and leadership formation and the other side includes democratic process, dialogue and participation in decision-making technique for conflict resolution.

Sinha (1999) defined empowerment as a social process that involves participatory approach and transforms the basic structure of subordination. It always tries to change the nature and direction of the systematic forces.

According to Subburaj and Karunaakaran (2003) empowerment can be viewed as a means of creating a social environment in which one can take decision and make choices either individually or collectively for social transformation. It strengthens

innate ability by the way of acquiring knowledge, power and experience. Thus it enables and authorizes an individual to think, behave, and take action and control conflict in an autonomous way.

2.3.4 Community Mobilization

Cohen (1996) advocated that social mobilization is a process of engaging a large numbers of people in joint action for achieving societal goals through self-reliant efforts. Its immediate expected resources and the sustained adoption/utilization of appropriate policies, technologies or services through the modifications of attitudes and behaviour of various social actors.

According to UNICEF (1997) social mobilization is the process of dialogue, negotiation and consensus building for action by people, communities and organizations etc. to identify address and solve common problem. It is an effective strategy to create sustained behaviour change, which will bring community participation for sustainability and self-reliance.

Baruah (2001) mentioned that mobilization is the process by which energy that is latent from viewpoint of acting unit is made available for collective action. It is both a process of change (in the control of structure) and a changing process. It helps in exploring the inner potentials towards actualization.

According to UNDP (2002), social mobilization is an approach and tool that enables people to organize for collective action, by polling resource and building solidarity required to resolve common problems and work toward community advancement.

Prasad (2003) mentioned that the term social mobilization and community mobilization are used interchangeably. When social mobilization is confined to particular communities, it is called community mobilization. He argued that social mobilization is a participatory process where people are educated, organized, motivated and enabled to undertake social enquiry and analysis for understanding their life situation and taking decisions and actions to change it for their well being.

When the target group is local communities, the common aim of social mobilization as argued by him are as follows:

- To create awareness among the community inhabitants about the development programmes.
- To build local organizations for development action, encompassing whole communities or specific intended beneficiaries only for promoting the participation of disadvantaged into the development programme.
- To strengthen the people's ability to analyze their problems and possible solutions, augment their skills to undertake work for improving their living situation.
- To make sharpen the decision making capacity of the people.
- To mobilize peoples own and other under utilized or not utilized resources.
- To establish link between community organization and out side institution to get external support.

2.3.5 Community Organization

Röling (1988) defined community organization as human resource development, mentioned that through organizing the people, it is possible to develop the people them selves, so as to make them better leaders, entrepreneurs, decision makers and help them to organize themselves into effective associations, institutions and of course constituencies.

Chamber *et al.* (1991) mentioned that when the farmers are organized it could exchange the effectiveness and efficiency on agricultural technology systems in several ways. It helps in building better interaction and communication between researchers and farmers, feeding researchable information to the researcher and disseminates farm applicable information from researcher to farmers.

Supe (1997) defined that community organization is a process by which a community identifies its needs, orders these needs, develops the confidence and will to work at them, finds resources to deal with them, and in doing so, extends and develops co-operative and collaborative attitude and practices in the community. He

argued that the basic idea of community organization is to involve the people collectively in formulating and solving their common problem.

Chamala and Shingi (1997) suggested several steps how farmer can be organized effectively. These are -

- Understanding the village community.
- Identification of potential leaders in the community.
- Taking to the identical leaders and seeking co-operation from other agencies, operating from the village.
- Facilitating the local leaders to convene community meetings.
- Nominating core-group leaders to establish or develop the farmer's organization through education and action learning.
- Gearing-up for action.
- Implementing selected projects.
- Monitoring and evaluation of progress of farmer's organizations.

Prasad (2003) advocated that through community organization, community member can maximize their potential not only by organizing themselves but also by grading up their existing skills in regards to their self development with support of change agent through the process of training, exchange visit other capacity building activities based on needs identified by the members of the community organization.

2.4 SUSTAINABLE DEVELOPMENT WITH PEOPLE'S PARTICIPATION

The term sustainable development was coined by the World Commission on Environment and Development, headed by Gro-Harlem Brundtland in the report '*Our Common Future*' published at London in 1987. Though, there are numerous definitions of sustainable development, the most original widely accepted definition is that included in the Brundtland Report (1987) that stated :

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own need."

According to Nichodemus (1992) sustainability is the successful management of resources to satisfy changing human needs, while maintaining or enhancing the quality of environment and conserving natural resources.

De and Singh (1996) mentioned that sustainable development referred to a particular type of human activity that could maintain the availability and quality of natural resources over time. For a community to move towards sustainability, a number of principles concerning planning and management of natural resources must be observed.

Ramkrishnan (1993) observed that the concept of sustainability implies the use of ecological systems in a manner that satisfies current needs without compromising the needs or options of future generations. He argued that though the concept is being used in different disciplines in different contexts by different authors, sustainable development always involves a series of compromises, keeping in view the twin objectives of better *quality of life* for humans while maintaining *environmental quality* without any obvious degradation of natural resources base. However sustainable development and effective rehabilitation/management of ecosystem with adequate concern for bio-diversity represent two sides of the same coin. Sustainability on long-term basis is possible; only when there exist a strong people's participation in the program formulation and implementation stages of development programme (Ramakrishnan, 1994; Ramakrishnan, 1993).

FAO (1979) mentioned that social forestry programme carried out in China over some decades through active peoples participation showed impressive production on their own land Similarly, massive fuel wood plantation was established and degraded forestlands rehabilitated in the republic of Korea through village forestry association (FAO, 1982).

Griffin (1988) mentioned that due to active people's participation in Nepal - Australia forestry programme for the Nepal Himalayas, the project was succeeded as it involved the people in the early stages of programme, rather than at the end.

Kothyari *et al.* (1991) stated that-people participation could occur only if it is based on needs as they perceive them rather than going to the people with an already identified agenda of development agency. Their observation was based on their study on "Institutional approach in development and transfer of water harvest technology in Himalayas" where water was identified as a key resource and variety of restoration and re-development projects were launched for providing sustainable livelihood to the local communities through cheap rain water harvesting tanks.

Rathore (1994) warns that unless the people are put at the core of any development activity, the relationship among the environmental development ceases to exist.

Kumarappa (1995) stated that environmental protection is possible only through effective participation of people and any conservation effort without the involvement of the people would be futile.

Jyothi's (2000) study found that people's participation is the most determining factor of bio-diversity conservation. People living in and around the Periyar Tiger Reserve of Kerala can be taken as an example.

Acharya (2002) also suggested a bottom up approach that stated from the people, for sustainable rural development as a guiding principle to organize people for any planning process in rural development.

Agarwal (2003) mentioned that to succeed in watershed development program people participation is must because local community should be involved from conceptualization to decentralize implementing stage which will be more effective and fruitful than piece meal approach.

Mukundan (2004) argued that sustainable rural development hints at the rational use of scarce resources with the support of local people and economic policies adopting strategic environmental management practices. Hence, a multifarious strategy needs to be formulated to solve the rural problems through development process and to protect the environment through community participation only.

2.5 SUSTAINABLE DEVELOPMENT OF FISHERIES INCLUDING *BEEL* FISHERIES

Hussain (1996) mentioned that sustainable development of wetlands in Bangladesh is possible only when there exist is a strong community participation in regards to effective conservation and utilization of the resources, as well as planning, designing and implementation wetland development programmes. Government and other non-government organization should also come forward and involve educating the target clientele for mass awareness programme regarding values and importance of these resources, but more importantly, a high level political commitment to conserve and development is also urgently needed.

Kutty (1997) mentioned that aquaculture is unlikely to sustain it-self based on economic viability alone but will need to ensure social and environmental sustainability as well.

Sugunan (2001) stated that in comparison to intensive aquaculture, capture and culture-based fisheries management options in reservoirs, *beel*s, boars, chaurs, etc. are more compliant with the norms of sustainable development; as the management system offers relatively eco-friendly options for sustainable management of these precious water resources.

Bhaumik (2002) mentioned that participatory management approaches are indispensable for successful management of fisheries in open water bodies so that people can understand, identify, priorities and solve their problems and situations, mobilize local resources, organize the people and can evaluate problems for their benefit.

Nath and Das (2004) advocated that sustainable development of fisheries is very much relevant to both capture and culture system and their products, design in such a manner so as to maintain sustain productivity and usefulness to society for pretty long period. They argued that, capture and culture based capture fisheries management norms are more compliant with options for sustainable development of fisheries in open water bodies such as flood plain wet lands / *beel*s, reservoirs, shallow

natural lakes, because these management options are eco-friendly, non degrading, technically viable with more social acceptance. To cater to long lasting social and nutritional benefits, fisheries development should be environmentally, socially and economically sustainable.

According to, Ayyappan and Jena (2004) sustainable development is possible only when there is a concrete formulation of appropriate policies and position of code of conduct for responsible fisheries and aquaculture by giving equal emphasis on social, economical, technological and institutional aspects.

2.6 *BEEL* FISHERIES OF ASSAM

2.6.1 Limnology and fisheries of *beel*

The *beels* (floodplain wetlands) spread over the eastern and northeastern regions of India represent extensive and rich areas for fisheries. The growing interest in these wetlands stems from the fact that they are one of the most productive environments of the world. Floodplain wetlands can produce benefits eight times more than those of a paddy field of an equivalent area (Jhingran, 1989). They are resilient and highly dynamic ecosystems, and are important habitats for a large number of plant and animal species, many of which have commercial importance. These wetlands play an extremely important role in fish production and livelihood security, and have a number of other (direct/indirect) values.

The shallow nature, penetration of light up to bottom, rich nutrient status of the soil and rich growth of macrophytes leading to high detritus load at the bottom are some of the characters that make *beel*s a separate identity. Ecological investigations specific to these unique wetlands are, therefore, needed to formulate and adopt suitable management measures for optimizing the fish production from them. The importance of the floodplain wetlands as an important ecotone/fishery resource has been recognized all over the world in recent years. As a result, many aspects of the hydrobiology and fisheries of these unique wetlands have been investigated in different parts of the globe during the past three decades following the Ramsar Convention. Nevertheless, a large volume of documented scientific literature is available on these aspects both in India and abroad. In view of the above, it is rather

difficult to discuss all of them in detail. Hence, an attempt is made to review the recent works among them, which are relevant to the present investigation. Deka (1999) and Bhattacharjya (2002) have reviewed the earlier literature on various aspects of limnology and fisheries of floodplain wetlands (*beels*) of India.

In India, Chaudhuri and Banerjea (1965) carried out pioneering studies in Takmu *beel* area in Manipur. Subsequently, many workers have studied the hydrodynamics (Vass, 1992b), limnology and fisheries (*e.g.*, Pathak *et al.*, 1986; De and Mukherjee, 1992; Paul, 1992; Vass, 1992a; Rana *et al.*, 1996) of Indian *beels*. Kumar (1985) initiated studies on the hydrobiology of a *beel* of Bihar, which was followed by studies on their ecology and fisheries of some oxbow lakes (*beels*/*mauns*) of the state (Chitranshi, 1992; Jaiswal and Singh, 1994; Jha, 1995, 1997; Singh and Singh, 1997; Sinha and Jha, 1997). An overview of the productivity status of Indian *beels* was given by Vass (1989), while Jha (1989) gave an overview of the *beel* fishery resources of Bihar. Vass and Langer (1990) assessed the changes in primary production and trophic status of a Kashmir oxbow lake, consequent to man-made modifications in the environment. Singh (1990, 2000) studied phyto and zooplankton in an ox-bow lake of Uttar Pradesh. Some generalized account of the community structure and seasonality of aquatic macrophytes and associated fauna in *beels* is available (Mitra, 1989, 1992; Mitra and Ghosh, 1992). The removal of macrophytes in a West Bengal *beel* resulted in over three folds increase in its fish yield (Saha *et al.*, 1990). Choudhury (1989, 1992a, 1992b) gave an account of the various fishing methods employed in floodplain lakes together with their fish landings and catch composition. Parameswaran and Vass (1995) gave an overview of *beels* in West Bengal. Sugunan and Mukhopadhyaya (1995), based on the case studies in two open and closed *beels* of West Bengal, showed that soil and water quality as well as biotic communities varied considerably in these two types of *beels*. This notion was further strengthened with the synthesis and compilation of the results of studies conducted by the Central Inland Fisheries Research Institute (CIFRI) in selected *beels* located in all the agro-climatic sub-regions of West Bengal (Sugunan *et al.*, 2000).

In Assam, which is endowed with the largest number (and area) of *beel*s among the Indian states, very few systematic studies have been made. Dey (1977, 1980, 1981) made pioneering observations on the limnology of some commercially important *beel*s of Kamrup District in lower Assam and their bearing on fish production. Following this, workers like Lahon (1979, 1980, 1983), Lahon and Dey (1979, 1980), Goswami and Dey (1980), Lahon *et al.* (1982a, 1982b), Yadava *et al.* (1983, 1984, 1986), Kolekar *et al.* (1983), Yadava and Choudhury (1984), Goswami (1985), Singh *et al.* (1985), Bhuyan (1987), Choudhury (1987a, 1987b), Dewri and Lahon (1987), Jhingran and Pathak (1987), Yadava (1987a, 1987b, 1988), Sarma *et al.* (1993) and Acharjee *et al.* (1995, 1999) studied various aspects of limnology and fisheries of selected *beel*s of the Brahmaputra Valley. Various indigenous fishing methods employed in Assam *beel*s have been well documented (Yadava *et al.*, 1981; Yadava and Choudhury, 1986; Choudhury, 1987b; Goswami *et al.*, 1994; Ali, 1997). Goswami and Devaraj (1993) estimated the potential yield of *Labeo rohita* from Dhir *Beel* in lower Assam.

As per the details of distribution of *beels* in the state, Sugunan and Bhattacharjya (2000), Srivastava and Bhattacharjya (2003) mentioned that in general, there are total 1392 nos. of enlisted *beel*s in the state covering a total area of 1.0 lakh hectares, out of which 423 are registered *beel*s (30.4%) and the remaining 969 are unregistered *beel*s (69.6%). Again out of the total unregistered *beel*s, 505 nos. are under the control of both government and 464 nos. are under semi-government / public bodies like Mahakuma Parishads / Gram Panchayats, etc. The Barak Valley contains, enlisted 322 nos. of *beel*s covering 8000ha. of water areas. The Brahmaputra Valley contains a 1,070 nos. of *beel*s covering 92,000 ha water areas. The central hilly region does not have any enlisted *beel*. Srivastava and Bhattacharjya (2003) also stated the production scenario of some selected *beel* in the state and argued that the flood plain wetland *beel*s are the most potential and lucrative water resource of the state that cover approximately 72.45percent of total lentic areas of the state and 49.45 percent of total flood plain wetlands of the country.

A few workers have concentrated on the limnology and productivity of selected *beels* of lower Brahmaputra Basin (Yadava, 1987a; Yadava *et al.*, 1987; Acharjee, 1997; Acharjee *et al.*, 1998). Goswami (1985) and Acharjee *et al.* (1997) gave an account of aquatic macrophytes present in Assam *beels*. Agarwala (1996) concentrated on the productivity indicators in *beels*. Deka (1999) assessed the status of selected *beel* fisheries of Assam and their impact on the fishermen community. Most of these studies were concentrated in lower Assam with the *beels* of Kamrup District receiving far greater scientific attention than those of the other districts. Only a few reports are available on the limnology and fisheries of Sone *Beel* of the Barak Valley (Kar, 1984; Kar and Dey, 1986, 1993). Fish species occurring in selected *beels* of the state have been documented (Chandra *et al.*, 1990; Kar and Dey, 1986, 1993, Deka *et al.*, 2001). Yadava *et al.* (1987) reported the occurrence of juveniles and adults of prized hilsa in certain open *beels* like Dhir, Dora and Sone *beels* of the state. Sugunan and Bhattacharjya (2000) gave a comprehensive overview of the ecology and fisheries of *beels* of the state based on extensive field surveys conducted by CIFRI in both the Brahmaputra and Barak Vallies. Deka *et al.* (2001) observed that fish diversity of selected *beels* of the state has declined over the past few years due to some extrinsic and intrinsic factors with associated impact on the income of the fishermen community. Thus, Shrivastava and Bhattacharjya (2003) gave a comprehensive account of fisheries of floodplain wetlands of Assam while Bhattacharjya (2003a) outlined the fisheries enhancement measures currently practiced in *beels* of the state.

Published literature on aspects related to fish production potential and trophic structure of *beel* ecosystems in India is rare. Pathak *et al.* (1985) showed the importance of detritus food chain in *beel* ecosystem. Pathak (1990) gave a comparative account of energy dynamics of open and closed *beels* in the Ganga and Brahmaputra basin. It is apt to mention the brief account of energy flow pathways generally found in open and closed *beels* of West Bengal (Sugunan *et al.*, 2000). Bhattacharjya (2002), based on the case studies in two open and closed *beels* of the Central Brahmaputra Valley Zone of Assam, showed for the first time that the trophic structure and fishery potential varied significantly between these two types of *beels*.

Investigations conducted so far in Indian *beels* mainly concentrated on their soil and water quality, and the abundance and quality composition of biotic communities as well as their fisheries.

No literature is available on systematic study on the role of community participation on sustainable development of *beels* of Assam. However, presently, the government of Assam, Department of Fisheries has initiated a community-based *beel* development policy under the World Bank financed fisheries project popularly called as ARIASP (Assam Rural Infrastructure and Agricultural Service Project) on pilot basis in some selected *beels* of the state with a holistic development approach (Anon, 2002). It is heartening to mention here that the production scenario of the Kacharidal *Beel* due to active involvement of local people, non-government organization and district fisheries and general administration was totally changed. And thus as a whole 452 household family belonged to the three adjacent village nearer to the *beel* namely Soulpam, Bachacuba, Dhekipar were equally benefited (Anon, 2003). Thus, the present investigation is carried out at Deek *Beel* under Kamalpur development block of Kamrup District, Assam is an attempt to study the details of CBFM with people's participation for sustainable development of *beel* in the state.

2.7 SOCIO-ECONOMIC PROFILE OF FISHERS

The socio-economic condition of fishers plays a significant role in over all economic status of their family as well as on general livelihood. Socio-economic status, there fore, is regarded as one of the most potential instrument for assessing the living standard of the fishers in the society.

Makkar and Sohal (1974) conducted the study in community development block of Ludhiana in Punjab revealed that farmers having higher level of education carry more favourable attitude to-wards scientific soil testing for enhanced crop production. However, Haque and Ray (1983) mentioned that fishermen were mostly low in literacy and usually belong to the poorer section of the society.

Dana (1987) reported that educational level and knowledge of livestock owners about artificial insemination in cattle showed significant positive correlation with the attitude of the livestock owner towards artificial insemination in cattle. According to

his research findings, annual income, land holding, social participation herd size, mass media exposure, availability of critical inputs as perceived by live stock owners were found to be significantly and positively correlated with the attitude of live stock owners toward artificial insemination in cattle. However, age, family size and family type were not significantly associated with the attitude of the livestock owners toward artificial insemination in cattle.

Bhaumik and Saha (1994) from their study on socio-economic condition of Sundarban, West Bengal mentioned that 84.4percent of the fishers were from the scheduled caste community, but the involvement of higher caste community in aquaculture activities were very few and even nil.

Akhtar (1995) observed that fishermen community is mainly distressed, mostly lacking in education with low-income level.

Pattnaik (1996) found that the participation of women in farm management was low which was due to in adequate exposures to the mass media, lack of extension contact, social restriction, lack of time, illiteracy and large size of family.

Fatunla (1996) stated that without proper education sustainable development in the fishery sector is just impossible.

Sen *et al.* (1997) studied the transport and marketing system in Sundarban and stated that poor transport facilities resulted tremendous set back in marketing of agricultural produces.

Majumdar (1998) mentioned that 51% of the population was illiterate and another 8%can barley signs their names. They were mostly illiterate (51%).

From a study on inland fisherman Bhaumik (1999) mentioned that only 21percent on the fisher had education up to primary standard, 7percent secondary and 2 percent continued studies above the secondary level.

In India, 5.4 million people are fully engaged in different fishery activities, out of these, 3.8 million are fishermen and 1.6 million are fisher women Samantrary and Pathak (2001).

Khare and Punekar (2001) reported that socio-economic status of fisherwomen such as age, caste, education, occupation, social participation, income, experience, farm size were found to be positively and significantly correlated with attitude towards fish farming.

Tripathy and Patil (2001) mentioned that aquaculture activities need much less labour and time than agriculture. Thus, women can involve in different fishery activities in addition to their family duty. The high economic return would not only up-lift their social status but also it will empower them.

Based on a study on socio-economic status and life style of the fishermen in Sundarban, West Bengal, (India); Maiti (2003) observed that fishermen are generally the poorest, most disadvantageous with low education, income, poor basic amenities and infrastructure. In his study about 81.33percent of the fishermen were schedule caste and involvement of higher caste community in this sector was almost nil.

Dana *et al.* (2003) advocated that by giving due recognition of economic role of fisherwomen and by empowering them in different fisheries activities, especially in *beel* fisheries, the socio-economic condition fishers could be substantially raised.

Goswami (2003) from his study on contribution of women in fishery sector at South 24 Parganas district of West Bengal mentioned that the fisherwomen were from lower income-group, with an average annual income of Rs. 8547. This annual income was positively and significantly associated with amount of fish selling, fish seed collection and fish harvesting by the fisherwomen. He further mentioned that most of the respondents i.e. 59.09 percent were from backward classes; followed by 35.45 percent scheduled caste and remaining i.e. 6 percent were from higher classes. Again their land holding was poor with average 26 kathas of lands and found to have no association with amount of seed collection, amount of net weaving, amount of fish selling and harvesting. The level of education found to be varied from primary to middle class their and involvement in decision-making process were also varied from poor to high with average 17.60 decision-making scores.

CHAPTER – III

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The study entitled **"Community-based fisheries management with people's participation for sustainable development of *beel* fisheries"** was conducted in Kamrup district of Assam. To conduct the study scientifically, a suitable research design was evolved in order to arrive at an authentic conclusion. This chapter deals with the details of the methodology adopted for the present study. Now for the sake of convenience, the chapter is sub divided into the following subheadings

3.1 Locale of the study.

3.2 Land and the people.

3.3 Selection of respondents.

3.4 Operationalization of variables and their measurement.

3.5 Methods of data collection.

3.6 Statistical analysis of data.

3.7 Case study on pen culture through CBFM with people's participation approach.

3.1 LOCALE OF THE STUDY

The study was conducted purposively at the village Bardekpar under the Kamalpur Development Block of Kamrup district, Assam. A closed *beel* of convenient size about 7.0 ha water spread area was selected for the present study. The *beel* is locally known as Dek*Beel*. The village was located about 50 Km away from Guwahati city. The population of the village was 650 with 150-house hold family. The people were living in the surrounding area of the *beel*. The reasons behind the selection of the area are stated below :

- The Kamrup district is one of the leading aquaculture and fisheries district of the state of Assam. There are a large numbers of *beel* fisheries with or without government intervention in the district. Fisheries and aquaculture was the secondary occupation of majority of the resident of this block.
- The researcher being a resident of the adjacent district is well acquainted with the culture, social custom, situations and language. This helped him to establish

A map of Assam

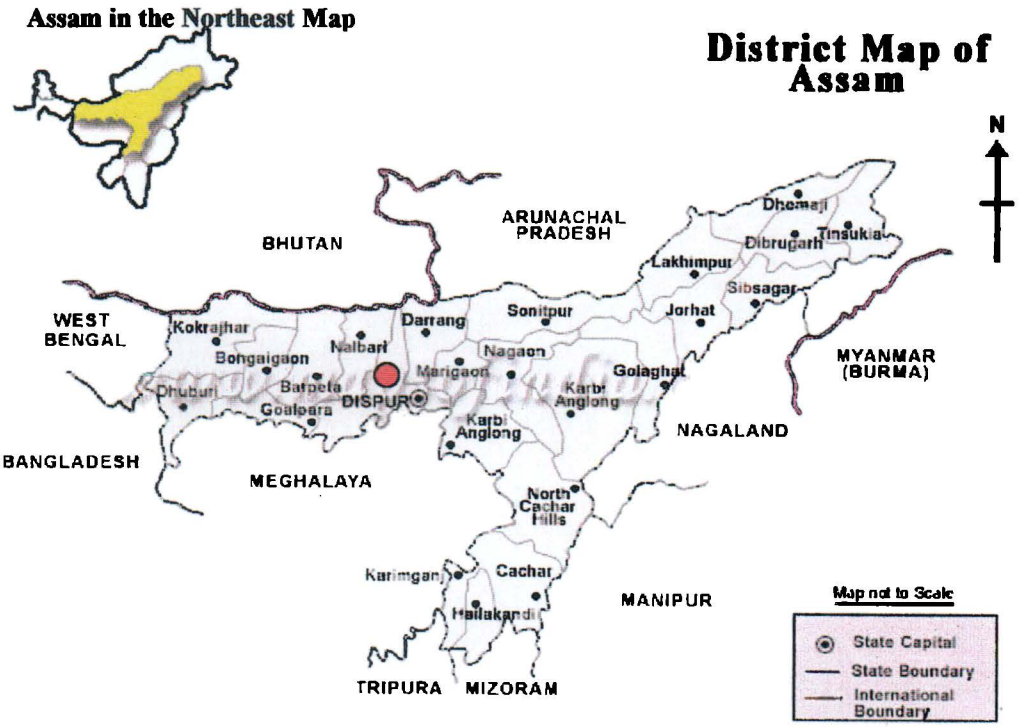


Figure 1. A Map of Assam

A map of District Kamrup

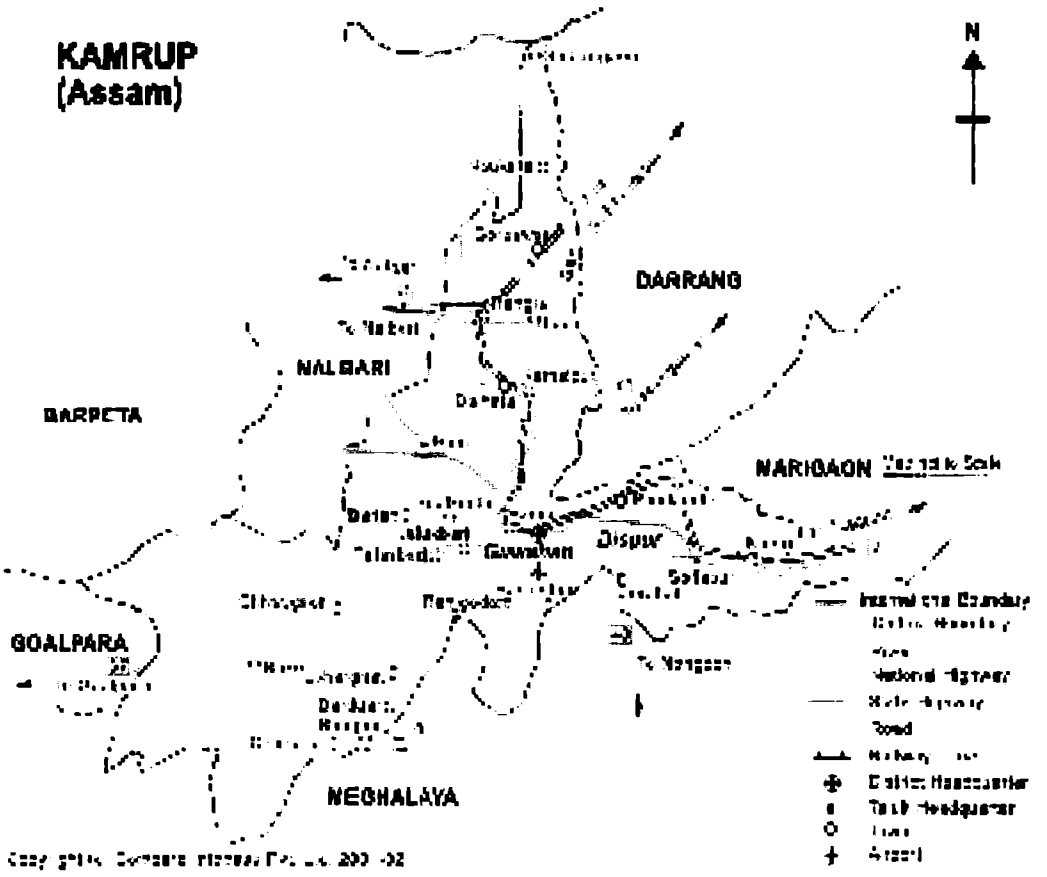


Figure 2. A Map of District Kamrup

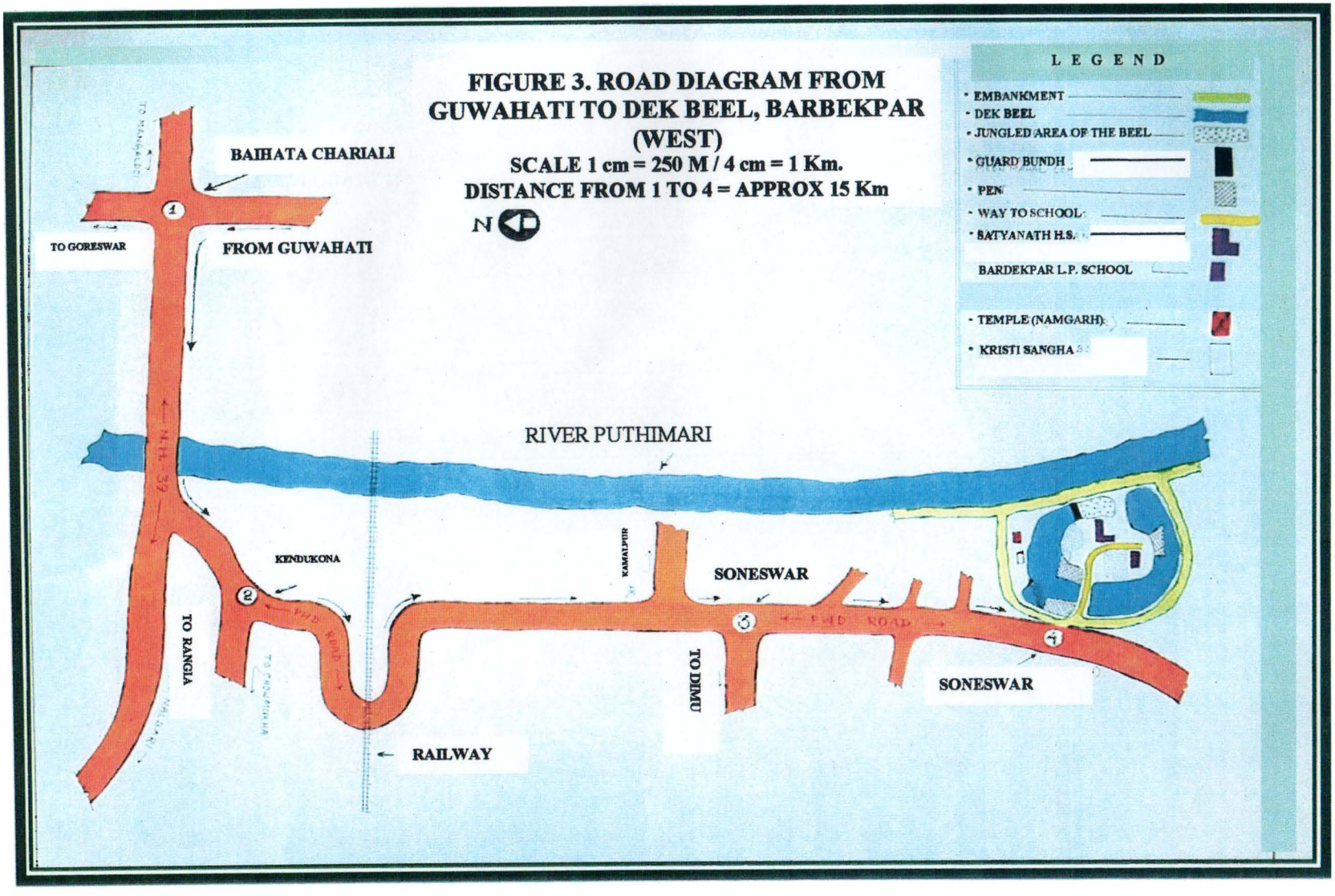
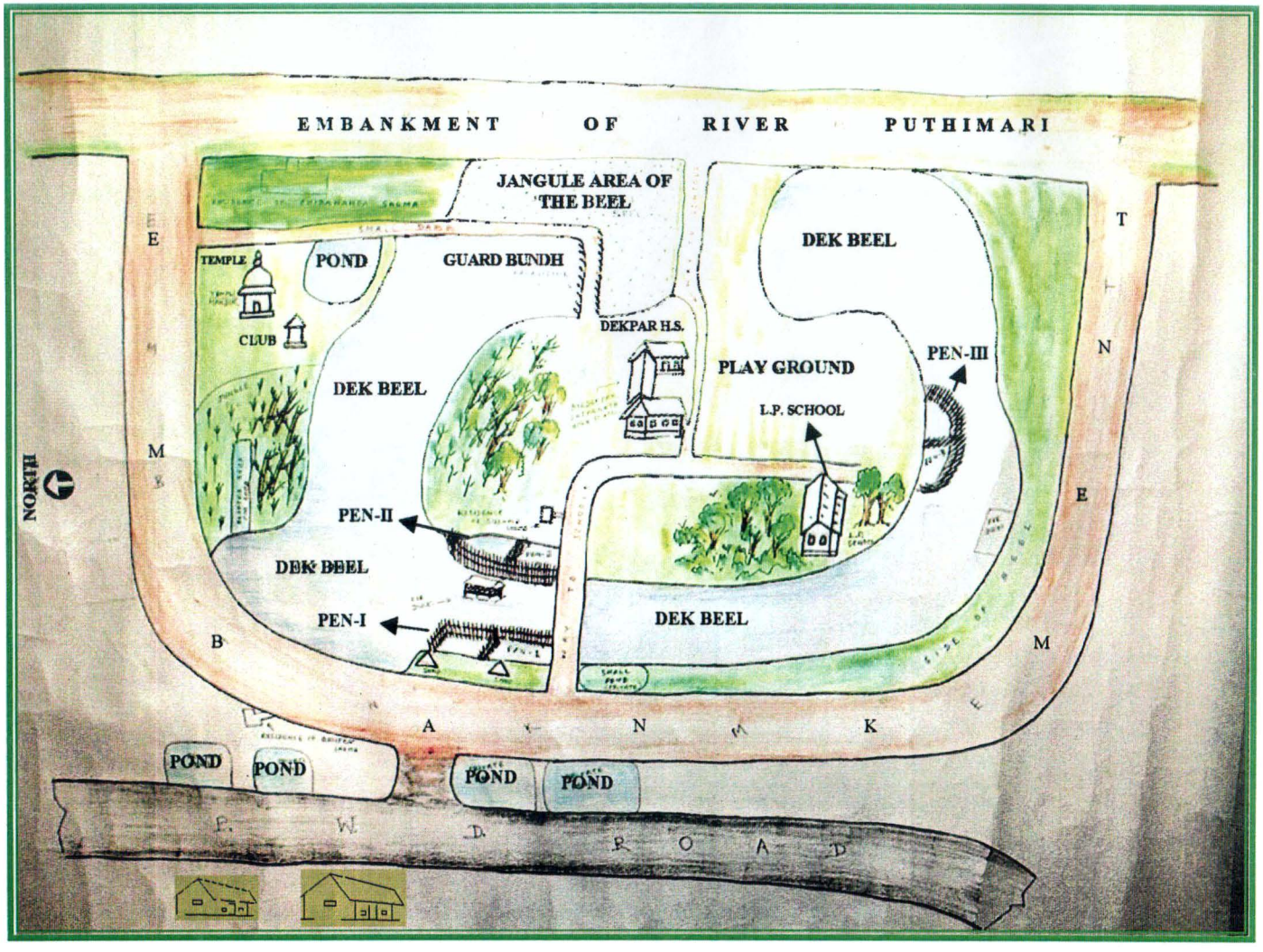


FIGURE 3. ROAD DIAGRAM FROM GUWAHATI TO DEK BEEL, BARBEKPAR (WEST)
SCALE 1 cm = 250 M / 4 cm = 1 Km.
DISTANCE FROM 1 TO 4 = APPROX 15 Km
N
LEGEND
EMBANKMENT
DEK BEEL
JUNGLED AREA OF THE BEEL
GUARD BUNDH
PEN
WAY TO SCHOOL
SATYANATH H.S.
BARDEKPAR L.P. SCHOOL
TEMPLE (NAMGARH)
KRISTI SANGHA
BAIHATA CHARIALI
TO GORESWAR
FROM GUWAHATI
RIVER PUTHIMARI
N.H. 37
KENDUKONA
KAMALPUR
SONESWAR
TO RANGIA
TO DIMU
SONESWAR
RAILWAY
1
2
3
4

FIGURE 4. A SOCIAL MAP OF VILLAGE DEKPAR SHOWING THE LOCATION OF DEK *BEEL*



a close liaison with the respondents and enabled him to get reliable informations.

- Easy approachability either by road or rail.
- The annual fish production from all the fisheries and aqua cultural sources of the district is about 0.10 lakh metric tones against the demand of 0.25 lakh metric tones (Kamrup District Fisheries Profile, 2002-2003) causing a huge gap between demand and supply. Hence it was thought that the outcome of the research study would help to those who work, design and implement programs on fisheries aspects.

3.2. LAND AND THE PEOPLE

Historically, the district Kamrup is one of the most renowned districts in the State of Assam since the era of Mahabharata, the great Indian epics time. Its king Bhaga Dutta fought terribly in the history famous Karukhetra War against the *Pancha Pandava* and their *Sarthi-Krishna*. Kumar Bhaskar Barman was the first and most powerful king from the district. The district profile of modern Kamrup (Kamrup District Fisheries Profile 2002-03) has stated below:

The district Kamrup is situated between 25.43^0 north and 26.51^0 south latitude and between 90.36^0 east and 92.12^0 west longitudes. It is surrounded by the foothills of Bhutan and Nalbari district in the North, the state of Meghalaya in the South, Nagaon and Darrang district into the East and Goalpara and Nalbari district in the West.

Its geographical area is 4345 sq. km. The district is divided into two sub-divisions namely Guwahati and Rangia. The district has a total of 15 Revenue Circles within 17 Development Blocks. Total numbers of villages are 1393 out of which 1234 nos electrified.

The total population of the district is 25,15,030 (2001 census). The population comprises of 1614512 nos. urban, 900518 nos. rural people. The annual rainfall of the district ranges from 1,500 mm up to 2,600 mm with a mean humidity of 75%. The maximum and minimum temperature varies between 38.5^0C and 7.0^0C.

The Brahmaputra is the main river in the district and on its south bank, Guwahati, the headquarter of the district is located at an elevation of 54.75 m (msl). The other principal rivers are Kulsi, Digaru, Singra, Kolongsuti and Bharalu.

The district of Kamrup is serviced by 26 Banks having a total of 186 operating branches comprising of commercial banks 148 nos. Foreign Bank 1 nos., Co-Operative Bank 14 nos and RRB 25 nos.

The occupational profile of the people is 2,01,299 nos. cultivators, 1,51,280 nos. small & marginal farmers, 50,523 nos. artisans, 47187 nos. agricultural laborers 13788 numbers other workers.

3.2.1 Water resources of the district

The district of Kamrup is rich in fishery and aquaculture resources with varied types. These are

Water Resources of Kamrup District, Assam.

Sl. No.	Resources	Area (in hectare)
1.	River fisheries (Regd.)	2027
2.	*Beel* fisheries (Regd.)	1353.25
3.	*Beel* fisheries (Un-regd.)	1082.00
4.	Ponds & tanks	2465.40
5.	Others (Low-lying areas, Derelict water bodies etc)	1646.92
6.	*Beel* fisheries under A.F.D.C.	1255.40
Grand Total		**9829.97**

Source : Kamrup district fisheries profile (2002-03).

3.3 SELECTION OF RESPONDENTS

From the total population of 650 villagers, a list of 434 surrounding *beel* users both male and female engaged in different activities was prepared. Now, from the list of 434 *beel* users, 120 respondents i.e *beel* users were selected by simple random sampling. Thus 120 numbers of *beel* users i.e respondents were taken as the sample size for this study.

3.4 OPERATIONALISATION OF THE VARIABLES AND THEIR MEASUREMENT

3.4.1 Independent variables

3.4.1.1 Personal characteristics

3.4.1.1.1 Age: It refers to the chronological age of the *beel* users and consisted of the following three categories -

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 is up to 31-50 years.

Old aged *beel* users – It refers to those *beel* users whose age is more than 50 years.

3.4.1.1.2 Education

It refers to the *beel* users academic qualification acquired through formal schooling. The formal educational levels, which were used in this study, are as follows:

Illiterate – It refers to those *beel* users whose education is nil.

Read only – It refers to those *beel* users who can read Assamese only.

Read and write – It refers to those *beel* users who can read and write Assamese.

Primary – It refers to those *beel* users whose education is up to primary.

Middle – It refers to those *beel* users whose education is up to middle level (Class-V to VIII).

High school – It refers to those *beel* users whose education is up to Higher Secondary (H.S.).

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 - illiterate-0; can read only-1; can read and write-2; primary-3; middle-4; high school-5; graduate-6.

3.4.2.1.3 Family size

In a nuclear family, it refers to total number of persons of the family of a *beel* user, which includes his wife, sons, daughters etc., irrespective of their age, but in a joint family, in addition to the above-mentioned family members, it also includes the *beel* user's, father, mother, sisters, brothers and grand parents. The total number of family members was taken as the family size. The total family sizes were categorized as 'small size family' (1-4 members); 'medium size family' (5-9 members) and 'large size family' (10 or above).

3.4.1.1.4 Family type

It refers to the types of family possessed by a *beel* user, the following two types of families were considered in this study.

Nuclear family: It refers to the family of the *beel* users living only with his wife and children.

Joint family: It refers to the family when a *beel* user in addition to his wife and children, is living with his father, mother, brother(s), sister(s) and grand parents.

Single and joint family was quantified with the scores of 1 and 2 respectively.

3.4.1.2 Socio-Economic Characteristics

3.4.1.2.1.1 *Income*

It refers to the total annual income of *beel* user's family earned through agriculture as well as through other professions like service, business, labour and animal husbandry and fishery. *Beel* users were categorized as low (upto Rs. 25000.00); middle (Rs. 26000.00 to 50000.00) and higher (more than Rs. 50000.00) as the level of annual income groups.

3.4.1.2.1.2 ***Caste***

It refers to the caste of the *beel* users. Three categories of the caste were considered in this study namely scheduled caste, backward caste and higher caste.

3.4.1.2.1.3 ***Occupation***

It refers to the main or subsidiary professions to which the *beel* users belong. This variable was divided into five categories and the scoring for variable was done as service-5; agriculture-4; business-3; labour-2; and fisheries-1.

3.4.1.2.1.4 ***Land holding***

It refers to the total land areas (cultivated and household) possessed by the *beel* users.

3.4.1.2.1.5 ***Social participation***

It refers to the degree to which a *beel* users is associated with different organizations like village-Panchayat, Panchayat Sammittee, Fish Farmers Club, Rural Development Club, Zila Parishad, Co-operative Society, Fishermen's Co-operative society etc. This variable was divided into four categories and scoring was done as member of one organization-1; member of more than one organization-2; office holder-3; not a member of any organization-0.

3.4.1.2.1.6 ***Fisheries infrastructure***

It refers to the infrastructure available to the *beel* users, which include cultivable fishpond, model fish farm with or without eco-hatchery, craft and gear used in fishing and harvesting. The fisheries infrastructure was quantified with the score of high infrasructure-3; medium infrastructure-2; poor infrastructure-1; and without infrastructure-0.

3.4.1.2.1.7 ***Involvement of diversified agriculture***

It refers to the involvement of a *beel* user with different agriculture, horticulture, and animal husbandry activities besides his/her fisheries activities including ornamental fish farming. The scoring has been done for involvement in diversified agriculture as high involvement-3, medium involvement-2, low involvement-1, without involvement-0.

3.4.1.3.1 Communication characteristics

3.4.1.3.1.1 Utilization of information sources: It refers to the various sources through which the respondent receives the information regarding fishery activities. According to the frequency of utilization, scores has been allotted for individual scores as 'most often'-4; 'often'-3; 'some times'-2; 'never'-1.

3.4.1.4.1 Psychological Characteristics

3.4.1.4.1.1 Participation in development program

It refers to the degree to which a *beel* user is associated with different phases of the development program including fisheries initiated by different development agencies. Modayil (2003) stated that for effective management of marine fisheries, management approaches should change from a regulatory mode to a participatory mode with stakeholder participation right from policy formulation to implementation and monitoring. Such an approach will yield the required results in a scenario where diverse, cultural, ethical, social and economic aspirations of stakeholders are involved. For the study, following points were analyzed taking responses from the respondents and the scores were distributed as follows

Sl No.	Category	Score
	Beel user should ***participate*** *in*	
a.	all stages of development program only.	7
b.	project formulation, identification, implementation only.	6
c.	project implementation and monitoring only.	5
d.	project evaluation and monitoring only.	4
e.	project group, community group, organization only.	3
f.	development is possible only through people's participation.	2
g.	project monitoring only.	1

3.4.1.4.1.2 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). For the *beel* users, working in different fisheries activities, their participation in decision-making process especially in any fisheries development program is fairly a good indicator of their status. For the present study, decision making process of the *beel* users were analyzed by taking their responses on the following points & score were distributed as follows :

Sl No.	Category	Score
	*Beel user should take **decision** themselves on*	
a.	participation in each and every stages of development.	6
b.	development of *beel* fisheries through community-based/ group-based organization.	5
c.	fishing restriction and effective regulation.	4
d.	fish harvesting and marketing.	3
e.	equitable distribution of profit with gender neutralized approach.	2
f.	direction and instruction of government for effective utilization of resource.	1

3.4.1.4.1.3 Woman empowerment

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). Fisherwomen play a significant role in general livelihood of fishermen family. They can contribute significantly to the fisheries and aquaculture activities besides their day-to-day work. Empowering the women to take decision on different fisheries development activities, sharing the benefit in equitable manner are quite important when sustainability of *beel* fisheries is in concerned. This variable was analyzed by taking responses from the respondent on the following points. For each of

these, a dichotomous type of questions were structured. Here, while scoring, **'yes'** response of the *beel* users was awarded with score of **I** and for **'no'** type response, the score 'O' was given. For finding out the total scores of woman empowerment for sustainable development of *beel* fisheries, the scores for each item were added.

a) Fisherwomen should not involve in any kind of fisheries activities.
b) Fisherwomen if engaged in different fisheries activities, will not get enough time to perform their domestic duties.
c) Fisherwomen should stay at home to take care of their family only.
d) Fisherwomen should be involved in scientific fish culture including pre stocking, stocking and post stocking management activities.
e) Fisherwomen can involve in fish seed raising easily.
f) Making and repairing of net weaving is a good source for fisherwomen involvement.
g) Fisherwomen should not take part on any organization or social participation activities.

3.4.1.5.1 Situational characteristics

3.4.1.5.1.1 Availability of critical inputs

In this study, it refers to the availability of crucial and decisive inputs for sustainable development of *beel* 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 agriculture and animal husbandry inputs; marketing facilities etc. For each of these, a dichotomous type of questions were structured. Here, while scoring, **'yes'** response of the *beel* users was awarded with score of **I** and for **'no'** type response, the score 'O' was given. For finding out the total score of availability of critical inputs for sustainable development of *beel* fisheries, the scores for each item were added.

3.4.1.5.1.2 Marketing facilities

This refers to the selling and purchasing of aquaculture and fisheries inputs and produces. The marketing facility should be well developed whenever sustainability is

also concerned. For this study, following points were analyzed taking responses from the respondents. For each of these, a dichotomous type of questions were structured. Here, while scoring, **'yes'** response of the *beel* users was awarded with score of **I** and for **'no'** type response, the score 'O' was given. For finding out the total scores for sustainable development of *beel* fisheries, the scores for each item were added.

a) Market news is not useful to a fisherman.
b) A fisherman can get good price by grading his/her produces.
c) Ware house, cold storage can help the fisherman to get better price of his/her produces.
d) One should sell his/her produces to the nearest market irrespective of the price.
e) One should purchase her inputs from the shop where his/her other relatives purchase.
f) One should grow those carps that have more market demand.
g) For good marketing facilities, communication is not essential.

3.4.1.6. Institutional Characteristics

3.4.1.6.1.1.1 Building community-based fisheries organization

This refers to the establishment of community-based fisheries organization for accelerating the pace of development of fisheries. It may be the important currency to determine the *beel* fisheries sustainability. This variable was analyzed by taking the responses from respondents on the following points. Here, while scoring, **'yes'** response of the *beel* users was awarded with score of **I** and for **'no'** type response, the score 'O' was given. For finding out the total scores of building community-based fisheries organization for sustainable development of *beel* fisheries, the scores for each item were added.

a) Group-based organized / community-based organized effort cannot succeed in *beel* fisheries activities.
b) For development of *beel* fisheries, there is no need of group-based organization / community-based organization.
c) Community-based organization with active peoples participation is the most important step toward sustainable development of *beel*.

d) Through community-based organization with active peoples participation at local level of planning and management can be fruitful for awareness building, motivation of fellow farmer towards the development of *beel*.

e) Community-based organization at the village level can help for good understanding among the *beel*.

f) If *beel* fisheries are managed through co-operative organized system, the management cost will be minimized.

g) Reward and punishment, proper demarcation of boundary, free interaction among the stake holders are must for community-based fisheries for its sustainability.

3.4.1.6.1.2 *Beel* user's capacity building

It is an essential pre-requisite for empowerment that enhances community's participation (Pattanaik, 2004). This refers the awareness raising, need based training, change of behaviour and attitude, confidence building, participation in decision making, leadership development and organization aspect of individuals (Crowder, 1996). For sustainable development of *beel*, the fisher's capacity building must be enhanced. This variable was analyzed by taking responses from respondent on the following points and score was given as follows:

Sl. No.	Category	Score
a.	Training is highly essential to get the knowledge of effective management of *beel* fisheries	5
b.	Training can change attitude and behaviour of *beel* user for its sustainable management.	4
c.	*Beel* users should not take part on any decision-making regarding its sustainable development.	3
d.	A good leadership with effective people organization is required for development of *beel* fisheries.	2
e.	Every body should be aware, regarding values and importance of *beel* fisheries.	1

3.4.2 Dependent variable

3.4.2.1 Knowledge scores of *beel* users on sustainable development of *beel* fisheries

The World Bank report (1998-1999) has emphasized, "knowledge is the critical for development because everything we do depends on knowledge. Simply to live we must transform the resource we have into the things we need and that takes knowledge" Here knowledge refers to the information and understanding of *beel* users regarding sustainable development of *beel*. In this study, their knowledge was measured with the help of "**KNOWLEDGE TEST**" scale developed by Dana (1987), Shaikh *et al.* (1993) with slight modification for this study. For each of the correct answer, a score 'X' was given and for the incorrect answer, 'O' was assigned. Then such scores were added up finally in order to yield a knowledge scores out of 100 for them.

3.4.2.1.1 Procedure followed in developing knowledge test

The following procedure was followed for developing this "KNOWLEDGE TEST".

3.4.2.1.2 Collection of items and sub-items

Firstly, after detailed review of literature and discussion with the scientists and post graduate students of Faculty of Fishery Science, WBUAFS, fishery extension specialists, the major items and sub items of knowledge about sustainable development of *beel* fisheries with their definite correct answers (of major items and sub-items) were collected.

3.4.2.1.3 Assigning weightage to items and sub-items

The selected items and sub-items of '**knowledge test**' –were given to 50 judges (Annexure- I). These judges were consisted of scientists, extension specialist, and postgraduate students from faculty of Fishery Sciences, Mohanpur, Fishery Extension Officer (s) from state Directorate of Fisheries, Assam and West Bengal. Each of the 50 judges were asked to distribute the weights (marks) to each of the four major items and the sub-items under the major items, taking consideration of their relative importance in regards to sustainable development of *beel* fisheries, so that total become 100. Final score for each of the items and sub-items were finalized by calculating arithmetic means of the score given to the items and sub-items by the experts.

The final selection and allocation of weightage to items and sub items are as follows:

Major Items/Sub-Items	**Score**
i) ***Awareness*** Have you heard about sustainable development of *beels* fisheries	**10**
ii) ***Concept of sustainable development of beel fisheries (SDBF)***	**21**
a) It is the development of *beel* fisheries, which is designed to maintain productivity and usefulness to the society without any time limit.	5
b) Both capture and culture based fisheries mánagement options are taken for effective management.	5
c) This mode of fisheries management offers relatively eco-friendly option for enhanced fish production.	5
d) Without involvement of local communities right through conceptualization, planning, implementation of location specific strategy with bottom up approach, sustainable development of *beel* fisheries is not possible.	6
iii) ***Advantages of Sustainable development of beel fisheries***	
a) Environmentally non-degradable.	**28**
b) Technically viable due to adoption of appropriate technology and location specificity.	4
c) Socially acceptable.	3
d) Economically sound. i.e. cost effective.	3
e) Conserve bio-diversity of the *beel* through strong peoples involvement.	4
f) Enhancing production of fish without degrading water and soil quality.	7
g) People are the center of this development approach.	4
iv) ***Sustainable development of beel fisheries can be achieved by***	3 **41**
a) Strengthen conservation measures for the resource and biodiversity of the *beel*.	3

b) Introduction of mass media such as TV, Radio, and Newspaper, Drama, Documentary for highlighting the issues relating to wise use of *beels*, their values and importance.	3
c) Management of soil and water quality.	2
d) Creating complete environmental awareness by different environment campaign.	2
e) Empowering men and women through fisheries	3
f) Effective utilization of *beel* through integrated agricultural approach.	3
g) Providing right and responsibilities of ownership of the *beel* to the local fishers through appropriate policy design.	2
h) Through community participation in planning, management, implementation, continuous monitoring.	3
i) Introduction of appropriate technology for development & management of *beel* through locally available resources.	3
j) Gender neutrality approach through women empowerment in *beel* fisheries.	2
k) Introduction of bottom up community-based fisheries management approach in *beel* resources.	3
l) Introduction of culture-based and captured fishery management option.	3
m) Need based training on effective management of *beel* fisheries for enhancing capacity building of the fishers & their empowerment.	2
n) Involvement of government, NGOs, village level organizations for arousing mass awareness regarding values and importance of *beel* fisheries.	4
o) Introduction of environmental education for awareness building at school level especially targeting school children.	1
p) Marketing orientation.	2

3.4 OPERATIONALIZATION OF VARIABLES AND THEIR MEASUREMENTS

In this section a brief introduction of different variables and their measurements are presented. Total 19 independent variables and one dependent variable are included in this study. Dependent and independent variables along with their measurements are given below.

Independent Variables

A. Personal characteristics:

I	Age	Chronological age in years.
II	Education	Schedule was developed for the study.
III	Family size	Schedule was developed for the study.
IV	Family type	Schedule was developed for the study.

B. Socio-economic characteristics

I	Caste	Schedule was developed for the study.
II	Occupation	Schedule was developed for the study.
III	Annual income	Schedule was developed for the study.
IV	Land holding	Schedule was developed for the study.
V	Social participation	Schedule was developed for the study.
VI	Fishery infrastructure	Schedule was developed for the study.
VII	Involvement of integrated agriculture	Schedule was developed for the study.
VIII	Women empowerment	Schedule was developed for the study.

C. Communicational characteristics:

I	Utilization of information sources	Schedule was developed for the study.

D. Psychological characteristics:

I	Participation in development program	Schedule was developed for the study.
II	Decision making process	Schedule was developed for the study.

E. Situational characteristics:

I	Availability of critical input	Schedule was developed for the study.
II	Marketing facilities	Schedule was developed for the study.

F. Institutional characteristics

I	Building community-base fisheries organization	Schedule was developed for the study.
II	*Beel* user's capacity building	Schedule was developed for the study.

Dependent variable

Knowledge scores of *beel* users on sustainable development of *beel* fisheries.	Scale developed by Dana (1987) and Shaikh *et al.* (1993) with little modification.

3.5 METHODS OF DATA COLLECTION

After quantifying the variables for measurement, structured interview schedule was prepared systematically. Before final data collection, the schedule was pre-tested with non-sample respondents of the area.

Data were collected during March to June 2004 by the investigator personally with the help of structured interview schedule. Initially, data were collected through local language and replies were recorded simultaneously in English. For collection of primary data, the investigator contacted Gram Panchayat, Block and Circle Office. Besides an in-depth **case study** was conducted to study the impact of community-based fisheries management on sustainable development of *beel* fisheries with active people's participation. The researcher has narrated the details of the case study from his personal experiences as he actively dealt with the community's member for their mobilization and organization toward the effective management and utilization of the local natural resource, the *Dek Beel*. Thus, the researcher collected different informations by his personal visits many a times to the project location.

Some time, the researcher also took the help of non-participant observation techniques, discussion – both formal and informal with the *beel* users and their opinion leaders. However, some data were collected through the social mapping also.

3.6 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 fed to the computer and the following statistical techniques were used to analyze the data using Software Statistical Package for Social Sciences (SPSS).

3.6.1 Correlation coefficient

In order to study the relationship between knowledge score of *beel* users on sustainable development of *beel* fisheries and any one of 18 independent variables (excluding *caste* as an independent variable) under the study such as : age, education,

family size, family type, annual income, occupation, land holding, social participation, fishery infrastructure, involvement in integrated agriculture, utilization of information sources, participation in development program, decision making process, availability of critical inputs, marketing facilities, women empowerment, community-based fisheries organization, *beel* users capacity building as perceived by *beel* users, the correlation matrix was prepared.

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

$$r = \frac{Cor_{\bullet}(X,Y)}{\sqrt{V(X).\ V(Y)}}$$

3.6.2 Regression analysis

Regression analysis was carried out to study the effect or influence of different factors (independent variables) such as : age, education, family size, family type, annual income, occupation, land holding, social participation, fishery infrastructure, involvement in integrated agriculture, utilization of information sources, participation in development program, decision making ability, availability of critical inputs, marketing facilities, women empowerment, community- based fisheries organization, *beel* users capacity building as perceived by *beel* users for their on knowledge scores on sustainable development of *beel* fisheries (dependent variable).

The independent variables were selected on the basis of significant correlation between the dependent and independent variable. Variables were selected on the basis of 'F' values and R^2 values, following stepwise regression technique. Ultimately the following regression equation was fitted in the data to explain the variability of dependent variables by predictor variables.

$$Yi = \alpha + \beta_1 X_1 i + \beta_2 X_2 i + \text{----------} + \beta_n X_n i + ei$$

Where,

i = 1, 2, 3, ... 120

Yi = Values of dependent variables of i^{th} respondent.

Xni = Independent variables of i^{th} respondents selected through stepwise procedure.

ei = Error term associated with i^{th} observation and is assumed to be normally and independently distributed with mean zero and constant variance σ^2

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).

3.6.4 Factor analysis

The main objective of factor analysis is to obtain scientific parsimony or economy of description. This technique 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 orthogonal factors based on *Varimax* procedure of principal component analysis on the basis of *eigen* values more than 1.

3.6.5 Path analysis

Causal effect relationship like path analysis is also done 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.

3.6.6 Analysis of variance

One-way analysis of variance was applied to study the effect of all the predictors' variable of varying levels on the knowledge scores of *beel* users on sustainable development of *beel* fisheries. Means of different levels of each predictor were tested at 0.05 significance level following Duncan's test.

CHAPTER – IV

RESULTS

4. RESULTS

The results of the study have been presented in two parts systematically. The first part deals with back ground information of the *beel* users that includes their personal, situational, socio-economic, psychological, communicational and institutional characteristics. The second part discusses relational analysis of the data i.e. relationship between and/or among different independent and dependent variables taken out for the study.

PART - 1

Background information of the *beel* users

In order to understand the *beel* users clearly and comprehensively for this study, some of their personal, socio-economic, communicational, psycholological, situational and institutional characteristics were taken into account, which are discussed below one by one.

4.1 INDEPENDENT VARIABLE S

4.1.1 Personal characteristics

4.1.1.1 Age

Age of the *beel* users varied from 18 years to 69 years. Out of 120 *beel* users, majority i.e. 80 (66.67%) was in the age group of 31-50 years (middle aged); 36 (30%) were in the age group of 18-30 years (young aged) and the remaining 4 (3.33%) were in the age group of more than 50 years (old aged). However, the average age of the *beel* users were 36.48 years (S.D=11.09).

Table 1. Distribution of respondents according to age **N = 120**

Category	Frequency	Percentage
a) Young (18-30 years)	36	30
b) Middle aged (31-50 years)	80	66.67
c) Old aged (more than 50 years)	4	3.33

4.1.1.2 Education

The education of the *beel* users of this study varied from primary to graduate and above level. Out of 120 *beel* users, majority i.e. 112 (93.3%) were educated and the remaining 8 (6.7%) were illiterate. Among 112 educated *beel* users, majority i.e. 33 (27.5%) were graduate and above followed by 27 (22.5%) *beel* users with middle school level of education. However, the study also further revealed that there were 22 (18.3%) *beel* users with primary level of education and 14 (11.7%) had high school level of education. There were 9 (7.5%) *beel* users who could read and write Assamese and only 7 (5.8%) *beel* users were found who could read Assamese only.

Table 2. Distribution of respondents according to education		**N = 120**
Category	**Frequency**	**Percentage**
a) Illiterate	8	6.7
b) Can read only	7	5.8
c) Can read and write	9	7.5
d) Primary school level	22	18.3
e) Middle school level	27	22.5
f) High school level	14	11.7
g) Graduate and above	33	27.5

4.1.1.3 Family size

The study revealed that out of 120 *beel* users, majority i.e. 61 (50.8%) were having medium size of family (5-10 members) followed by 49 (40.8%) with small sized family (1-5 members). There were only 10 (8.4%) *beel* users having large sized family (10-15 members). However the average family size of the *beel* users were 6.

Table 3. Distribution of respondents according to family size		**N = 120**
Category	**Frequency**	**Percentage**
a) Small size (1-5members)	49	40.8
b) Medium size (5-9 members)	61	50.8
c) Large size (10 or above members)	10	8.4

4.1.1.4 Family type

The study indicated that out the 120-beel users, majority of the *beel* users i.e. 69 (57.5%) were from nuclear family where as only 51 (42.5%) respondents were from joint family.

Table 4. Distribution or respondents according to the family type N = 120		
Category	**Frequency**	**Percentage**
a) Nuclear family	69	57.5
b) Joint family	51	42.5

4.1.2 Socio-economic characteristics

4.1.2.1 Caste

The study revealed that majority i.e. 84 (70%) *beel* users were from higher caste followed by 22 (18.33%) scheduled caste and remaining 14 (11.67%) were from other backward caste.

4.1.2.2 Annual income

The study revealed that out of 120 *beel* users, majority i.e. 47 (39.2%) *beels* users were from middle annual income group (Rs. 26000.00 – Rs. 50000.00) followed by 38 (31.7%) *beel* users with low annual income group (upto Rs. 25000.00). There were only 35 (29.1%) *beel* users from high annual income group (more than Rs. 50000.00). However, the average annual income of the *beel* users were found Rs. 40960.00 (S.D.=24.18).

Table 5. Distribution of respondents according to the annual income N = 120		
Category	**Frequency**	**Percentage**
a) Low (upto 25000.00)	38	31.7
b) Middle (Rs. 25000.00 - 50000.00)	47	39.2
c) Higher (More than Rs. 50000.00)	35	29.1

4.1.2.3 Occupation

Table 6. Distribution of respondents according to the occupation		N = 120
Category	**Frequency**	**Percentage**
a) Service	25	20.8
b) Agriculture	42	35
c) Business	23	19.2
d) Labour	17	14.2
e) Fisheries	13	10.8

Table 6 revealed that out of 120 *beel* users, majority i.e. 42 (35%) were having their major profession as agriculture followed by 25 (20.8%) *beel* users found engaged in service. However, 23 (19.2%) were engaged in business, 17 (14.2%) in labour activities and only 13 (10.8%) *beel* users took fishery as their major source of livelihood.

4.1.2.4 Land holding

The maximum and minimum possession of land areas of the *beel* users were 100 kathas and 2 kathas respectively, while, the mean being 24.43 kathas (S.D.=14.69).

Out of 120 *beel* users, 45 (37.5%) had 16-30 kathas of land areas, 40 (33.3%) had upto 15 kathas of land areas and the reaming 35 (29.2%) had above 30 kathas of lands.

Table 7. Distribution of respondents according to land holding		N = 120
Category	**Frequency**	**Percentage**
a) Upto 15 Kathas	40	33.3
b) 16 to 30 Kathas	45	37.5
c) Above 30 Kathas	35	29.2

4.1.2.5 Social participation

Table 8. Distribution of respondents according to social participation		N = 120
Category	**Frequency**	**Percentage**
a) Not member of any organization	13	10.8
b) Member of only one organization	37	30.8
c) Member of more than one organizations	62	51.7
d) Office bearer/holder	8	6.7

Table 8 revealed that out of 120 *beel* users, majority i.e. 62 (51.7%) were the member of more than one organization followed by 37 (30.8%) as the member of only one organization. Again 13 (10.8%) were not the member of any organization but 8 (6.7%) were found as the office bearer of some organizations.

4.1.2.6 Fisheries infrastructure

Table 9. Distribution of respondents according to fishery infrastructure		N = 120
Category	**Frequency**	**Percentage**
a) Without infrastructure facilities	19	15.8
b) Poor infrastructure facilities	52	43.3
c) Medium infrastructure facilities	42	35.0
d) High infrastructure facilities	7	5.8

Table 9 revealed that majority of *beel* users i.e. 52 (43.3%) had poor fisheries infrastructure facilities followed by 42 (35.0%) medium infrastructure facilities. Only 7 (5.8%) had high infrastructure facilities while 19 (15.8%) were without any fisheries infrastructure facilities.

4.1.2.7 Involvement in integrated agriculture

Table 10. Distribution of respondents according to involvement in integrated agriculture		N = 120
Category	**Frequency**	**Percentage**
a) High involvement (3 out of 4)	20	16.7
b) Medium involvement (2 out of 4)	54	45.0
c) Low involvement (1 out of 4)	36	30.0
d) Without involvement (0 out of 4)	10	8.3

Table 10 revealed that majority i.e. 54 (45%) *beel* users had obtained medium involvement scores in regards to involvement in integrated agriculture, while 36 (30%) obtained low integrated agriculture involvement scores. Again 20 (16.7) *beel* user also obtained the high agriculture involvement scores but only few i.e. 10 (8.3%) obtained the scores of without involvement in integrated agriculture.

4.1.2.7 WOMEN EMPOWERMENT

Table 11. Distribution of respondents according to women empowerment.		N = 120
Category	**Frequency**	**Percentage**
a) High empowerment scores (More than 4 out of 7)	24	20.0
b) Medium empowerment scores (3-4 out of 7)	42	35
c) Low empowerment scores (2-3 out of 7)	43	35.8
d) Very low empowerment scores (1 out of 7)	11	9.2

It is clear from the Table 11 that majority of the *beel* users i.e. 43 (35.8%) obtained low women empowerment scores followed by 42 (35%) had medium women empowerment scores. It was further followed by 24 (20%) *beel* users who obtained high women empowerment scores and remaining 11 (9.2%) got very low women empowerment scores.

4.1.3 COMMUNICATIONAL CHARACTERISTICS

4.1.3.1 Utilization of information sources

Table 12. Distribution of respondents according to utilization of information sources **N = 120**

Category	Frequency	Percentage
a) Poor (5-10)	26	21.7
c) Medium (11-15)	60	50
e) High (16-21)	34	28.3

In case of utilization of information sources, majority i.e. 60 (50%) of *beel* users were in medium utilization of information source group while 34 (28.3%) and 26 (21.7%) *beel* users were under the category of high and poor utilization of information sources respectively.

4.1.3.2 Utilization of different information sources

Table 13. Distribution of respondents according to different information sources **N = 120**

Category	Frequency	Percentage
a) Radio	108	90.00
b) TV	55	45.83
c) News paper	52	43.33
d) Leaflet (Fishery)	8	6.67
e) Documentary	6	5.00
f) Friends & Relatives	72	60.00
g) FEO & FDA	51	42.5

(The percentage do not add up to 100 because of multiple responses occur)

Table 13 revealed that majority of the *beel* users i.e. 108 (90%) used to listen radio as information source. Again 72 (60%) *beel* users got information from their friends and relatives; 55(45.83%) received information through TV followed by 52 (43.33%) through news paper and the remaining 8 (6.67%) and 6(5%) *beel* users got information from leaf let (fishery) and documentary respectively.

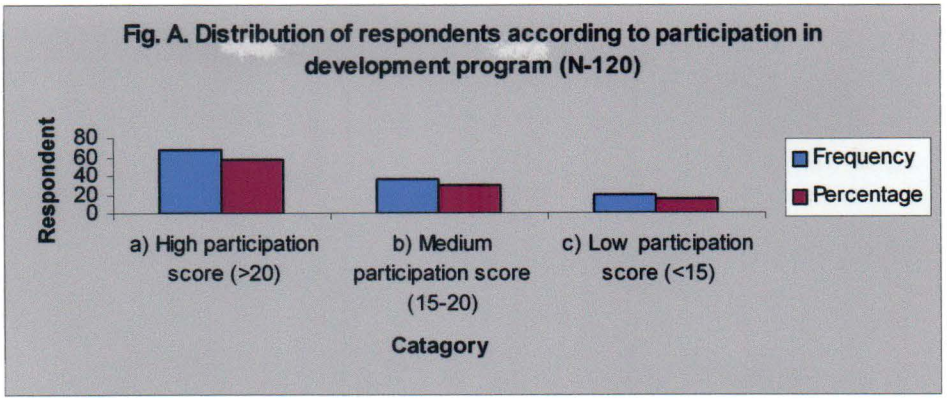


Fig. A. Distribution of respondents according to participation in development program (N-120)
Respondent
80
60
40
20
0
a) High participation score (>20)
b) Medium participation score (15-20)
c) Low participation score (<15)
Catagory
Frequency
Percentage

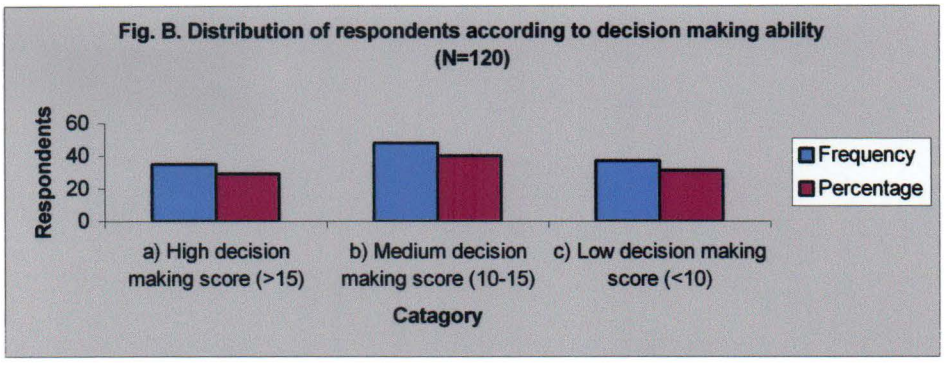


Fig. B. Distribution of respondents according to decision making ability (N=120)
Respondents
60
40
20
0
a) High decision making score (>15)
b) Medium decision making score (10-15)
c) Low decision making score (<10)
Catagory
Frequency
Percentage

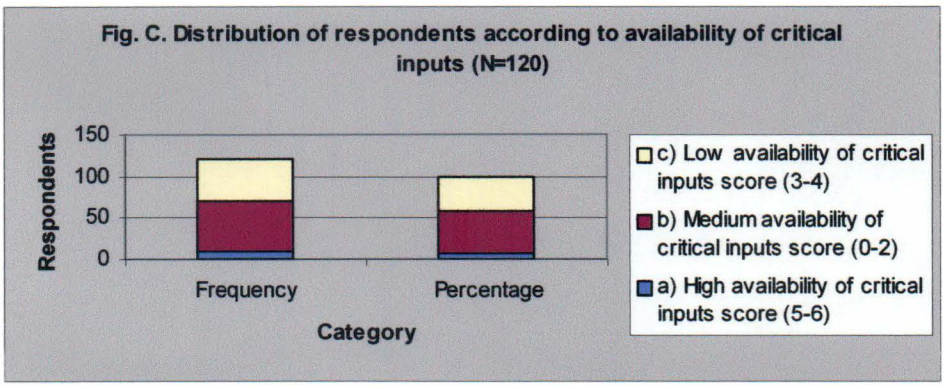


Fig. C. Distribution of respondents according to availability of critical inputs (N=120)
Respondents
150
100
50
0
Frequency
Percentage
Category
c) Low availability of critical inputs score (3-4)
b) Medium availability of critical inputs score (0-2)
a) High availability of critical inputs score (5-6)

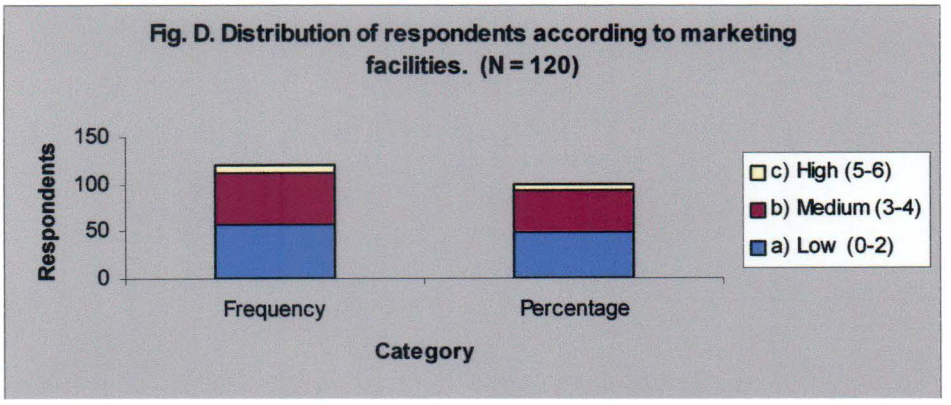


Fig. D. Distribution of respondents according to marketing facilities. (N = 120)
Respondents
150
100
50
0
Frequency
Percentage
Category
c) High (5-6)
b) Medium (3-4)
a) Low (0-2)

4.1.4 PSYCHOLOGICAL CHARACTERISTICS

4.1.4.1 Participation in development program

Table 14. Distribution of respondents according to participation in development program **N = 120**

Category	Frequency	Percentage
a) High participation scores (>20)	67	55.8
b) Medium participation scores (15-20)	35	29.2
c) Low participation scores (<15)	18	15.0

With regards to *beel* users participation in development program, majority 67(55.8%) *beel* users obtained high participation scores followed by 35 (29.2%) had medium participation scores and there were only 18 (15%) *beel* users who obtained low participation scores.

4.1.4.2 Decision making ability

Table 15. Distribution of respondents according to decision making ability **N = 120**

Category	Frequency	Percentage
a) High decision making scores (>15)	35	29.2
b) Medium decision making scores (10-15)	48	40.0
c) Low decision making scores (<10)	37	30.8

With regards to the *beel* users decision-making scores, majority 48 (40%) *beel* users obtained medium decision making scores followed by 37 (30.8%) low decision making scores. The remaining 35 (29.2%) *beel* users, however, obtained high decision making scores.

4.1.5 SITUATIONAL CHARACTERISTICS

4.1.5.1 Availability of critical inputs

Table 16. Distribution of respondents according to availability of critical inputs
N = 120

Category	Frequency	Percentage
a) High availability of critical inputs scores (5-6)	10	8.3
b) Medium availability of critical inputs scores (3-4)	59	49.2
c) Low availability of critical inputs scores (0-2)	51	42.5

Table 16 revealed that majority i.e. 59 (49.2%) *beel* users obtained medium availability of critical input scores followed by 51 (42.5%) low availability critical input scores while only 10 (8.3%) had obtained high availability critical input scores.

4.1.5.2 MARKETING FACILITIES

Table 17. Distribution of respondents according to marketing facilities. N = 120

Category	Frequency	Percentage
a) Low (0-2)	58	48.3
b) Medium (3-4)	54	45.0
c) High (5-6)	8	6.7

Table 17 revealed that majority of the *beel* users i.e. 58 (48.3%) obtained low marketing facility scores followed by 54 (45%) medium marketing facilities scores while the remaining 8 (6.7)% obtained high marketing facility scores.

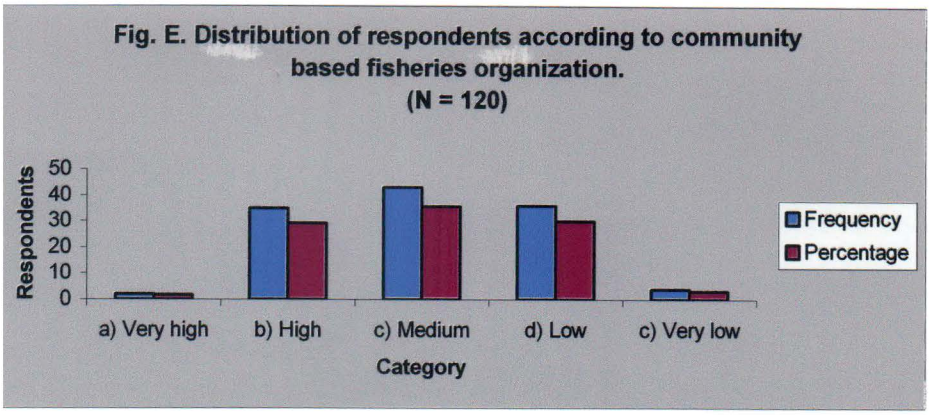


Fig. E. Distribution of respondents according to community based fisheries organization.
(N = 120)
Respondents
50
40
30
20
10
0
a) Very high
b) High
c) Medium
d) Low
c) Very low
Category
Frequency
Percentage

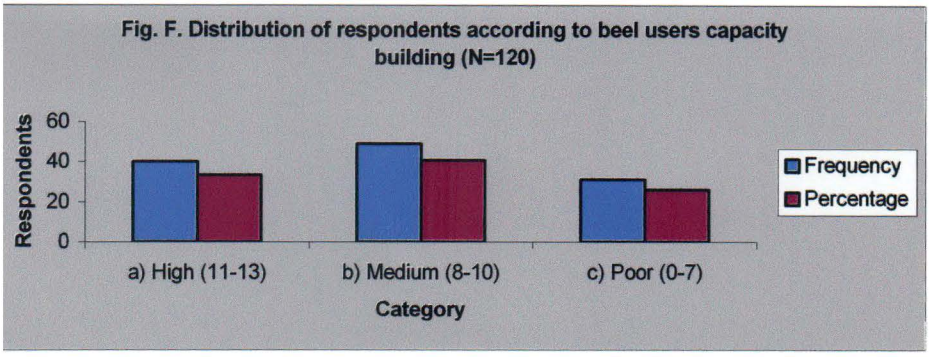


Fig. F. Distribution of respondents according to beel users capacity building (N=120)
Respondents
60
40
20
0
a) High (11-13)
b) Medium (8-10)
c) Poor (0-7)
Category
Frequency
Percentage

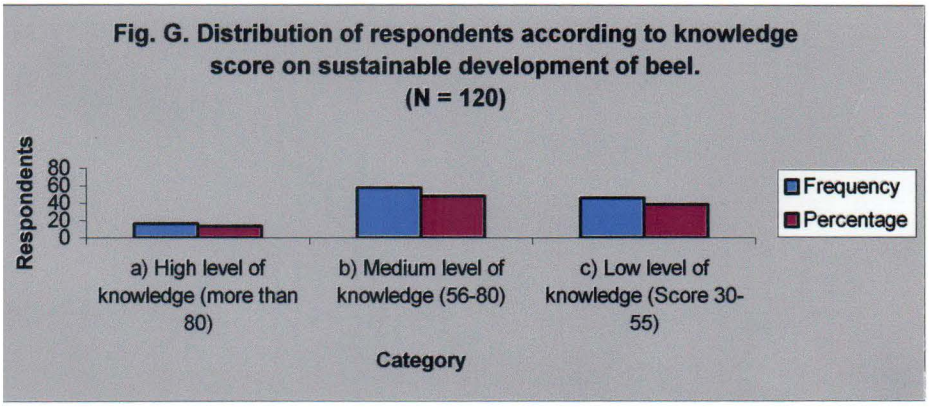


Fig. G. Distribution of respondents according to knowledge score on sustainable development of beel.
(N = 120)
Respondents
80
60
40
20
0
a) High level of knowledge (more than 80)
b) Medium level of knowledge (56-80)
c) Low level of knowledge (Score 30-55)
Category
Frequency
Percentage

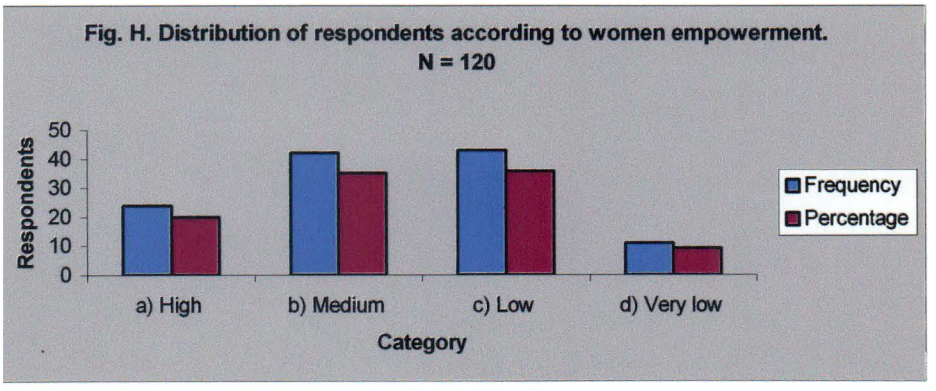


Fig. H. Distribution of respondents according to women empowerment.
N = 120
Respondents
50
40
30
20
10
0
a) High
b) Medium
c) Low
d) Very low
Category
Frequency
Percentage

4.1.6 INSTITUTIONAL CHARACTERISTICS

4.1.6.1 Community based fisheries organizations:

Table 18. Distribution of respondents according to community based fisheries organization. N = 120

Category	Frequency	Percentage
a) Very high (5 out of 7)	2	1.7
b) High (4 out of 7)	35	29.2
c) Medium (3 out of 7)	43	35.8
d) Low (2 out of 7)	36	30.0
c) Very low (1 out of 7)	4	3.3

Table 18 revealed that majority of the *beel* users i.e. 43 (35.8%) obtained the medium community-based fisheries organization scores followed by 36 (30.0%) low community-based fisheries organization scores. However 35 (29.2%) obtained high community-based organization scores. Very interestingly only 2 (1.7%) and 4 (3.3%) *beel* users obtained very high and very low community-based organization scores.

4.1.6.2 *Beel* users capacity building.

Table 19. Distribution of respondents according to *beel* users capacity building N = 120

Category	Frequency	Percentage
a) High (11-13)	40	33.3
b) Medium (8-10)	49	40.8
c) Poor (0-7)	31	25.9

In regards to *beel* users capacity building, majority i.e. 49 (40.8%) *beel* user obtained medium capacity building scores followed by 40 (33.3%) high capacity building score, while the remaining 31 (25.99%) obtained poor capacity building scores.

4.2 DEPENDENT VARIABLE

4.2.1 Knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Table 20. Distribution of respondents according to knowledge score on sustainable development of *beel*.		**N = 120**
Category	**Frequency**	**Percentage**
a) High knowledge scores (more than 80)	16	13.3
b) Medium knowledge scores (56-80)	58	48.4
c) Low knowledge scores scores (30-55)	46	38.3

Table 20 revealed the distribution of respondents according to knowledge scores on sustainable development of *beel*. Here out of 120 *beel* users, majority i.e. 58 (48.4%) obtained medium knowledge scores followed by 46 (38.3%) *beel* users with low knowledge scores. However, only 16 (13.3%) had score high knowledge scores in regards to sustainable development of *beel* fisheries.

Part-II

Relation analysis

Relational analysis is one of the most important aspects in regards to know the relationships as existed between and among the different dependent and independent/predictor variables. Here different methods of test analysis were computed to see the effect of eighteen independent variables (X_1-X_{18}) on the dependent variables (Y). These are shown and explained in the following tables :

Table 1. Correlation of different independent variables with knowledge level of *beel* users on sustainable development of *beels* as dependent variable.

Sl. No. code	Predictor variables	'r' values
X_1.	Age	0.26**
X_2.	Education	0.50**
X_3.	Family size	0.00^{NS}
X_4.	Family type	$-.01^{NS}$
X_5.	Annual income	0.45**
X_6.	Occupation	0.25*
X_7.	Land holding	0.14^{NS}
X_8.	Social participation	0.54**
X_9.	Fishery infrastructure facilities	0.21*
X_{10}.	Involvement in integrated agriculture	0.40**
X_{11}.	Utilization of information sources	0.54**
X_{12}.	Participation in development program	0.64**
X_{13}.	Decision making ability	0.63**
X_{14}.	Availability of critical inputs	0.56**
X_{15}.	Marketing facilities	0.42**
X_{16}.	Women empowerment	0.63**
X_{17}.	Community-based fisheries organization	0.69**
X_{18}.	*Beel* user's capacity building	0.56*

Table 1 revealed that out of 18 predictor variables, only three variables namely family size, family type and land holdings were not found significantly associated (P>0.05) with knowledge level of *beel* users on sustainable development of *beel*. The remaining 15-predictor variables were found to be significantly associated either at 1% (p<0.01) or 5% (P<0.05) level of probability

NS = *Non significant*

* = *Significant at 0.05 level of probability (P<0.05)*

** = *Significant at 0.01 level of probability (P<0.01)*

Table 2. Best fitted regression co-efficients and 't' values of regression of *beel* user knowledge on sustainable development of *beel* on eight significantly contributed variables following stepwise method.

Sl. No.	Sl. No. Code	Predictor Variables	Beta co-efficient	't' value	step
1.	X_{17}	Community-based fisheries organization	4.976	5.297**	I
2.	X_{13}	Decision making ability	0.567	2.212*	II
3.	X_{14}	Availability of critical inputs	4.042	5.198**	III
4.	X_{16}	Women empowerment	3.923	3.793**	IV
5.	X_2	Education	1.451	3.391**	V
6.	X_9	Fishery infrastructure	2.286	2.447*	VI
7.	X_{12}	Participation in development program	0.460	2.074*	VII
8.	X_{10}	Involvement in integrated agriculture	1.847	2.026*	VIII
	Constant		**- 2.796**	**- 9.25**	

** Significant at 0.05 level of probability (P<0.05)*

*** Significant at 0.01 level of probability (P<0.01)*

Table 2 revealed that out of 15 predictor variables which were found to be significant either at 5% (P<0.05) or 1% (P<0.01) level of probability, only 8 independent variables namely community-based fisheries organization, decision making ability, availability of critical inputs, women empowerment, education, fishery infrastructure, participation in development program, involvement in integrated agriculture were found to be most significantly contributed predictor variables that explained the variability of *beel* users knowledge level on sustainable development of *beel*. Further more, out of 8 predictor variables as mentioned here, only 4 variables namely community based fisheries organization, availability of critical inputs, women empowerment, education were found to be most significantly contributed variables on the basis of their 't' values 5.297**, 5.198**, 3.793**, 3.391** respectively and each of them contributed at 1% (P<0.1) level of probability.

Table 3. Change R^2 due to step-wise multiple regression level of *beel* users of knowledge on sustainable development of *beel* on 8 predictor variables.

Step No	Variables	Variables name	R	R^2	Adjusted R^2	Standard error of the estimate
1.	X_{17}	Community based organized	0.692	0.479	0.475	11.27
2.	X_{13}	Decision making ability	0.787	0.620	0.673	9.67
3.	X_{14}	Availability of critical inputs	0.822	0.675	0.667	8.98
4.	X_{16}	Women empowerment	0.862	0.742	0.734	8.03
5.	X_2	Education	0.877	0.770	0.759	7.63
6.	X_9	Fishery infrastructure	0.888	0.789	0.778	7.33
7.	X_{12}	Participation in development program	0.893	0.797	0.784	7.23
8.	X_{10}	Involvement in integrated agriculture	.897	**0.804**	**0.790**	7.13

Table 3 indicates best fitted multiple regression in equation following stepwise methods where 'F' value to enter is 0.05 and to remove is 0.01. Adjusted R^2 (Table 3) indicated that the 8 independent variable included in the regression equation, now, can predict 79% of dependent variable on *beel* users knowledge score on sustainable development of *beel*. The required regression equation is given by : **(using table-2)**

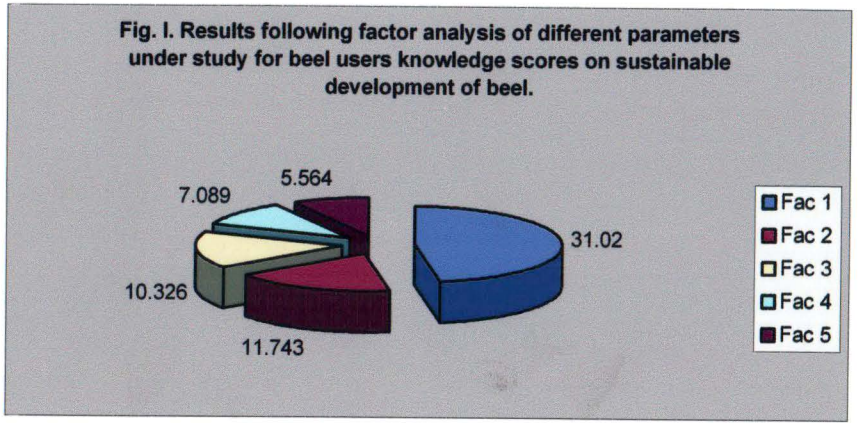
$$Y = \text{Constant} + 4.98 \times X_{17} + 0.57 \times X_{13} + 4.04 \times X_{14} + 3.92 \times X_{16} + 1.45 \times X_2 + 2.29 \times X_9 + 0.46 \times X_{12} + 1.85 \times X_{10}$$

Here, $R^2 = 0.80$, Adjusted $R^2 = 0.79$, Standard Error (estimated) = 7.13

Table 4 : Factor analysis : Results following factor analysis of different parameters under study for *beel* users knowledge scores on sustainable development of *beel.* (*Method :* Factor analysis extracted by orthogonal factors based on variamax procedure of principal component analysis on the basis of eigen values more than 1).

A. Variation explained

Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Eigen value	5.894	2.231	1.962	1.347	*1.057*	0.986	0.73	0.683	0.668	0.562	0.523	0.481	0.393	0.327	0.314	0.275	0.248	0.189	0.129
Total variance percentage	31.02	11.743	10.326	7.089	5.564	5.191	3.844	3.592	3.517	2.96	2.753	2.534	2.071	1.719	1.65	1.45	1.30	0.992	0.681
Cumulative percentage of variance	31.02	42.763	53.089	60.178	*65.743*	70.934	74.778	78.73	81.87	84.846	87.599	90.134	92.204	93.923	95.573	97.023	98.327	99.399	100



B. Rotated Component Matrix following factors extraction (Varimax) method					
Variables	**Components / factors**				
	1	**2**	**3**	**4**	**5**
X_1.	0.06	0.05	0.11	**0.81**	-0.09
X_2.	0.25	**0.66**	-0.23	0.09	-0.05
X_3.	0.00	-0.11	**0.85**	0.11	0.09
X_4.	0.04	0.06	**0.77**	-0.04	0.10
X_5.	0.15	**0.76**	0.10	0.00	0.05
X_6.	0.16	**0.59**	0.16	0.08	-0.54
X_7.	-0.19	**0.63**	0.39	-0.03	0.18
X_8.	0.13	**0.62**	0.04	0.52	0.23
X_9.	0.05	0.19	0.31	-0.21	**0.73**
X_{10}.	0.20	0.09	0.06	0.15	**0.73**
X_{11}.	**0.60**	0.19	-0.16	0.19	0.11
X_{12}.	**0.68**	0.28	-0.10	0.39	-0.14
X_{13}.	**0.59**	0.37	-0.12	0.22	0.02
X_{14}.	**0.82**	0.06	0.17	-0.08	0.16
X_{15}.	**0.80**	-0.03	0.20	0.23	-0.05
X_{16}.	0.32	0.53	-0.29	0.44	0.09
X_{17}.	**0.52**	0.26	-0.20	0.38	0.20
X_{18}.	0.24	**0.63**	0.32	0.19	0.18
Y	**0.71**				

From the each factor's loading as found here the variables of significance on the basis of limit between highest loading within factor and 10% reduction allowed to this highest loading, we can conclude that X_{15} and X_{14} from factor; X_5 from factor 2; X_3 and X_4 from factor 3; X_1 from factor 4 and both X_9 and X_{10} from factor 5 are sharing maximum variance of the study by their significant role in *beel* users knowledge level on sustainable development of *beel*. All such variables within factor do have severe impact on other variables members within the factor.

Table 4. Factor affecting on sustainable development of *beel*			
Sl. No.	**Variables**	**Factors name**	**Attributes**
1.	• Utilization of information sources (X_{11}) • Development programs participation (X_{12}) • Decision making ability (X_{13}) • Critical inputs supply (X_{14}) • Marketing facilities (X_{15}) • Community-based fisheries organization (X_{17}) • **Knowledge scores of *beel* users on sustainable development of *beel* (Y)**	**Sustainable development with peoples participation factor**	• Mainly responsible for achieving sustainable development of *beel*. • Contributes 31% out of 66% of total variance explained.
2.	• Education (X_2) • Income (X_5) • Occupation (X_6) • Land holding (X_7) • Women empowerment (X_{16}) • Social participation (X_8) • ***Beel* user's capacity building (X_{18})**	***Beel* user's human capital development factor**	• Mainly responsible for achieving sustainable development of *beel* on long-term basis. • Contributes 12% out of 66% of total variance explained.
3.	• Family size (X_3) • Family type (X_4)	**Family significance factor**	• Contribute towards physical development of *beel* • Contributes 10% out of 66% of total variance explained.
4.	• Age (X_1)	**Age of participants**	• Indicates how to accustom with sustainable development of *beel* • Contributes 7% out of 66% of total variance explained.
5.	• Infrastructure (X_9) • Involvement in integrated agriculture (X_{10})	**Integrated farming system development factor**	• Important catalyst for sustainable development of *beel* • Contributes 6% out of 66% of total variance explained.

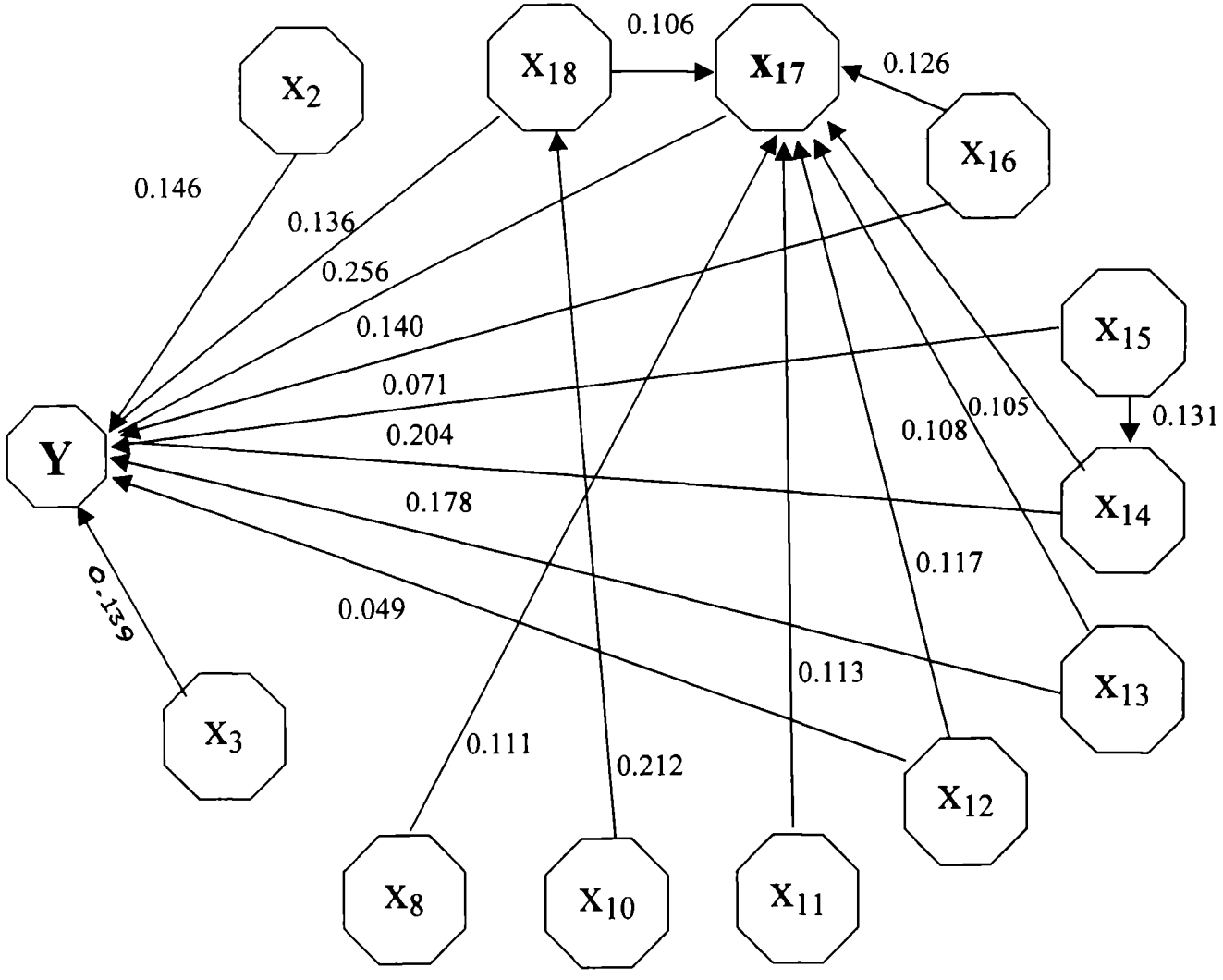
Table 6. Path analysis when $Y_{(19)}$ is effect variable and X_1-X_{18} (1-18) are casual variable

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
X_1	***0.048***	0.012	0.002	0.006	0.013	-0.005	0.000	-0.007	-0.002	0.009	0.008	0.016	0.026	0.016	0.001	0.033	0.060	0.021
X_2	0.005	***0.146***	-0.024	0.006	0.026	-0.009	-0.000	-0.010	0.002	0.013	0.018	0.021	0.075	0.018	0.007	0.068	0.070	0.072
X_3	0.001	-0.025	***0.139***	-0.046	-0.003	-0.003	-0.000	-0.001	0.013	0.009	-0.005	-0.004	-0.022	0.023	0.006	-0.022	-0.030	-0.036
X_4	-0.004	-0.012	0.082	**-0.079**	0.002	-0.004	-0.000	-0.002	0.010	0.019	-0.004	-0.003	0.001	0.012	0.011	-0.012	-0.029	-0.005
X_5	0.008	0.045	-0.005	-0.002	**0.076**	-0.010	-0.000	-0.009	0.010	0.022	0.011	0.014	0.034	0.031	0.011	0.058	0.086	0.056
X_6	0.010	0.058	-0.002	-0.002	0.034	**-0.023**	-0.000	-0.006	-0.009	-0.010	0.009	0.015	0.050	0.013	-0.006	0.034	0.041	0.024
X_7	0.005	0.021	0.025	-0.017	0.034	-0.005	**-0.000**	-0.008	0.014	0.014	0.001	0.000	0.013	-0.000	-0.006	0.009	0.018	0.028
X_8	0.017	0.067	0.008	-0.006	0.032	-0.006	-0.000	**-0.021**	0.008	0.037	0.017	0.021	0.077	0.020	0.001	0.018	**0.111**	0.071
X_9	-0.002	0.008	0.037	-0.017	0.016	0.004	-0.000	-0.004	**0.047**	0.056	0.005	-0.004	0.011	0.037	0.009	-0.007	0.002	0.010
X_{10}	0.003	0.014	0.010	-0.012	0.013	0.002	0.000	-0.006	0.020	***0.135***	0.011	0.007	0.023	0.053	0.007	0.032	0.064	***0.212***
X_{11}	0.007	0.048	-0.013	0.006	0.016	-0.004	0.000	-0.007	0.004	0.026	**0.055**	0.027	0.075	0.080	0.019	0.046	**0.113**	0.045
X_{12}	0.012	0.061	-0.011	0.005	0.022	-0.007	0.000	-0.009	-0.004	0.019	0.031	**0.049**	0.012	0.078	0.030	0.075	**0.117**	0.056
X_{13}	0.007	0.061	-0.017	-0.001	0.017	-0.007	0.000	-0.009	0.003	0.018	0.023	0.031	***0.178***	0.069	0.022	0.074	**0.108**	0.005
X_{14}	0.004	0.013	0.016	-0.005	0.011	-0.001	0.000	-0.002	0.009	0.035	0.022	0.019	0.061	***0.204***	0.046	0.014	**0.105**	0.015
X_{15}	0.001	0.014	0.011	-0.012	0.011	-0.002	0.000	-0.000	0.006	0.013	0.015	0.021	0.055	0.131	**0.071**	0.018	0.055	0.017
X_{16}	0.011	0.071	-0.021	0.007	0.032	-0.006	0.000	-0.012	-0.002	0.030	0.018	0.026	0.094	0.021	0.009	***0.140***	**0.126**	0.087
X_{17}	0.011	0.040	-0.016	0.009	0.026	-0.04	0.000	-0.009	0.000	0.033	0.024	0.023	0.075	0.084	0.015	0.069	***0.256***	0.056
X_{18}	0.017	0.078	-0.034	0.003	0.031	-0.004	-0.000	-0.011	0.003	0.021	0.018	0.020	0.072	0.023	0.009	0.090	**0.106**	***0.136***

Residual = 0.1729

Table 6 revealed that community-based fisheries organization (X_{17}) was the most prominent variable that affected the dependent variable, *beel users knowledge on sustainable development of beel fisheries* (Y) through its (i.e. X_{17}) direct effect, however social participation (X_8), utilization of information sources(X_{11}), participation in development programme (X_{12}), decision making ability (X_{13}), availability of critical inputs (X_{14}), women empowerment (X_{16}), *beel* users capacity building (X_{18}) also did effect on *beel users knowledge score on sustainable development of beel* (Y) via community based fisheries organization (X_{17}) as its indirect effect. X_2, X_3, X_{10}, X_{13}, X_{14}, X_{16} and X_{18} also have considerable direct effect on Y. Indirect effect of X_{10} via X_{18} is of higher magnitude for affecting Y.

Fig. J. Path diagram only considering prominent direct and indirect casual effect relationship (Partial representation)



4.4 ANALYSIS OF VARIANCE

Table 1. Analysis of variance of different age groups on *beel* users knowledge level on sustainable development of *beel.*

Source of variation	df	S.S.	M.S.S.	F. Value
Between age groups	2	1970.561	985.218	4.298*
Error	117	26823.806	229.263	
Total	**119**	**28794.367**		

** Significant at 5% level of significance (P<0.05)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with different age groups

	Young aged	Middle aged	Old aged
Mean ±	52.86 [b]	60.88 [ab]	68.25 [a]
S.D.	14.35	15.66	8.96

** Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 1 revealed that the different age groups significantly affected (P<0.05) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of young-aged, middle-aged and old-aged *beel* users were 52.86, 60.88 and 68.25 respectively. It indicated that young *beel* users were significantly lower level of knowledge scores as compared to old-aged *beel* users but the knowledge scores of young-aged group is found to be homogenous to middle aged group.

The perusal of the table 1 in totality concluded that old-aged *beel* users were having significantly higher level of knowledge scores as compared to middle and young aged *beel* users.

Table 2. Analysis of variance of different level of education of *beel* users knowledge level on sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between scores of education level	6	9813.638	1635.606	9.77**
Error	113	18980.729	167.971	
Total	119	28794.367		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with different levels of education

	Graduate & above	High school level	Middle level	Primary level	Can read and write	Can read only	Illeterate
Mean±	71.67 [a]	63.07 [ab]	54.89 [bc]	51.73 [c]	44.44 [c]	52.57 [bc]	51.25 [C]
S.D.	10.06	43.10	15.17	14.31	8.76	12.46	13.75

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 2 revealed that the different levels of education significantly affected (P<0.01) the knowledge level of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of different levels of education as shown in the Table2 indicated that illiterate *beel* users were having significantly lower knowledge scores as compared to other *beel* users.

The perusal of the table 2 in totality concluded that the *beel* users with graduate level of education have significantly higher level of knowledge scores as compared to other *beel* users except *beel* users with high school education. However, knowledge scores of *beel* users having high school and above level of education are found to be homogenous to each other.

Table 3. Analysis of variance of annual income groups on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between income groups	2	591.787	2895.894	14.730**
Error	117	23002.579	196.603	
Total	**119**	**28794.367**		

*** Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with different levels of income groups

	Low annual income	Middle annual income	High annual income
Mean ±	50.74 [c]	57.89 [b]	68.49 [a]
S.D.	14.54	14.67	12.45

** Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 3 revealed that the different levels of income significantly affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of low, medium and high annual income groups *beel* users were 50.74, 57.89 and 68.49 respectively. It indicated that *beel* users with low and middle annual income group had significantly less knowledge scores as compared to *beel* users with high annual income.

The perusal of the table 3 in totality concluded that the knowledge scores of *beel* users increased with the increase of their income level in a systematic way. So, as a whole it can be mentioned that *beel* users with high annual income have significantly higher level of knowledge scores as compared to other *beel* users. Again middle annual income groups of *beel* users have significantly higher knowledge scores than that of low annual income groups.

Table 4. Analysis of variance of scores of occupation on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between level occupations	4	3169.377	792.344	
Error	115	25624.989	222.826	3.556*
Total	**119**	**28794.367**		

** *Significant at 5% level of significance (P<0.05)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with different levels of occupations

	Service	Agriculture	Business	Labour	Fisheries
Mean ±	66.64 [a]	56.97 [bc]	60.15 [ab]	49.94 [c]	55.62 [bc]
S.D.	14.66	14.24	15.46	15.91	14.38

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 4 revealed that the different levels of occupation significantly affected (P<0.05) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of different *beel* users according to their level of occupation as shown in the table 4 indicated that *beel* users engaged with different labour activities have significantly less knowledge scores as compared to service holder *beel* users.

The perusal of the table 4 in totality concluded that the *beel* users involved as labourer possess significantly low level of knowledge scores than that of service holder and business bound *beel* users. But their knowledge scores were found to be homogeneous to them who are involved in agriculture and fisheries.

Table 5. Analysis of variance of scores of different level of social participation of *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between social participation scores	3	9222.991	3074.330	18.222**
Error	116	19571.376	168.719	
Total	119	28794.367		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with different levels of social participation

	Office bearer	Member of more than one organization	Member of only one organization	No membership of any organization
Mean ±	79.50 [a]	63.52 [b]	49.95 [c]	48.00 [c]
S.D.	7.75	11.88	14.82	14.79

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 5 revealed that the different levels of social participation significantly affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of different *beel* users according to their level of social participation as shown in the table 5 indicated that *beel* users with no membership of any organization had significantly less knowledge scores as compared to *beel* users who were either office bearer or members of more than one organizations.

The perusal of the table 5 in totality concluded that as the level of social participation increased, the average knowledge scores also increase in a systematic progression. So knowledge scores of *beel* users with more than one organization had significantly higher knowledge scores as compared to the *beel* users who have membership of either one organization or no membership of any organization. However, the knowledge scores of both the later groups are found to have homogenous.

Table 6. Analysis of variance in scores of fisheries infrastructure facilities of *beel* users knowledge level on sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between fisheries infrastructure scores	3	1328.693	442.898	1.871*
Error	116	27465.674	236.773	
Total	119	28794.367		

** Significant at 1% level of significance (P<0.05)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with different levels of fisheries infrastructure

	High infrastructure	Medium infrastructure	Poor infrastructure	Without infrastructure
Mean ±	67.29 [a]	61.52 [ab]	56.65 [ab]	55.00 [b]
S.D. ±	8.71	12.93	16.58	18.46

** Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 6 revealed that the different levels of fisheries infrastructure significantly affected (P<0.05) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of different *beel* users according to their level of fisheries infrastructure as shown in the table-6 indicated that *beel* users with higher fisheries infrastructure had significantly higher knowledge scores as compared to *beel* users without having any fisheries infrastructure.

The perusal of the table 6 in totality concluded that the knowledge level of *beel* users increased with the increase of fisheries infrastructure facilities in systematic progression. However the knowledge scores among the *beel* users with medium and higher fisheries infrastructure are also homogonous to knowledge score obtained by the *beel* users having poor fisheries infrastructure.

Table 7. Analysis of variance in scores of *beel* users involvement in integrated agriculture and their knowledge level on sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between age group	3	5257.244	1752.415	8.637**
Error	116	23537.122	202.906	
Total	119	28794.367		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with different levels of involvement in integrated agriculture

	High involvement	Medium involvement	Poor involvement	Without involvement
Mean ±	65.15 [a]	63.39 [a]	51.19 [b]	47.70 [b]
S.D.	12.60	15.23	13.49	14.38

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 7 revealed that the different levels of involvement in integrated agriculture significantly affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of different *beel* users according to their level of involvement in integrated agriculture as shown in the table 7 indicated that *beel* users having poor and without any involvement in integrated agriculture had significantly less knowledge scores as compared to *beel* users with medium and high involvement in integrated agriculture.

The perusal of the table 7 in totality concluded that the knowledge scores of *beel* users with involvement in integrated agriculture are homogeneous to each other but have significantly higher level of knowledge scores as compared to *beel* users with low and without involvement in integrated agriculture but their knowledge level scores found to be homogeneous to each other.

Table 8. Analysis of variance in scores of different level of utilization of information sources on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between age group	13	10616.044	783.522	4.810**
Error	105	17825.065	169.763	
Total	108	27441.109		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of utilization of information sources.

	High	Medium	Poor
Mean ±	71.66 [a]	58.12 [b]	47.64 [c]
S.D.	8.83	13.84	13.65

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 8 revealed that the different levels of utilization of information sources affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of *beel* users with poor, medium and high utilization of information sources were 47.64, 58.12 and 71.66 respectively. It indicated that *beel* users with poor utilization of information sources had significantly less knowledge scores as compared to *beel* users with high utilization of information sources of *beel* users.

The perusal of the table 8 in totality concluded that the knowledge scores of *beel* users increased with the increase of their level of utilization of information sources. So, as a whole it can be mentioned that *beel* users with high utilization of information sources have significantly higher level of knowledge scores as compared to other *beel* users.

Table 9. Analysis of variance in scores of different level of participation in development programme on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between age group	15	13239.998	882.667	5.902**
Error	104	15554.369	149.561	
Total	119	28794.367		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of participation in development program.

	High participation	Medium participation	Low participation
Mean ±	70.64 [a]	66.87 [ab]	51.01 [b]
S.D.	7.57	11.94	12.65

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table-9 revealed that the different levels of participation in development program significantly affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel*.

Mean knowledge scores of different *beel* users according to their level of participation in development program as shown in the table 9 indicated that *beel* users with lower participation in development program had significantly less knowledge scores as compared to *beel* users with high participation in development program.

The perusal of the table 9 in totality concluded that the knowledge level of *beel* users increased with the increase of participation in development program in a systematic progression. So, the knowledge scores of *beel* users with high participation in development program have significantly higher knowledge scores as compared to *beel* users with lower participation in development program.

Table 10. Analysis of variance in scores of different level of decision-making ability on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between decision making scores	13	12251.089	942.391	6.038**
Error	106	16543.277	156.069	
Total	**119**	**28794.367**		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of decision-making ability.

	High decision	Medium decision	Low decision
Mean ±	74.27 [a]	57.44 [ab]	47.39 [b]
S.D.	11.82	12.12	12.19

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 10 revealed that the different levels of decision-making ability affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of *beel* users with poor, medium and high decision making ability were 74.27, 57.44 and 47.39 respectively. It indicated that *beel* users with low decision-making ability had significantly less knowledge scores as compared to *beel* users with high decision-making ability.

The perusal of the table10 in totality concluded that the knowledge scores of *beel* users increased with the increase of their income level in a systematic way. So, as a whole it can be mentioned that *beel* users with high decision making ability have significantly higher level of knowledge scores as compared to other *beel* users with low decision making ability.

Table 11. Analysis of variance in scores of different level of availably of critical inputs on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between age group	5	9447.215	1889.443	11.133**
Error	114	19347.152	169.712	
Total	**119**	**28794.367**		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of critical inputs.

	High	Medium	Low
Mean ±	72.22 [a]	63.77 [b]	49.68 [c]
S.D.	10	13.72	12.55

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table11 revealed that the different levels of critical inputs affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel*. Here initially DMRT was not possible as atleast one of the six observations had only one observation. But later, it was not included in any group and hence DMRT was done on the basis of 5 groups of observations.

Mean knowledge scores of poor, medium and high critical inputs *beel* users were 49.68, 63.73 and 72.22 respectively. It indicated that *beel* users with poor critical inputs had significantly less knowledge scores as compared to *beel* users with high critical inputs scores.

The perusal of the table 11 in totality concluded that the knowledge scores of *beel* users increased with the increase of their critical inputs in a systematic way. So, as a whole it can be mentioned that *beel* users with high critical inputs scores have significantly higher level of knowledge scores as compared to other *beel* users.

Table 12. Analysis of variance in scores of different level of marketing facilities on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between of marketing facilities scores	5	6486.290	1297.258	6.629**
Error	114	22308.077	195.685	
Total	119	28794.367		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of marketing facilities process.

	High	Medium	Low
Mean ±	78.29 [a]	62.18 [ab]	53.26 [b]
S.D.	8.2	14.11	14.38

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table12 revealed that the different levels of marketing facilities affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries. Here initially DMRT was not possible as at least one of the six observations had only one observation. But later, it was not included in any groups and hence DMRT was done on the basis of 5 groups of observations.

Mean knowledge scores of low, medium and high marketing facilities *beel* users were 53.26, 62.18 and 78.29 respectively. It indicated that *beel* users with poor marketing facilities had significantly less knowledge scores as compared to *beel* users with high marketing facilities.

The perusal of the table12 in totality concluded that the knowledge scores of *beel* users increased with the increase of their marketing facilities in a systematic way. So, as a whole it can be mentioned that *beel* users with high marketing facilities have significantly higher level of knowledge scores as compared to other *beel* users with low and medium marketing facilities scores.

Table 13. Analysis of variance in scores of different women empowerment of *beel* users & their knowledge level on sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between level of women empowerment scores	3	12414.889	4138.296	29.308**
Error	116	16379.478	141.202	
Total	**119**	**28794.367**		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of women empowerment.

	High	Medium	Low	Very low
Mean ±	75.67 [a]	61.60 [b]	49.21 [c]	47.91 [c]
S.D.	9.27	12.69	12.20	12.42

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table 13 revealed that the different levels of women empowerment significantly affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of different *beel* users according to their level of women empowerment as shown in the table13 indicated that *beel* users with lower women empowerment had significantly less knowledge scores as compared to *beel* users with high women empowerment.

The perusal of the table 13 in totality concluded that the knowledge scores of *beel* users increased with the increase of level of women empowerment in systematic progression. So, the knowledge scores of *beel* users with high women empowerment attitude have significantly higher knowledge scores as compared to *beel* users with very low, low and medium level of women empowerment attitude. However the knowledge scores of *beel* users with very low and low level of women empowerment attitude are found to be homogenous to each other.

Table 14. Analysis of variance in scores of different level of Community-based fisheries organization of *beel* users and their knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between the level of community-based fisheries organization	4	14334.971	3583.743	28.503**
Error	115	14459.396	125.734	
Total	**119**	**28794.367**		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of community-based fisheries organization.

	Very high	High	Medium	Low	Very low
Mean ±	73.17 [a]	71.00 [ab]	58.23 [bc]	46.75 [cd]	39.00 [d]
S.D.	14.14	9.84	12.40	11.24	5.82

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table14 revealed that the different levels of community based fisheries organization significantly affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of different *beel* users according to their level of community-based fisheries organization as shown in the table14 indicated that *beel* users with lower community-based fisheries organization had significantly less knowledge scores as compared to *beel* users with high community-based fisheries organization.

The perusal of the table14 in totality concluded that *beel* users with very high and high knowledge scores are significantly differ from *beel* users with very low and low level of community based fisheries organization in regards to their knowledge scores. But the *beel* users knowledge scores of very low and low level are homogenous to each other.

Table 15. Analysis of variance in scores of different level of capacity building on *beel* users knowledge level for sustainable development of *beel*.

Source of variation	df	S.S.	M.S.S.	F. Value
Between the *beel* users capacity building scores	9	12360.903	1373.434	9.193**
Error	110	16433.464	149.395	
Total	**119**	**28794.367**		

** *Significant at 1% level of significance (P<0.01)*

Mean knowledge scores of *beel* users on sustainable development of *beel* fisheries with their different levels of capacity building.

	High	Medium	Low
Mean ±	70.62 [a]	56.59 [ab]	48.78 [b]
S.D.	13.57	10.81	12.37

* *Similar alphabets denote homogenous means following Duncan's test at 5% level of significance.*

The analysis of variance table15 revealed that the different levels of capacity building affected (P<0.01) the knowledge scores of *beel* users on sustainable development of *beel* fisheries.

Mean knowledge scores of *beel* users with low; medium and high capacity building were 48.78, 56.59 and 70.62 respectively. It indicated that *beel* users with low capacity building had significantly less knowledge scores as compared to other *beel* users with high capacity building.

The perusal of the table15 in totality concluded that the knowledge scores of *beel* users increased with the increase of their capacity building in a systematic way. So, as a whole it can be mentioned that *beel* users with high capacity building have significantly higher level of knowledge scores as compared to other *beel* users having medium and low level of capacity building. However knowledge scores of *beel* users having medium level of capacity building have homogenous knowledge scores with *beel* users having both high and low level of capacity building scores.

CHAPTER – V

DISCUSSION

5. DISCUSSION

The flood plain wet lands which are locally called as *beel* (in most of the states) constitute an important fishery resource throughout the country. It contributes significantly to the total fish production of those states. It also provide livlihood to thousands of poor in general.

Assam *beels* are the most potential and lucrative water resource of the state. Even though, its production potentiality has not been exploited properly. Considering the sustainable development of the *beel*, the study was conducted at *Dek Beel* under Kamalpur Development Block of Kamrup district, Assam and hence its research findings are now discussed below.

5.1 Background information of *beel* users

The findings of the study revealed that majority of the *beel* users were middle-aged. They had high school and above level of education, had nuclear type of family and medium family size. They were mainly having agriculture as their occupation with middle level of annual income (Rs. 26,000.00 – Rs. 50,000.00) and 15-30 kathas of land areas. They had also medium type of social participation with poor fisheries infrastructure. The majority of them had medium utilization of information sources with radio as their most credible source of information.

5.2 Predictor variables and their effect on dependent variables

The result of the study indicated that age of the *beel* users was found to be positively and significantly associated with their knowledge scores on sustainable development of *beel* fisheries, which is inconsonance with research findings of Khare and Punekar (2001). It seems that their knowledge increases with the increase of age. This may be due to more experience gained by the *beel* users with the passage of time, situations, etc.

Education level generally affect the process of thinking in human being. This was true because educational level of *beel* users affect their thinking process and ultimately facilitates enhanced learning. It further leads to their increased knowledge on sustainable development of *beel* fisheries. Thus, it was established that without proper education to the *beel* users and their children, sustainable development of *beel* fisheries is just impossible. Because education was positively and significantly

associated with the knowledge of *beel* users on sustainable development of *beel* fisheries. Similar findings have also been reported by Fatunla (1996). Further, it was established that *beel* users with high school and above level of education have significantly higher knowledge score as compared to *beel* users who could only read and write or have even primary level of education. This was also evidenced by Makkar and Sohal (1994), Dana (1987). This is probably due to the fact that higher is the level of education, higher is the learning and positive attitude for gaining knowledge on sustainable development of *beel* fisheries.

The study revealed that majority i.e. 84 (70%) *beel* users were from higher caste followed by 22 (18.33%) scheduled caste and remaining 14(11.67%) were from other backward caste. These findings are not similar with the findings of Bhaumik and Saha (1994), Khare and Punekar (2001), Dana *et al.* (2004). This may be due to the fact that higher caste people dominated the whole locality of the study. More over, with the abrupt change of employment and economic scenario in the state, today, fisheries and aquaculture has gained much importance as an alternative measure of livelihood for the farming community. Because it can easily provide employment opportunity to all segments of people-young and old, educated and uneducated, male and female, job seekers and job less or even to school drop outs and so on. Besides, most of the respondents were educated but unemployed. Considering the profit and return from fisheries and aquaculture, perhaps they confined their mind to take it as their new vocation for livelihood.

Family size and family type found to have no association with the knowledge scores of *beel* users on sustainable development of *beel* fisheries. Similar findings have also been reported by Dana (1987), Goswami (2003). This indicates that family size and family type do not affect the knowledge scores on sustainable development of *beel* fisheries.

Land holding was also found to have no association with the knowledge scores of *beel* users on sustainable development of *beel* fisheries. Similar findings have reported by Singh and Kunzru (1985), Goswami (2003). This may be due to the fact that *beel* user may have a convenient size of land area but may be completely lack of

educational back ground, experience in fisheries and aquaculture practices or even void of social participation.

The result indicated that annual income was positively and significantly associated with *beel* users knowledge scores on sustainable development of *beel* fisheries. This attributes to the fact that knowledge level increases with the increase of annual income in a systematic progression. Similar findings have also been reported by Khare and Punekar (2001) and Dana (1987). This may be due to their good vision and out look toward conservation and effective utilization of common property resources like *beel.*

The result also revealed that social participation was significantly associated with the knowledge scores of *beel* users. The reason behind it may be advocated that due to high level social participation, the *beel* users are in a position to acquire knowledge especially on values and importance of *beel* as well as its effective conservation and management, which is in agreement with the research findings of Khare and Punekar (2001), Dana (1997). On the contrary, those *beel* users who were not the members of any organization i.e who has without any social participation evidenced their lower knowledge scores on sustainable development of *beel* as compared to those who had high social participation. Again it may be due to higher the social participation, greater is the chances of social interaction with different section of people. This may due to their low exposure to mass media, illiteracy, lack of extension contact, which is also inconsonance with the research findings of Pattanaik (1996).

Beel users involvement in integrated agriculture showed positive and significant association with their knowledge scores on sustainable development of *beel* fisheries. It may be due to the fact that with the active involvement in integrated aquaculture and fisheries practices, a *beel* user can earn sufficient knowledge and experiences on effective management of their potential aquatic resources for enhancing their productivity in a sustained manner. So, it may be argued that probably *beel* users with high and medium involvement in integrated agriculture had significantly higher knowledge scores as compared to the other *beel* users with low or without involvement in integrated agri-aquaculture approach.

The result also indicated that *beel* users participation in development program initiated by any development agencies was positively and significantly associated with the knowledge scores of *beel* users on sustainable development of *beel* fisheries. Similar findings have also been reported by Ramakrishnan (1994), Hussain (1996), Griffin (1988), FAO (1979), Sultan *et al.* (2002), Agarwal (2003), Modayil (2004), Mukundan (2004). The result is, of course, imperative here due to the fact that knowledge scores of *beel* users on sustainable development of *beel* fisheries are found to be increased with the increase of their participation in each stage of *beel* development program. It is obvious that aquaculture is unlikely to sustain itself on long term basis on economic viability alone as perceived by Kutty (1997) unless and until people participate willingly in the development since its early stages of development program, rather than at the end (Griffin, 1988). Thus, it can be strongly argued that sustainability on long-term basis is possible only when there is a strong participation of *beel* users in the development program. It is also a fact that when *beel* user's participation in the development program is being ascertained, their skills are also developed, interest to the development activities will be grown and ultimately will lead towards its sustainability. Similar findings have also been reported by Cohen and Up Hoff (1977), FAO (1988), Bhoumik (2002), Prasad (2003).

The result of the study revealed that utilization of information source is significantly associated with the *beel* user's knowledge scores on sustainable development of *beel* fisheries. This is probably due to the fact that *beel* user's knowledge increases with the increase of utilization of different information sources. It is however obvious that *beel* users with high utilization of information sources can learn more about the usefulness of sustainable development of *beel* fisheries as compared to *beel* users with poor and medium level of utilization of information sources. Similar findings have also been reported by Dana (1997), Goswami (2003). Further the study indicated that radio was regarded as most credible source of information and majority of them utilized it as their source of information.

Decision making of *beel* user showed that there is a significant association between the knowledge on sustainable development of *beel* fisheries and the decision-making ability. As *beel* users are the potential actors of such development approach, it

is arguable that knowledge is increased with the increase of decision-making ability. Mazumdar (1998), Sultan *et al.* (2002) also revealed similar findings.

Availability and supply of critical inputs is one of the most prominent components of sustainable development of *beel* fisheries. Inputs like quality fish seeds, lime, organic and inorganic fertilizers, prophylactic and therapeutic drugs, fishing and harvesting equipments, agricultural and other animal husbandry inputs required for multi approach aquaculture practices are the pre-requisites of sustainable fisheries. Availability of such critical inputs in time and their effective transportation is highly essential when sustainable fisheries and aquaculture is concerned. This is probably due to the fact that availability of critical inputs and *beel* users knowledge scores on sustainable development of *beel* fisheries are significantly associated. Similar finding have also been reported by Dana (1997). The study also further revealed that transportation facility is also highly essential in regards to sustainable development of *beel* fisheries. This is may be due to the fact that for marketing the farm produces and to accelerate the income avenues, market facility must be well equipped to sale their produces at congenial price and in appropriate time. Thus, healthy marketing facility can enhance the production potentials of the farm. So, without such facilities, there may appear a set back to *beel* fisheries sustainability which is also inconsonance with research findings of Sen *et al.* (1997).

In today's scenario for evaluating sustainable development, empowerment of target community is imperative just to take their own decision, to know regarding the pattern of equitable distribution of benefit in order to achieve a quality of life. Empowerment helps one to improve his or her living standard. Empowering the women to take decision on different fisheries activities are the most important inputs for sustainable development of *beel* fisheries. Women, the most vulnerable and weaker section of the society must be empowered first through different fisheries activities with a complete gender neutralizing approach because it is probably the shortest path of upliftment of socio-economic condition of the *beel* users. Because, empowerment includes resource, skill, training for development, leadership development, conflict resolution and enhanced social environment. Similar findings have also been reported by Srinath and Tungamani (1993), Ramakrishnan (1993), Lalitha (1996), Subburaj and Karunakaran (2003).

The study also further revealed that community-based organization has a positive and significant association with *beel* user's knowledge scores on sustainable development of *beel*. This is due to the fact that strong mobilization and organization approach is probably one of the leading approaches of enhancing and asserting community's involvement that ultimately lead surest participation and then empowerment. Through this potential approach, interaction among all the stakes holders, reduction of management costs, minimization of fishing conflict, legitimization of ownership provision, development of local leadership, are quite possible. Similar findings have also been reported by Chong & Kurien (1997) Madhu (1997), Sen (1997), Kuperan *et al.* (1999), Baruah *et al.* (2000), Bhaumik (2001), Sultan *et al.* (2002), Das (2003).

For sustainable development of *beel* fisheries, capacity building is regarded as an essential pre-requisite as it is related to creation of awareness, formulation of need-based training programme to change the behaviour and attitudes of the *beel* users, participation in development program and enhancement of self confidence. Probably, due to these facts capacity building is being significantly and positively associated with the *beel* users knowledge scores on sustainable development of *beel* fisheries. Similar findings have also been reported by Crowder (1996).

From this study it is worthwhile to mention that **community-based fisheries organization, availability of critical inputs, women empowerment** and **education** were regarded as most significantly contributing predictor variables to *beel* users knowledge scores on sustainable development of *beel* fisheries. It signifies that organized approach in regards to education, women empowerment, availability of critical inputs achieve its best only when communities are organized, mobilized systematically. So, *beel* fisheries management through **community-based fisheries organization** approach may widen up a new vista for sustainable development of *beel* fisheries in the state.

To see the feasibility and viability of CBFM approach, a case study was conducted in *Dek Beel* at Kamalpur Development Block in the district of Kamrup, Assam. The details of the case study and its results has been discussed in details from next pages –

A case study on pen culture in *Dek Beel* through the community- based fisheries management approach

5.3 INTRODUCTION

A case study of the existing situation is the first step in extension programme planning (Leagans, 1961 and Dahama and Bhatnagar, 1985). It is only from such a study that the needs, problems and interests of the members of a community can be ascertained or extracted. Keeping these facts in mind, a case study on pen culture through the CBFM approach was conducted in *Dek Beel*,Kamrup.

The enclosure culture systems like cages and pens are gaining much importance in open water fisheries throughout the world for production enhancement Bandyopadhyay (2003).

The earliest report available on cage culture in India is that of Dehadrai *et al.* (1975) in the swamps of Assam for rearing the air-breathing fishes. Natarajan *et al.* (1979) reared Indian major carps in floating cages in riverine and pond environments. Later on, Kumaraih *et al.* (1986), Sivakami *et al.* (1991) and Bandyopadhyay *et al.* (1991) carried out studies on cage culture using exotic species in India. Though some research findings are available on cage culture in India, the information on penculture in fisheries from India is scanty. Carp seed rising in pens at Bhavanisagar and Tungabhadra reservoirs in South India during 1978 was probably the first attempt on pen culture (Bandyopadhyaya, 2003). Fish culture in pen and cage enclosures in *beels* can be developed as an independent enterprise parallel to the enhancement of their capture fisheries (Bhattachrajya, 2003a). For construction of pens, marginal area of *beels* is encircled with split- bamboo screens (*bana*) lined with small meshed nets. The Central Inland Fisheries Research Institute (CIFRI) successfully carried out pen culture experiments in *beels* for rearing of carp fingerlings in Assam (Bhattacharjya, 2003b). These pens can also be used to raise table fish (Bhattacharjya *et al.*, op.cit.). Thus, the technology refined under the National Agricultural Technological Project (Jai-Vigyan) sub-project on *"Enhancing freshwater fish production from beels*

through pen culture" (Bhattachrjya, 2003b) was adopted with some modifications in the *Dek Beel* under Kamalpur Development Block of Kamrup District, Assam through involvement of local community. The salient points of the technology adopted by the community are given below.

5.3.1 Pen Culture Project in *Dek Beel* : An example of organized approach

Dek Beel is an ox-bow shaped closed *beel* created by river Puthimari(a north bank tributary of River Brahmaputra) of Kamrup district, Assam. Its maximum water spread area is 7.0 ha during the monsoon season (June-September) and 5.0 ha during the pre monsoon season (March-May). It is located 50km northeast from Guwahati city at $26^0 10.096'$ N latitude and $91^0 39.945'$E longitudes. The depth of the *beel* ranges from 0.5-2.0 m during pre monsoon and 2.5-4.0 m during peak monsoon months (July-August). Nearly 650 persons belonging to 150 families inhabit Deekpar village surrounding the *beel.* According to village elder the *beel* originated during the devastating earthquake that shook the Northern India in 1887. Nearly 70% of the population of the village belonged to the high caste Brahmin. Initially they had little knowledge and interests about commercial fisheries and aquaculture. Most of the village community was educated. However acute unemployment problem in recent years has compelled the young generation to think of taking up aquaculture and live stock rearing for income and employment generation. It was then that some of them thought of renovating the *beel* for undertaking scientific fish production in it. However the *beel* was completely choked with aquatic macrophytes with secondary mat formation. The floating macrophyte mass covering the *beel* surface was so thick that even cattle could walk over these for grazing and nobody dared it to clear for fish culture practices. At this juncture, the researcher came to know that some section of the community realized that there is a need of development of this *beel.* The researcher utilize the opportunity to motivate the local community for effective utilization of this untapped fishery resource through a community led and community driven approach involving the village leaders, school teachers, elders and youth supported by scientific personnel of the Northeastern. Regional Centre, (NERC) of CIFRI, Guwahati .The researcher explained his back ground, purpose of his work and

Figure 5. Completely aquatic macrophytes chocked Dek *Beel*

Figure 6. Researcher explaining his back ground, purpose of his work to the community members.

Figure 7. *Beel* users participation in discussion with CIFRIS Scientists.

tried to convince the *beel* users that he is really keen to help them (Ross and Lappin, 1967; Gangrade, 1971; Verhagen, 1982).

The researcher perceived the potentiality of this local natural resource quietly. He involved himself in mobilizing and organizing the local people for self-reliant action for the purpose of achieving a sustainable development of the resource. Initially, the researcher tried to understand the existing social situation, needs and interests of the community and persued the matter with the representatives from diverse groups with quite different interests and beliefs, seeking to find means of working together on a problem of natural concern (Ross and Lappin, 1967). The maximum emphasis was given on confidence and capacity building for effective empowerment of the *beel* users through local level planning, management, implementation, monitoring, and so on. Being a professional change agent, the researcher applied the theory of participatory extension and training, group discussion, staying at the village, spent days with the villagers, ate with them and shared his room with the villagers (Singh 1952 and Veeranna, 1997) as a measure of building their confidence and capacity.

These types of approaches were assigned to empower the local *beel* users to call forth their leadership and commitment to act as a catalyst in their communities for mobilizing the people for self-reliant action (Majumdar, 1998). The researcher was confident enough that the community-based fisheries management (CBFM) approach may act as a viable alternative for enhancing community-based human capital development through stake holder's whole-hearted participation in each stage of development of this resource. The community was so motivated that each household contributed their own funds, materials (eg. *bamboo*) and labour who cleared the floating macrophytes mass from the entire *beel*. In the meanwhile, the NERC, CIFRI (ICAR), Guwahati came forward to implement a pen culture demonstration project in the *beel*. This further accelerated the pace of development of the resource in the latter part of the work execution. With due support from CIFRI, the researcher tried to adopt the CBFM approach in the pen culture project so as to examine the feasibility of this approach mainly in respect of strengthening management efficiencies, reduction of management costs, minimization of fishing conflicts, minimum intervention of

Figure 8 . Community members are renovating the Dek *Beel*.

Figure 9. A newly renovated Dek *Beel*.

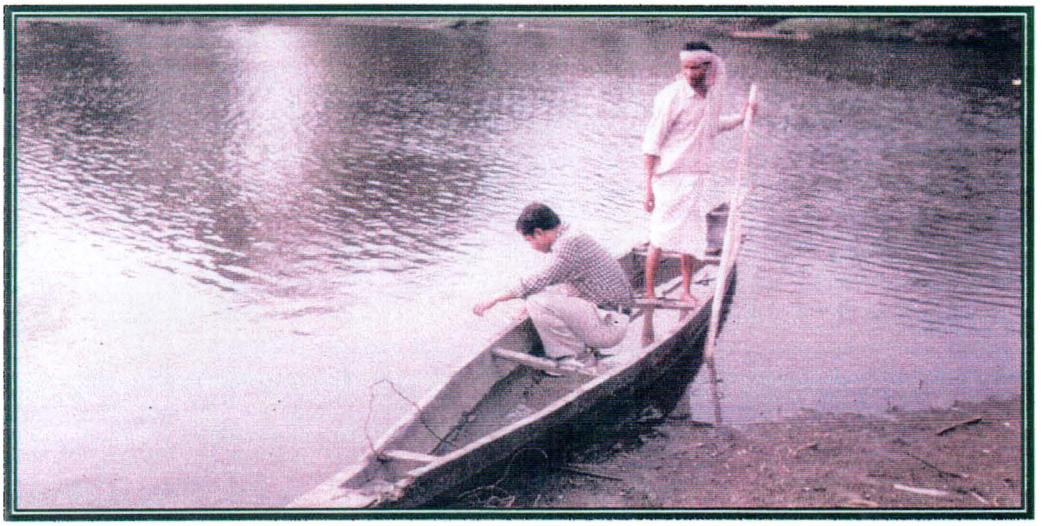


Figure 10. Soil and water sample collection for scientific analysis.

contractor system, etc. for sustainable development of the *beel* fisheries. It was encouraging that the *beel* users fully involved themselves in construction of the pens and in the pre- and post- stocking management practices. They were observed to be in upbeat mood through out the activities probably due to CBFM principle, which can be attributed to their enhanced self-reliance, and self-empowerment through this approach.

5.3.1.1 Site selection

As a first step, three suitable sites were selected inside the *beel* for construction of the pens through participatory discussion with the local people. The pen sites were selected on the basis of following technical points as suggested by Sugunan *et al.* (2003), Bhattachrjya *et al.* (2003c).

- A firm bottom with gentle slopping.
- A mild water flow is preferable.
- A water depth of 1.5-2.5m, which should not be less than 1 m even during dry season.
- Free from high wind action.
- Free from shading or tree lined areas.
- Availability of sufficient sunlight.
- Good communication and transportation facilities.
- Easy availability of construction materials.

In addition, the local community was of the opinion that the proposed pen sites should be nearer to the community's residential area to avoid poaching.

5.3.1.2 Pen construction

5.3.1.2.1 Pen size and shape

Previous experiments in pen culture in *beel*s of Assam showed that pens measuring 500 m^2 were both economical and manageable (Bhattacharjya *et al.*, 2003b) however, in the present case, slight variations were made in the pen size to suit local situations. Thus, while the first two pens measured 450 m^2 each, the remaining 4 pens measured 600 m^2 .To reduce the cost of construction, the pens were constructed

Figure 11. *Beel* users are preparing split-bamboo strips (*Kami*)

Figure 12. *Beel* users are preparing split-bamboo screen (*Bana*)

Figure 13. *Beel* users are stitching the split-bamboo screen with polyethylene mosquito net.

as batteries of two adjacent pens each. Out of the six pens constructed, five rectangular shaped, while one was made pentagonal to suit bottom topography.

5.3.1.2.2 Pen materials

The following materials were used during preparation of pen.

- Local bamboo (*Jati*) to build pen frame.
- Bamboo poles to support the pen.
- Split bamboo screen (*bana*) to cover the pen wall.
- Polyethylene mosquito netting (*mosari jal*) to stop movement of fish across the wall which checks the entry of unwanted fish and escape of culture fish.
- Coir rope and synthetic twines for fastening materials.

5.3.1.2.3 How the pen were prepared ?

Pens were prepared with active involvement of the local community i.e. local *beel* users following the procedures suggested by Bhattacharjya (2003b), Bhattacharjye *et al.* (2003c), with slight modifications. The procedures followed for pen construction step by step has been shown in the figures. Initially, the Secretary and selected functionaries of the *Dek Beel* Milanjyoti Meen Mahal were trained by CIFRI scientists on various aspects of the technology. They were requested to train the other *beel* users of the community with stress on use of locally available materials for pen preparation and erection to enhance their empowerment through this practice. The salient steps actually practiced by the committee are out lined below –

- Initially matured jati bamboos were split into small strips of 8-10 mm thickness (*kathi*) for preparing screen (*bana*). For this purpose bamboos having 4-6 inch diameter, 25-35 feet length and 2^{+}year age of were used.
- The screen (*bana*) for encircling the pen was made by weaving split-bamboo strips using coir ropes The gap between two adjacent weaving was 1.5 ft
- To prevent movement of fishes to and from the pens, cheap polyethylene mosquito netting was stitched into the inner wall of the split bamboo screen (bana) by the *beel* users.
- Marking the place of pen installation was done by driving a few bamboo poles into the bottom at the corners in the area selected. These poles were joined with

Figure 14. Split-bamboo screens with net are now ready for installation.

Figure 15. Researcher with the *beel* users during marking the pen for installation.

Figure 16. Researcher with the *beel* users during pen installation

the coir ropes. The bottom along the rope was checked with a long pole to know how far the additional poles/posts are required to be driven into the bottom keep the pen standing firmly.

- Bamboos were then cut into poles considering the highest possible depth of water along the demarcated area, portion of pole that should be driven into bottom soil keeping at least and 50cm above the water. Thus the poles having 8-10 feet height (240-300 cm) length poles were cut and driven into soil bed around the rope line depending upon the depth of water. However, the main frame of the pen was then made by tying half or quarter split bamboos strips (*kami*) on the poles with the help of coir ropes.
- Next, the bamboo screens were driven into *beel* bottom along the inner side of the main frame from one end. The screens were tied on to the main frame with the help of quarter split bamboo (*kami*) and coir ropes.
- To support the weight of the pen, bamboo poles were spaced after every 1.5 m. In addition two poles were driven at an angle 45^0- one from inside and the other from out side the pen after every 4.5 m. These additional support poles were given considering the wind action, and the height of the screens (>2m).
- To prevent entry of ducks turtles, etc. into the pen through the side facing the *beel* bank (where *banas* were not erected to reduce the capital cost) was covered by indigenous low cost bamboo fencing.

5.3.1.2.4 Construction and installation costs

The *beel* users themselves planed and executed the construction and installation of the pens under technical guidance from CIFRI as per the procedure mentioned above. The researcher himself showed them as to how to construct and erect the pens. The broad specifications of the pen material suggested by NERC, CIFRI, Guwahati for *Dek Beel* has shown below –

Specification	Cost (Rs.)
Total no of pens = 6 nos.	
Height of the pen at deeper part = 8 feet.	
Area of the individual pen = 450m^2 (2 No) and 600 m^2 (4 No)	

Type of bamboo used = Mature *jati* bamboo.

Gap between adjacent split bamboo strips (k*athis*) in bana = 4-6 mm.

Distance between adjacent coir webbings in bana = 40-45 cm.

Mesh size of the polyethylene mosquito netting net = 100 pores/cm^2

Distance between adjacent bamboo poles = 1.5 m.

Distance between adjacent angular support poles = 4.5 m.

Total cost involved in construction of six pens through communities involvement was calculated to be Rs. 55,500.00

Source : NERC, CIFRI, Guwahati.

5.3.1.3 Management measures followed in pens

5.3.1.3.1 Pre-stocking management

Before stocking the pens with carp fry, predatory and weed fishes inside the pens if any, were removed by repeated netting with small mesh sized mosquito net (mosari jal). A preliminary water analysis carried out prior to initiating pen culture from the pen sites, revealed that the water temperature ranged between 29.2-29.8^{0}C,water pH 5.6-6.10 and dissolved oxygen-5.30-5.72mg/l

The *beel* users desilted two plots of marginal areas measuring approximately 1200 m^2 and 900 m^2 during last part of March 2004, which were found suitable for erecting the first four pens. In this two cluster of pen areas, fertilization was done as per package of practice for nursery and rearing ponds as suggested by Aravindakshan (1993). Soil liming was done @ 650kg ha^{-1} through phased manuring procedure for enhancing plankton population at desired level with the mixture of raw cow dung, urea, SSP, mustard oil cake as shown in table 1. The concentrated liquid mixture was applied all over the pens. A post fertilization of water analysis showed that water acidity was neutralized by liming (water pH 7.60-7.94) dissolved oxygen level was satisfactory (7.38-8.75mg/lt), specific conductivity was found to be 108-211µs/cm. Stocking was done in the morning hours when water temperature was moderate (29.0^{0}c- 29.8^{0}c) in the pens. The average initial lengths of the fish fry were 5.7cm for catla, rohu, mrigal and gonius. The stocking density was maintained average 30000 fry/ha. Initially the species ratio of 3 Catla: 2 Rohu: 1 Mrigal And 2 Catla: 2 Rohu: 1

Mrigal was prescribed for pen I and pen II and pen III respectively. However considering the preference of the community to the minor carp, gonius was also stock at the rate of one gonius against two rohu species. Thus, the species ratio of 3 surface feeder (Catla): 2 column feeder (Rohu and Gonius) : 1 bottom feeder (Mrigal) was followed in pen I, while species ratio was slightly modified as 2 surface feeder (Catla): 2 column feeder (Rohu and Gonius) : 1 bottom feeder (Mrigal) in response to changes in fish food organism in pen II and pen III.

Table 1. Management schedule followed in pens

Particulars	Pen-I (Net area=0.09ha)	Pen-II (Net area=0.12ha)	Pen-III (Net area=0.12ha)
I. Date of installation	02.05.04	09.05.04	16.05.04
II. Date of ploughing	04.05.04	11.05.04	17.05.04
III. Date of application of raw cow-dung	11.05.04	Phased manuring on split dose on 17.05.04 (raw cowdung, + MOC +SSP+ fish meal)	Phased manuring on split dose on 22.05.04 (raw cowdung, MOC + SSP+ fish meal)
IV. Date of application of urea and SSP	17.05.04		
V. Date of netting for predatory insects and weed fishes	18.05.04	18.05.04	25.05.04
VI. Date of fish seed released	19.05.04	19.05.04	28.05.04
VII. Quantity of fry released species wise :	3280 nos.	4360 nos.	4360 nos.
• *Catla catla*	1620 nos.	1760 nos.	1760 nos.
• *Labeo rohita*	600 nos.	800 nos.	800 nos.
• *Cirrhinus mrigala*	540 nos.	800 nos.	1000 nos.
• *Labeo gonius*	520 nos.	1000 nos.	1000 nos.

Figure 17. Installation of pen is now completed

Figure 18. Community members are participating in a general meeting.

Figure 19. Researcher with the principal scientists, CIFRI, Guwahati in a meeting at Dek *Beel*.

5.3.1.3.2 Post-stocking management

The stocked fishes were fed with supplementary feed @ 5% of their total body weight in addition to natural food for higher production. An improved feed was prepared by mixing locally available feed ingredients viz. mustard oil cake, rice bran, fishmeal and Minamil (A vitamin-mineral mixture from Brihans Laboratories Ltd, Pune). Thus following quantities of the in-gradients were used for preparation of 10 kg feed (Wheat flour and Minamil were excluded when quantities were kept fixed as 10 kg).

Ingredients	Quantities (kg)
Mustard oil cake	7.5
Rice bran	1.0
Fish meal	1.5
Wheat flour	0.50
Minamil	0.100

The feed preparation procedure was as suggested by Sugunan *et al.* (2003) with slight modification as given below:

- Feed ingredients were grinded into powder form and mixed well.
- Water was heated up in a utensil up to 70-80^{0}C.
- Feed ingredients were then poured into the hot water and stirred well.
- The feed mixture was removed from the heater and the vitamin-mineral mixture and binder (Wheat flour) was added.
- From the feed mixture, feed balls were prepared. The feed balls were kept in suspended feeding trays (made of bamboo basket) to minimize wastage and to observe feeding intensity.
- Fishes were fed twice a day (morning and afternoon) at fixed time and fixed place.

5.3.1.3.3 Feeding and monitoring

The balls were kept in suspended feeding trays (made of bamboo basket) to minimize wastage and to observe feeding intensity. The reared fish fry were fed twice a day (in the morning and afternoon) at fixed times and at fixed places. Feeding and monitoring was done with the help of special user groups (UGs) selected by the *Dek*

Beel Milanjyoti Meenmahal Committee (DBMMC). Feeding schedule was implemented as prescribed. However for overseen watch and ward arrangements, the DBMMC engaged a special sub-committee, *Beel* Cornadhar Committee (BCC) and it was strictly directed to comply with the rules and regulations of DMMC.

5.3.1.3.4 Harvesting

At the time of second sampling 21.07.2004, the fry has grown to advanced fingerlings (20.4, 13.6,13.3,12.8 cm in case of Catla, Rahu, Mrigal and Gonius respectively) and they were ready to be released in to the main *beel* for stock enhancement (culture base-fisheries). However, after much deliberation among the community members, the CIFRI personnel and the researcher, it was decided to postpone the harvesting for sometime due to the very high water levels in the *beel.*

5.3.1.3.5 A comparison of centralized pen culture and community-based pen culture with reference to *Dek Beel*

A comparison of economics especially the construction costs of pens in three *beel* of Assam where pen culture has been demonstrated by NERC-CIFRI is illustrated below :

Table 2. Comparison of pen construction and installation cost in the selected *beels.*

Particulars	**Samaguri *beel*, Nagaon**	**Kumri*beel*, Goalpara**	**Dek*beel*, Kamrup**
1. Project year	2002-03	2002-03	2003-04
2. Mode of execution.	**Centralized management**	**Centralized management**	**Community-based management**
3. Pen area developed	0.10ha	0.10ha	**0.33ha**
Cost (Screen 472.72M^2)	Rs. 20,326.96@ Rs. 34/M^2	Rs. 34035.84@ Rs. 72/M^2	As per specification

5. Bamboo (Whole)	Rs. 4815.00 for 107 Nos @ Rs. 45/No.	Rs. 7280.00 for 200 Nos @ Rs. 35/No.	shown in 5.3.1.2.4
6. Bamboo splits	Rs. 384.75 for 31 Nos. @ Rs. 11.25/No.	Rs. 800.00 for 30 Nos. @ Rs. 10/No.	
7. Nylon net ($470M^2$)	Rs. 3776.00 @ Rs. $8/M^2$	Rs. 4700.00 @ Rs. $10/M^2$	
8. Execution cost	Rs. 10877.00 @ Rs. 72/Mannual for 151 Manual	Rs. 8651.00 @ Rs. 211/Mannual for 41 Manual	
9. Total	**Rs. 40,135.70**	**Rs. 55,546.84**	**Rs. 55,500.00***
10. Price escalation @ 10%	(+) 4,014.00	(+) 5,547.00	NIL

Source NERC: CIFRI (ICAR), Guwahati (2004).

5.3.1.3.5 Recurring Expenditure.

A comparative recurring expenditure incurred in pen culture in two selected *beel*s of Assam under NATP (JV), Assam sub-project has shown in the table 3.

Table 3. Comparison of recurring cost in two selected *beel*s of Assam.

Sl. No.	Items of Expenditure	Expenditure incurred (Rs. per 500 sq. m.)	
		Samuguri *Beel*	*Dek Beel*
I	Cost of eradication of unwanted aquatic weeds including forage fishes	Rs. 608/	Done by community members
II	Cost of lime	Rs. 340/	Rs. 240
III	Cost of Urea	Not applied	Rs. 22.50/
IV	Cost of SSP	Not applied	Rs. 35/

V	Cost of raw cowdung	Not applied	Contributed by community members
VI	Cost of netting operations	Rs. 70/	Nil
VII	Cost of watch and wards.	Nil	Looked after by community members.
VIII	Feed (Feed cost is not included as the expenditure incurred against the ingredients wise)	Rs. 1600/	Rs. 1600/
IX	Assumed total cost	Rs. 3512	Rs. 2554

5.3.1.3.6 Result

From the *Dek Beel* experience it was found that CBFM approach could be regarded as one of most important development and management approach for sustainable development of *beel.* However, following results were observed in Dek*Beel* programme

- Minimization of construction and installation costs of pens.
- Minimization of operation costs during culture periods.
- No labour costs for liming, fertilization, etc.
- No costs of sample nettings and harvestings.
- No costs on watch and wards.
- Certainty of member's empowerment.
- Better chances for achieving sustainability on their resource.
- Enhance confidence and capacity of the members.
- Introduction and enforcement of community's rules and regulations for the purpose of enhanced production.
- Strengthen organizational bound-ness due to formation of DBMMC, BCC, SHGs.
- The members were found to be aware of effective conservation of *Dek Beel* irrespective of the gender dimension.

Thus results of pen cultural in *Dek Beel* were inconsonance with the findings of White, (1989), Mills (1994), Chong and Kurin (1997), Maduh (1997), Salim (1998), Kuperan *et al.* (1999), Baruah *et al.* (2000), Bhaumik (2001), Sultan *et al.* (2002).

Figure 20. Researcher engaged in counting and reporting the growth and weight of fish seeds.

Figure 21. Protection of the pen through indigenous low cost fencing.

Figure 22. Duck cum fish culture in pen.

5.3.2 *Dek Beel* pen culture project : A success story on CBFM approach

At the early conceptualization stage of the project, the local *beel* users could not muster courage to undertake any development programme for effective development of their untapped resource thinking that it will be exorbitantly costly affairs. Also considering the derelict condition of the *beel* before the floating macrophyte mass was cleared, some of them vividly advocated that taking any development program in the *beel* would be wastage of money and efforts. The researcher understood this pessimism of the resource users and came to a conclusion that there is no alternative for development but to initiate effective and well planned capacity building programmes for arousing mass awareness and motivation among the *beel* users towards in the resource development programme. So, the researcher planned to design to call forth their leadership for creating a vision for self-reliant action to develop this precious natural resource. Hence the researcher spent several days of intense interaction with the local *beel* users as well as with their leaders including few opinion leaders through informal group discussion, non participant observation, etc to collect the facts, figures and feelings from them and identified their needs and prioritized them accordingly. Slowly and steadily, the *beel* users came to a decision that creating a self reliant future for them is not a distant dream .It is achievable by effective utilization of their own resources and exercising their own leadership. During this time, the researcher also tried his level best to mobilize and organize local *beel* users with the help of multiple organization and mobilization tools as mentioned earlier here elsewhere. As the mobilization programme progressed, all the interested *beel* users came into under one umbrella. Finally, they form an organization called as *Dek Beel* Milanjyoti Meen Mahal Committee (DBMMC) with 62 nos. active members to implement the project according to their needs and desires. Sri Gopal Sarma, a retired school teacher who is an ideal person in the locality due to his dedicated and efficient teaching carrier and Sri Kartik Sarma – the young promising leader for his farsighted vision with discipline, dedication and clean imaged personality were elected as their President and Secretary respectively. They were given the leading roles fore smooth implementation of resource programmes.

Figure 23. *Beel* users are discussing the developing ideas with CIFRIS scientist and researcher.

Figure 24. Harvested fish after two months of stocking.

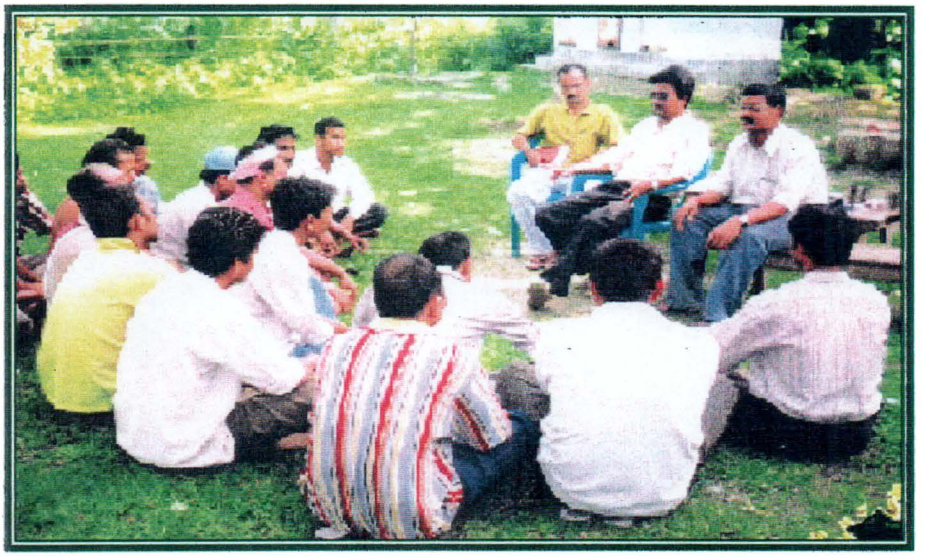


Figure 25. Researcher planning some new development ideas, *beel* users are participating in discussion .

Man proposes but god disposes. The proverb is well known to all. However it did not hold true in this study. The committee members under their efficient leader made a detail plan of work execution and found that nearly Rs. 2.0 lakhs would be required to shape up the project, as its initial renovation cost was a large amount for their standard and it looked to be a daunting hurdle to over come. They were completely shattered; self-courage and confidence were shrinkaged abruptly and nearly gave up the dreamed idea. Some member opined that they should approach to some out side funding or developing agencies for any financial assistance at-least at this stage. How ever, some other members did not like the approach rather they vividly advocated raising a special fund among themselves. At the length, the idea came into a concrete shape and each of them shared a sum of Rs. 3000.00. Those who were unable to share the said amount; they were given an option to contribute the amount on installment basis to which their responses were immense and whole-hearted. Utilizing this fund they completed the heavy renovation work within a month. This was possible due to their total dedication and commitment. Besides, they engaged some experienced workers from out side on wage basis to accelerate the pace of completion of work. Thus, they completed their renovation work of the *beel*. During this time, no government or any other organization did intervene. In the later part, when Shri Girish Sarma, an innovative member of DBMMC pursued the matter with NERC-CIFRI, Guwahati, the institute came forward willingly to help the *beel* users and by implementing a pen culture demonstration project under NATP JV (Jai Vigyan) project at the *Dek Beel* during the month of April. After completion of all the construction and erection/installation aspects of the pen, finally on 16th May 2004, an inaugural meeting was held in presence of all the *beel* users under the presidenship of Sri Gopal Sarma. Sri Kartik Sarma, the general secretary of the organization elaboratively discussed all these aspects and development. Dr. Mahadev choudhury, Officer- in-charge of NERC, CIFRI, Guwahati spoke on the occasion and inaugurated the pen culture project by releasing nearly 12000 fish seeds in presence of all the *beel* users and other distinguished guests. The researcher boldly argued in the meeting that their labour, dedication will come true and fruition only when they are able to effectively utilize the resources for many years without hampering the needs of the resource for their future

generation and at the same time it can satisfy their present needs also. This is possible only when they will sit together, plan together, executive work under distinct rules and regulations and their leader.

5.3.2.1 *Dek Beel* fisheries project and the people: How far away from the sustainable development?

From the pen culture at the *Dek Beel* (through community-based fisheries management with peoples participation), the researcher as well as other frontline *beel* users had to face some most daring challenges along the way of work execution. As mentioned earlier in somewhere else, some of them even thought that they will loss their identity of land ownership. Again, some of the relatively well to do *beel* users who were qualified also showed complete negative approach at the start of the project. However, as it became clear that the project would earn a significant gain, they supported the project slowly and steadily and came forward with hands in hands for success of the project.

Initially, the *beel* users involvement was very negligible. Probably, this was due to lack of self-confidence and knowledge for assigning the new work approach. Further, because of doubts and skepticism displayed by many of them, mobilization of the community member was an exciting challenge. Besides, most of them were not at all aware regarding the value and importance of this type of resource, because, they treated these resources as the common property resources, the tragedy of common (Hardin 1968). How ever, when the *beel* users were mobilized and organized, they got ample scope to interact freely with CIFRI's scientists, the researcher, and even among them selves.

As chamber (1991) advocated that farmer's to farmers dissemination of extension information always serves as a potential method of transfer, adaptation of appropriate technology at the farmers level, hence, it could be thought that the *Dek Beel* fisheries project would attain and retain the goal of sustainable fisheries in the near future; because all the *beel* users got ample scope for free and frank regarding adoption of pen culture technology.

Right at the outset, they had no organization. They were deprived from sitting together, discussing together interacting among themselves as well as sharing the views with their selected leaders. Thus formation of *Dek Beel* Milanjyoti Meen Mahal Committee (DBMMC) was one of the toughest challenges because many men had many minds. But a strong mobilization and organization approach showed that it is most probably one of the best methods of enhancing and ascertaining community's involvement that ultimately lead surest community empowerment. After fully involvement in the *Dek Beel* Fisheries Project, the local *beel* users decision making capacity was enhanced and was able to take decision themselves for participation in all stages of this types of development programme. So, undoubtedly it can be argued that *Dek Beel* fisheries project would surely achieve the goal of sustainable *beel* fisheries in the near future.

Initially, they had faced another burning Crisis. It was "Leader Crisis". *Beel* users were leaderless, visionless. It is often argued, even by Mazumdar (1998) that there must be one or more charismatic leader behind any successful participatory initiative. But ultimately they found their promising leader who could lead them from the front with distinct, dedicated, honest, persistent vision and leadership ability.

It was almost a regular affair that the secretary of the DBMMC, was being fade-up due to *beel* users push off mentality in many aspects. The researcher, hence, in each and every time pushed him up with clear clarifications that these are the parts and parcel of community-organized approach. So, at no cost, he should be disheartened rather he should guide his fellow *beel* users from the front with a solid and concrete vision for the success of *Dek Beel* fisheries programme towards it sustainability.

Initially, there was no artificial stock recruitment in the *Dek Beel*. Even they were completely ignored regarding any fisheries activities including pen construction and installation. But when their confidence and capacity were built up, their skills were developed immensely, empowerment was raised quietly. So they started to raise the advance fingerling through pen culture practice under CIFRI's guidance and supervision. This practice was followed to meet-up the need of advance fingerling to

be raised at the central portion of the *beel*. Today, they can install the pen at the appropriate site themselves and can raise the fish seed with an adoption of appropriate fish seed raising and management practice. What a fantastic example of community's empowerment? Obviously, their resource will move towards its sustainable development in the near future.

In the first year, the production may not be boosted-up because the organizer has made many errors, as they were inexperienced. It is now hoped that with the passage of time, they will gain more experience in the near future on the basis of *trial and error method* of learning approach. However, they are supposed to continue this culture practice as they are already motivated towards the effective utilization of the *Dek Beel* for their sustain livelihood.

The organizers are planning to perform the breeding operation in the *Dek Beel* from the third year and onwards, as there will not be any shortage of potential brooders after two years. It will not only minimize their purchasing cost of the fry but will also be able to sell and supply the fish seeds to the neighboring villagers. It will definitely widen-up their revenue earning sources.

From the experience, it is revealed that for profit maximization, market and marketing facilities are sine qua non for selling the farm produces and towards its sustainability. The *Dek Beel* Fisheries programme would certainly able to enhance the profit due to convenient communication to the Guwahati city, the state capital of Assam. It is just 45km away from Guwahati city, the northeast premier city. Again the organizers are supposed to get maximum chances to develop market ties with the middlemen to the city. This will fetch better price for fish and there by it will enhance their profit.

Before taking-up the project the whole *beel* area, was under a severe stressed environment as the *beel* was completely covered with thick and rooted unwanted aquatic vegetation, insects, poisonous snakes, etc. But after completion of all the renovation works including eradication of aquatic weeds, jungles, etc., and simultaneous application of lime at the surface of the water area, the environmental scenarios was changed immensely. Today whole water spread area of the *beel* is

without any unwanted vegetation. Now villagers are enjoying a fresh breathing under an open sky. Hence, it may be the most deciding factor for sustainable development of livelihood in the near future.

From the evident of elderly people of the locality, it was understood that before twenty years, the *beel* was used by the villagers for different domestic activities including washing of clothes, drinking water for men and animals, community fishing etc. During that time, the fishery was dominated by *Clarias spp., Anabas spp., Puntius spp., channa spp., chanda spp.* However, *Labeo spp., Cirrihinus mrigala., Catla catla* were also available to some extent. But, presently, only weed fishes such as *Putius spp. Esomas denricus* are mostly available. Besides, *Anabas spp, Clarias sp, Amphibolus kuchia* are also found abundantly. The declination of the stock may be attributed due to habitat modification, human activities such as over and destructive fishing, etc. In the middle stage, the *beel* was completely soaked with the different rooted aquatic weeds and people used it for grazing their animals. However, after completion of renovation work by the local people, stock enhancement and production approaches were carried out as per CIFRI's direction and guidance. The villagers were in very upbeat mood to see the result and production scenario of the *beel* in the near future. They were extremely optimistic that their *Dek Beel* fisheries programme would definitely attain its sustain ability for many years.

Very recently, the *beel* users themselves have constructed two duck-shed for adoption of duck cum fish culture practice in the *beel.* As per their decision this practice will run by their women Self Help Group (SHG). They are also cautiously planning to take up other integrated diversified approach including pig cum fish, horticulture cum fish, and tree-sampling plantation in surrounding *beel* area. They are actively considering for taking construction work of three cattle sheds, which would be looked after by some, their young member later on. It is hoped that there is no reason why the *Dek Beel* project should not be continued in the near future with an enhanced sustainability, because, it is people-led, people-driven development approach. Most of the members of BMMC were found to be honest, dedicated, persistent, and passionate and above all they took the responsibility for bringing a

change in their own lives and lives of the people in surrounding *beel* area. Today they have earned the trust and confidences of the fellow villagers. Mazumdar (1998) also noticed similar results from *Velakoba Fisheries Project*, Bangladesh. As he argued the project was succeeded because it was implemented under a new paradigm where community members took responsibility themselves rather than being mere by stand or beneficiaries of services delivered by other. Here also resource poor were recognized as resourceful, outsiders were not regarded as the driving force. The outsiders helped the local people only for catalyzing the local resource and empower local leadership. Let the *Dek Beel* Fisheries programme be the example of peoples programme in the state. Today, every body expects only such type of success story only in a true sense of people's participation for sustainable development of *beel* in the State.

Table 4. Major changes in *Dek Beel* before and after intervention of CBFM approach.

Sl. No.	Parameters	Before CBFM approach intervention	After CBFM approach intervention
1.	Physical condition of the *beel*	Was completely infested with deep-rooted aquatic weeds including heavy jungles, trees. Animal used it as a grazing field.	Completely clear from any kinds of aquatic weed infestation.
2.	Rehabilitation work	NIL	Completed construction of guard bundh of 30m through community's active participation, besides regular clearance of unwanted aquatic macrophytes.

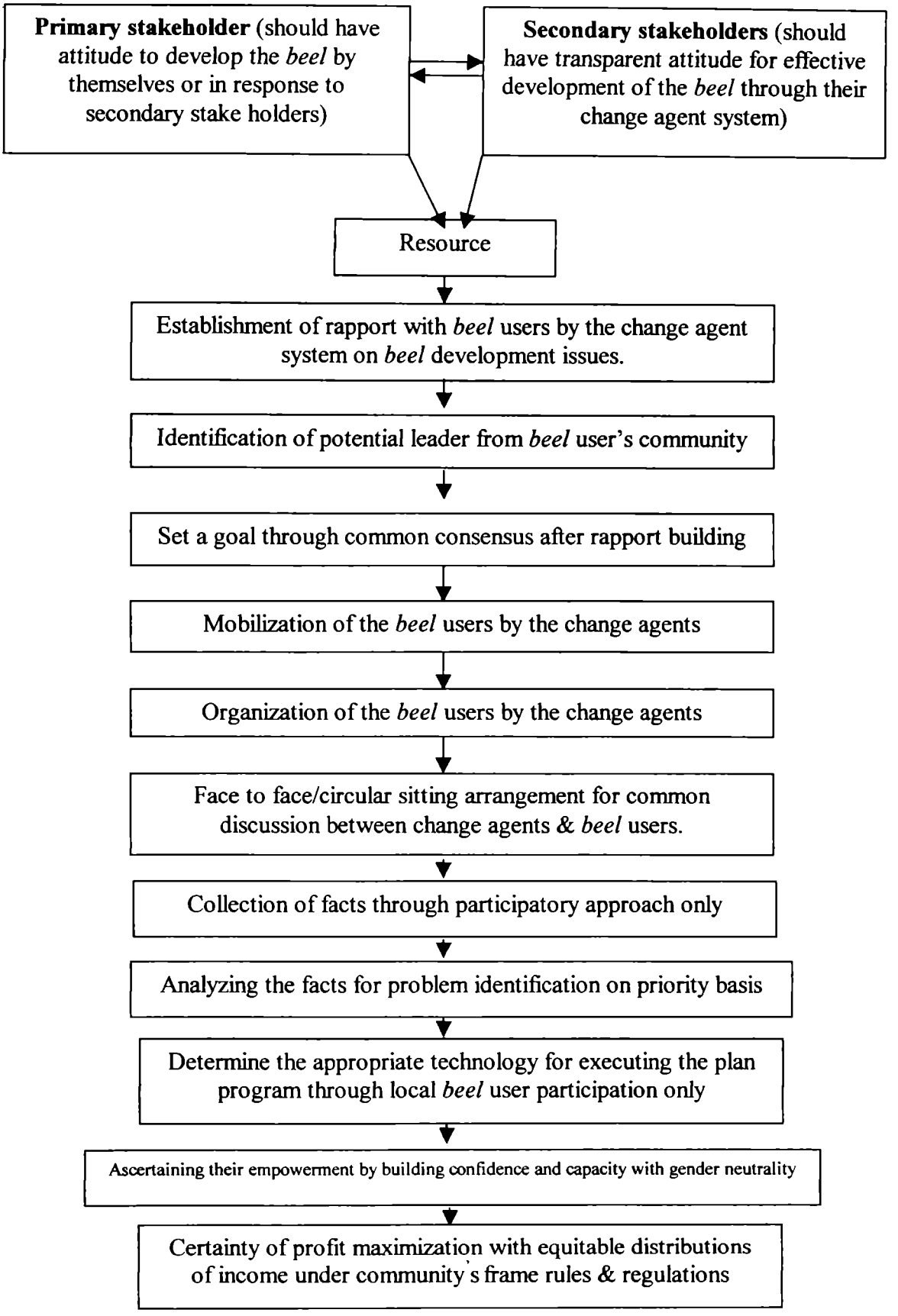
3.	Water and soil testing	NIL	After each two months of interval.
4.	Liming	NIL	Apply lime as and when required according to package adopted.
5.	Fertilization	NIL	Apply lime as and when required according to package adopted.
6.	Feeding management	NIL	Adopted feeding management package only.
7.	Community Organization	NIL	*Dek Beel* Milanjyoti Meen Mahal Committee, *Dek Beel* Cornodhar Committee, SHGs relating to duckery unit.
8.	Institutions financial help	NIL	CIFRI & DRDA, Kamrup (Assam)
9.	Production	@ 50 kg/ha.	Expecting @ 500kg-800kg/ha
10.	Community's meeting	NIL	Regular general body meeting on 2nd and 4th Saturday of each month.
11.	Integrated aquaculture farming approach	NIL	Proposed to take up pig cum fish, horticulture cum fish, cattle shed construction at the embankment besides duck farming in the *beel*.

For successful implementation of CBFM approach a flow diagram model of community based fisheries management (especially for *beel* fisheries) has stated below :

Figure 26. Researcher giving some new tips to them.

Figure 27. Probably, the community members are satisfied with the CBFM approach, Researcher is in picture.

A. Flow diagram model of community-based fisheries management (especially for beel fisheries)



N.B.- *Primary stakeholder* – *Beel* user community

Secondary Stakeholder – Directorate of fisheries, Fisheries Devt. Corp. etc

CHAPTER – VI

SUMMARY & IMPLICATIONS

6. SUMMARY AND IMPLICATIONS

6.1. Summary

India has extensive wetlands (low-lying areas) mainly associated with Brahmaputra and Ganga river basins, which are collectively termed as flood plain wet lands (Srivastava and Bhattacharjya, 2003). These wetlands together cover an area of 0.20 million hectares and constitute important fishery resources in the state of Assam, West Bengal, Bihar, Manipur, Arunachal pradesh, Tripura and Meghalaya (Sugunan, *et al.* 2000). As these water bodies are mostly situated in flood plains of major rivers, they are better designated as flood plain wetlands or flood plain lakes (Sugunan, 1997). These flood plain wet lands are locally called as *beel* in most states. Among the Indian states, Assam has maximum number of *beel*s associated with river Brahamputra and Barak (Sugunan and Bhattacharjya, 2000). It is the most lucrative and potential water resource of the state that covers approximately 72.45% of total lentic water areas of the state and 49.45% of total flood plain wetlands of the country. Its contribution to the states total fish production, however, mere 12.5% (Srivastava and Bhattacharjya, 2003).

Though the *beel*s in Assam are very rich in nutrients and have great production potential, its production is not up to its potential. The average production is about 173kg ha-yr- (Sugunan and Bhattacharjya, 2000; Srivastava and Bhattacharjya, 2003). Several factors viz. habitat modification, over exploitation, lack of scientific management etc., are responsible for low production of the *beel*. Though some investigators have made strong attempts to study as limnology and fishery aspects of selected *beel*s of Assam, systematic studies on the role of community participation on sustainable development of *beel* fisheries are lacking. Hence, keeping in view an attempt was made to study *beel*s aspects in Dek *Beel* under Kamalpur development block of Kamrup district, Assam with the following objectives : –

- To study the socio-economic profile of *beel* users.
- To find out the existing knowledge of *beel* users about sustainable development of *beel*.
- To find out the different factors associated with sustainable development of *beel*.

- To identify the variables contributing most significantly to the *beel* users knowledge level on sustainable development of *beel.*
- To mobilize and organize the community member (i.e. respondent) to participate in the fishery development program.
- To conduct a case study on pen culture through CBFM approach.

Further, it is hoped that the result of this investigation will help in introducing a participatory management approach to the clientele system in order to bringing a desirable change in knowledge, skills and attitudes of the stakeholders for sustainable development of *beel* or such types of natural resources. Again this study may help further to explore the possibilities of merging of extension work with community organization as an effective method of transfer of technology with immense feedback. The study will also help in planning, development and execution of fisheries development programs by the development planners, project executors, administrators fishery extension specialists, policy makers to think for viable cost effective alternative as mentioned here for sustainable development of *beel* or such type of common property resources.

Due to limited time and resource constraints the study was confined to purposively selected Dek *Beel* located at the village Dekpar under Kamalpur development block of district Kamrup, Assam. The findings of the study were obviously based on data obtained from the population covered under this study. There fore, results of this study will be directly applicable to that particular areas only, although results may have relevant applications to other areas having similar situational, socio-economic, socio-cultural, psychological, socio-institutional back ground.

The purposively selected Kamrup district has population of 25,15,030 (2001 census) with a sex ratio of 894 males against 1000 females. It has 900518 number rural people. The village Dekpar has a population of 650 with 150-house hold family. From the total population of 650 villagers, a list of 434 surrounding *beel* users both male and female engaged in different activities was prepared. Now, from the list of 434 *beel* users, 120 respondents i.e *beel* users were selected by simple random

sampling. Thus 120 numbers of *beel* users i.e respondents were taken as the sample size for this study. The main criterias behind the selection of the study area is listed below :

- Kamrup district is a leading aquaculture and fisheries district in the state.
- The researcher is an adjacent resident of the study area.
- Easy accessibility especially by road.

Here, a total of 20 variables were included in the study. Responses in regards to the dependent variable - **knowledge scores of *beel* users on sustainable development of *beel*** were obtained by employing the knowledge scale developed by Dana (1987), Shaikh *et al.* (1993). The remaining 19 variables included personal variables (4), socio-economic variables (8), Communication variables (1), Psychological variables (2), situational variable (2) and institutional variable (2). Data were obtained by employing the specially constructed schedule developed for the study. Besides, informal group discussions, meeting and discussion with village opinion leaders, observation technique were employed in order to draw authentic informations. Further data were tabulated, collected and analyzed using appropriate statistical methods viz. percentage, mean, correlation co-efficient, regression analysis, factor analysis, analysis of variance and path analysis.

On the basis of systematic and scientific analysis of data, the salient findings of the study are listed below :

- Age, education, occupation, annual income, social participation, fishery infrastructure, involvement of integrated agriculture, women empowerment, utilization of information sources, participation in development programme, decision making ability, availability of critical inputs, marketing facilities, community-based fisheries organization, capacity building as perceived by *beel* users were found to be positively and significantly correlated with the *beel* users knowledge scores on sustainable development of *beel* fisheries.

- Family size, family types, land holding, however were not significantly associated with knowledge scores of *beel* users on sustainable development of *beel* fisheries.

- Regression analysis showed that community-based fisheries organization, critical inputs supply, women empowerment, education, decision making ability, utilization of information sources, capacity building, involvement in integrated agriculture contributed significantly as the way of sustainable development of *beel* fisheries in long term basis.

- Factor analysis extract orthogonal factor based on varimax procedure of principal components analysis on the basis of eigen values more than one indicated that community-based fisheries management approach, critical inputs supply, marketing facilities, decision making ability, development program participation, utilization of information sources move hands in hands to reach their destination - *beel* user's knowledge scores on sustainable development of *beel* fisheries. But they maintain their movement on systematic progression i.e. an organized approach among these predictor variables can enhance their individual approach ability. So, this group was renamed as *Sustainable development with people's participation factor* that contributed 31percent of total variance of knowledge score on sustainable development of *beel* fisheries. On the other hand, capacity building, one of the prominent factor of sustainable development of *beel* fisheries, included the factors namely education, income, occupation, land holding, women empowerment, social participation under its domain, when ever sustainability was concerned. So, it was also renamed as *Beel users human capital development factor* that also contributed 12 percent of total variance. It is obvious that without formation and enhancement of human capital assets, sustainable development can not be achieved on long term bases.

- *Beel* users having high knowledge on sustainable development of *beel* fisheries were characterized by old-aged, having high school and above level of education, were members of more than one organization, high annual income,

medium and high involvement in integrated agriculture. They had also high and medium level of participation in development programme, high and medium level ability on empowering the women, high and above high community-based organization approach along with high and medium level of capacity building ability.

- *Beel* users with low level of knowledge on sustainable development of *beel* were characterized by low level of education, annual income, social participation; poor fisheries infrastructure; low and without involvement in integrated agriculture, poor utilization of information sources, low and very low women empowerment capabilities and community-based organization as well as low capacity building ability.
- From the stepwise multiple regression analysis it was found that community-based organization entered in the first step of analysis, which was immediately followed by decision-making ability of *beel* users as well as availability of critical inputs. The other variables namely women empowerment, education, fishery infrastructure, participation in development programme, involvement in integrated agriculture were entered in the remaining 4^{th}, 5^{th}, 6^{th} and 7^{th} steps respectively and showed that these eight variables can determine 80 percent of total variance of *beel* users knowledge score on sustainable development of *beel* fisheries.
- From the path analysis, it was cleared that community-based fisheries organization was the most prominent predictor variable that could mostly affect on sustainable development of *beel* through its direct effect on *beel* user's knowledge level on sustainable development of *beel*. However, social participation, utilization of information sources, participation in development programms, decision making ability, availability of critical inputs, women empowerment, *beel* users capacity building also did affect considerably on *beel* users knowledge level on sustainable development of *beel* fisheries via. Community-based fisheries organization as their indirect effect.

- However, education, family size, involvement in integrated agriculture, decision making ability, Critical inputs supply, women empowerment, *beel* users capacity building also have pronounced direct effect on *beel* users knowledge scores on sustainable development of *beel*. Now, it can be argued that by enhancing *beel* users capacity building through different extension education and transfer of technology packages and there by empowering them through different fisheries and aquaculture activities, sustainable development of *beel* fisheries can be achieved for enhancing the quality of life of the target clientele.
- It is worthy to mention here that we conducted a case study on pen culture through community-based fisheries management approach at Dek *Beel* of Kamrup district in Assam. The result revealed that through effective mobilization and organization of local community, this type of approach could easily be adopted as an effective management approach for sustainable development of *beel* fisheries or such types of common property resources.

6.2 IMPLICATIONS

Baruah *et al.* (2000) mentioned that Assam is struggling to build its economy through effective utilization of the *beel* in order to achieve a sustainable development of *beel* in the state. Following implications for action and further research may be the guiding principle, at least, to some extent for sustainable development of *beel* fisheries in the state.

- Greater emphasis should be given to educate the target clientele through participatory training mechanism to under stand the values and importance of the *beel*. Introduction of environmental education should be made compulsory in the formal and non-formal education at the schools and colleges for sustain utilization, conservation, development and management of *beel* by the user groups including children community.
- As a cost effective mechanism to sustain conservation, development and management of *beel* resources, a community-based fisheries management

approach by blending top down and bottom up extension mechanism should be introduced to bring a desirable change in the process of development and management. Through this approach, implementation of appropriate technology with active people's participation may widen a new vista for sustainable development of *beel*s in the near future. However, introduction of such types of community-based management approach by the state department of Fisheries is a really appreciable step at right direction in right time. How ever, for attaining and retaining the feasibility and viability of such approach, a reward and punishment mechanism is urgently needed.

- Sustainable development of the *beel* is not mere a concept but an approach that depends upon significantly on steady and continuous supply of critical agri-aqua inputs. Supply and availability such inputs in appropriate time and place will encourage the target clientele to take up different fisheries activities sincerely and seriously for sustainable utilization of the their aquaculture resources.

- People's participation in all stages of *beel* fisheries development program is definitely a key component for sustainable development of *beel*, as peoples are the cause and consequence of development. Necessary steps and dialogues should be kept ready to incorporate among the client system through the agent system for building their confidence and capacity for sustainable development of *beel*. Such appreciable steps will undoubtedly explore the skills and potential of the *beel* users for upgrading their quality of life. Creation and formation, building and enhancement of *beel* user's human capital assets, though may be the ultimate aim of sustainable *beel* fisheries, without active and spontaneous people's participation in *beel* development programs, the aim of such sustainability will not be fulfilled; rather it will be regarded as a distance dream, for ever.

- Once Napoleon told *"Give me a mother, I will present you a good nation"*. Sustainable development of *beel* fisheries is possible only when women, the most driving but disadvantaged fraction of society will be appropriately

empowered through different fisheries activities such as net and boat making, fish seed raising, ornamental fish farming and rearing, involvement in integrated aquaculture practices etc. Once they are empowered, their capacity and confidence will be boosted up, and will be organized themselves through certain action for effective empowerment.

- Different extension approaches to create awareness regarding values and importance of *beel* among the *beel* users community should be initiated especially through TV, regular radio programmes, documentary, puppet show, exhibitions etc. It will help in mass motivation towards conservation and effective utilization of *beel.*

- For minimizing as well as neutralizing the gender differences, formation of "*Beel users club*" at grass root level will undoubtedly stimulate male and female *beel* users to make them self reliant, self dependent and self decision maker. Because they will get chances to express their inner felling among themselves. Creation of ownership feeling is possible only through such type of organized activity. Regular supply of daily news papers, fisheries bulletins, besides provision of radio, TV at the club premises will definitely bring desirable changes in knowledge, attitudes, capacities and considerations of *beel* users to a considerable amount. Community school inside the *beel* periphery will be another encouraging step in this regard as it will obviously help in educating and capacity building of *beel* users and their children.

- Community mobilization and community organization with the aid of change agent system as well as non government organizations will definitely helps in development of human capital in the riparian community. Formation of self help groups (SHGs) in different *beel* aspects and their simultaneous involvement in such aspects will be regarded as most admirable steps in this regard. As because, through these approaches, they will be able to choose their leaders and leaders will able to perform better leadership under such organized approach.

- As Ramakrishnan (1992) argued sustainable development and effective management are the two sides of a same coin, there fore, government, non government voluntary and other development and financial organizations institutions and/or agencies should come forward to design, initiation and implementation of effective wet lands management options as suggested by Bhattacharjya *et al.* (2003) for sustainable development of the resources. However for long-term sustainability through adoption of such management options, we have to ascertain a strong people's participation in all stages of development and management aspects of *beel* fisheries.

6.2.1 Implications for further research

The above points are important in order to achieve a sustainable development of *beel* in the state. However all these steps are meaning less unless and until people participate in the development programme willingly. But before that we have to create and ascertain their development also, so that each of them can be a good decision maker, a good leader, a good communicator. However, in the present day scenario of the state like Assam, a high level political commitment in this regard is urgently needed. A further research should be conducted for achieving the goal of sustainable development of *beel* giving emphasis on following points.

- Human resource in the government, non-government organizations and local community level should be developed for effective conservation and development and management of *beel.*
- Any development activities should only be initiated through participatory bottom-up approach for effective peoples participation.
- Involvement of local non-government organizations in educating, implementing the development programme in the *beel.*
- Integrated agri-aquacultural approach for effective utilization of resources.
- Gender neutralizing approach to bring the women actor to the main stream of development.
- Introduction of developed population modeling approach for culture-based *beel* fisheries and to determine suitable conservation strategies for endanger species of fishes.

CHAPTER – VII

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7. REFERENCES

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Annexure I

A KNOWLEDGE TEST ABOUT SUSTAINABLE DEVELOPMENT OF *BEEL* FISHERIES.

(Only for Judges)

Respected Sir/Madam .....

We will be grateful to you, If you kindly participate in developing a **Knowledge Test** which is to used to test knowledge among the *beel* fishers of Kamalpur Development Block, Kamrup district, Assam.

Sir, you are allotted a total knowledge score 100 to be distributed among all the 4 nos. major items and 27 nos. sub-items as mentioned below on the basis o their relative significance and importance in regards to sustainable development of *beel* fisheries **(SDBF)** with peoples participation. Yours spontaneous participation in this regard is extremely solicited

Dr. S. S. Dana.
(Thesis guide)

R. C. Barman .
(M.F.Sc. student)

Major Item/Sub-Item	Score
i) Awareness : Have heard about sustainable *beel*s fisheries development	
ii) Concept of sustainable development of *beel* fisheries (SDBF) :	
a) It is the development of *beel* fisheries, which is designed to maintain productivity and usefulness to the society without any time limit. b) Both capture and culture based fisheries management options are taken for effective management. c) This mode of fisheries management offers relatively eco-friendly option for enhanced fish production. d) Without involvement of local communities right through conceptualization, planning, implementation of location specific strategy with bottom up approach, sustainable development of *beel* fisheries is not possible.	
iii) Advantages of Sustainable development of *beel* fisheries a) Environmentally non-degradable. b) Technically viable due to adoption of appropriate technology and location specificity. c) Socially acceptable. d) Economically sound. i.e. cost effective. e) Conserve bio-diversity of the *beel* through strong people involvement. f) Enhancing production of fish without degrading water and soil quality. g) People are the center of this development approach.	
iv) Sustainable development of *beel* fisheries S.D.B.F. can be achieved by	

a) Strengthen conservation measures for the resource and biodiversity of the *beel.* b) Introduction of mass media such as TV, Radio, News paper, Drama, Documentary for high lighting the issues relating to wise use of *beel* fisheries, their values and importance. c) Management of soil and water quality. d) Creating complete environmental awareness by different environment campaign. e) Empowering men and women through fisheries f) Effective utilization of *beel* fisheries through holistic integrated agricultural approach. g) Providing right and responsibilities of ownership of the *beel* to the local fishers through appropriate policy design. h) Through community participation in planning, management, implementation, continuous monitoring. i) Introduction of appropriate technology for development & management of *beel* fisheries through locally available resources. j) Gender neutrality approach through women empowerment in *beel* fisheries. k) Introduction of bottom up community based fisheries management approach in *beel* resources. l) Introduction of culture based and captures fishery management option. m) Need based training on effective management of *beel* fisheries for enhancing capacity building of the fishers & their empowerment. n) Involvement of government, NGOs, village level organizations for arousing mass awareness regarding values and importance of *beel* fisheries. o) Introduction of environmental education for awareness building at school level especially targeting school children. p) Marketing orientation.	

Signature of the judge

Date : .....

Designation

Annexure II

COMMUNITY-BASED FISHERIES MANAGEMENT WITH PEOPLE'S PARTICIPATION FOR SUSTAINABLE DEVELOPMENT OF *BEEL* FISHERIES

INTERVIEW SCHEDULE

Date : Village :

Block :

ABOUT THE RESPONDENT

1. Name of the respondent :
2. Age : 3. Sex: 4. Education:
5. Family Size :
   a] Male
   b] Female
   c] Total numbers
6. Family type: Joint/Single
7. Caste : General /SC/ST/OBC
8. Occupation : a] Primary
   b] Secondary
9. Annual income :
   a] From main occupation Rs.
   b] From secondary occupation Rs.
10. How many member (S) related with fisheries actives in the *beel* :
    a] Directly
    b] Indirectly
    c] Total
11. Land use pattern of the *beel* :
    a] Area used for fisheries
    b] Area used for agriculture
    c] Area encroached /occupied
    d] Area used for live stock rearing.

12. Land holding :

    a] Agriculture land

    b] Non-agricultural land

13. Educational status of family members

    a] Graduate and above.

    b] Intermediate (H.S).

    c] Matriculation (H.S.L.C.)

    d] Primary.

    e] Can read and write.

    f] Can read only.

    g] Illiterate .

ABOUT THE *BEEL*

1. Area of the *beel* :
   a) As per existing record.
   b) Actual area (Post monsoon).
2. Shape of the *beel* : Oxbow/crescent/serpentine/oval/irregular.
3. Nature of the riverine connection : Open/closed.
4. Extent of macrophyte infestation
   a) Floating
   b) Sub-merged.
   c) Marginal/rooted emergent.
   d) Total coverage.
5. Depth of water
   a) Maximum (rainy season).
   b) Minimum (pre-monsoon season)
   c) Average depth round the year.
6. Soil
   a) Texture.
   b) Reaction.
7. Water quality

8. Fisheries information :

a) Natural fish fauna available.

i) Major species.

ii) Minor species.

iii) Dominant species.

iv) Approximate yield (kg/ha) from natural stocks.

v) Commercially important species if any.

b) Constructed fish fauna

i) Species stocked.

ii) Species ratio

iii) Stocking density.

iv) Stocking frequency : Regular/occasional/rare.

v) Approximate yield (kg/ha).

c) Total yield (kg/ha).

d) Fishing craft used (No. & type).

e) Fishing gear used (No. & type).

f) No. of active fisher (Man days).

9. Fishery infrastructure facilities available

a) Cultivable fish pond (Nursery/rearing/stocking).

b) Fish farm with different agricultural activities.

c) Availability of quality fish seed.

d) Landing shed.

e) Office for management group.

f) Fish farm with eco-hatchery.

10. Type of involvement for integrated agriculture activities

a)	Do you involve in any kind of integrated agriculture practices in surrounding *beel* area ? If yes, mention the practice (Fish cum duck, poultry, pig, horticulture, etc.)	(Yes/No
b)	Do you think integrated agriculture is the best method of effective utilization of *beel* areas ?	(Yes/No)
c)	Do you think horticulture cum fish is a profitable	(Yes/No)

	business ?	
d)	Do you think integrated farming in *beel* produce more income and shall be continued ?	(Yes/No)

11. Social participation

Are you a member of any of the following organizations ?

If yes, then put the tick (√) mark against the organization and also indicate whether you are a member / office bearer, etc.

Sl. No.	**Name of the organization**	**Member**	**Office bearer**
a)	Village panchayat		
b)	Anchalick panchayat		
c)	Fish farmer's club		
d)	Rural development club.		
e)	Zila parishad		
f)	Co-operative society		
g)	Fisheries co-operative society		
h)	Any other (specify)		
	1.		
	2.		
	3.		

12. Utilization of information source

Sl. No.	**Sources of information**	**Information sought**			
		Most often (3)	**Often (2)**	**Some times (1)**	**Never (0)**
a)	Radio				
b)	T.V.				
c)	News paper				
d)	Leaf let / pamphlets (fisheries)				
e)	Friends and Relatives				
f)	F.E.Os.				

13. Decision making process

Please indicate 'Yes' and 'No' to the following statements.

Sl. No	Statements	Yes	No
a)	*Beel* users should take decisions them selves regarding their participation in each and every stage of development.		
b)	*Beel* users should take decisions them selves regarding fish harvesting and marketing.		
c)	*Beel* users should take decision themselves regarding restrictions imposed on fishing in the *beel.*		
d)	*Beel* users should take decision regarding development of *beel* fisheries through community based organization approach.		
e)	Regarding equitable distribution of profit from *beel* fisheries, *beel* user should take decision them selves.		
f)	*Beel* fisher should confirm the decision as per government direction.		

14. Availability of critical inputs

Please indicate Yes and No the following statement?

Sl. No.	Statements	Yes	No
a)	Availability of quality fish seed at appropriate time is must for enhanced fish production		
b)	For sustainable fish production judicious application of lime is must, organic and in-organic fertilizers, prophylactic and therapeutic drugs are essential and should be available at appropriate time		
c)	Fishing and harvesting equipments should be available to the *beel* fishers for enhanced production.		
d)	Application of recommended organic and inorganic fertilizers are not essential for culture-based fisheries enhancement		
e)	Fish prophylactic and therapeutic drugs are essential and should		

	be available at appropriate time for enhancement.		
f)	Agriculture inputs and marketing facilities are essential for sustainable development of *beel* fisheries.		

15. Marketing facilities

Please indicate to what extent do you **yes and no** to the following statement ?

Sl. No.	Statements	Yes	No
a)	Marketing news is not useful to a fisher.		
b)	A fisher can get good price by grading his/her produce.		
c)	Ware house, cold storage can help the fisher to get better price at his/her produces.		
d)	One should sell his/her produce to the nearest market irrespective of the price.		
e)	One should purchase his or her inputs from the shop where his/her other relatives purchase.		
f)	For good marketing facilities, communication is not essential.		

16. About sustainable *beel* fisheries development

i.		Have you heard about sustainable *beel* fisheries development ?	(Yes/No)
ii.		What is sustainable development of *beel* fisheries	
	a)	It is the development of *beel* fisheries, which is designed to maintain productivity and usefulness to the society without any time limit.	(Yes/No)
	b)	Both capture fisheries and enhancement options are needed for effective management of *beels*.	(Yes/No)
	c)	This mode of fisheries management offers relatively eco-friendly options for enhanced fish production.	(Yes/No)
	d)	Without involvement of local communities right through conceptualization, planning, implementation of location	(Yes/No)

		specific strategy with bottom up approach, sustainable development of *beel* fisheries is not possible.	
iii.		Please mark 'yes' and 'no' against the following possible advantages of sustainable development of *beel* fisheries	(Yes/No)
	a)	It is environmentally non degradable.	(Yes/No)
	b)	Technically viable due to adoption of appropriate technology and location specific.	(Yes/No)
	c)	Socially acceptable.	(Yes/No)
	d)	Cost effective	(Yes/No)
	e)	Conserve bio-diversity of *beel* through strong people involvement.	(Yes/No)
	f)	Enhanching fish production without degrading water and soil quality.	(Yes/No)
	g)	Sensitizing all the stakeholders is the center of this development approach.	(Yes/No)
iv.		The following are ways of achieving sustainable development of *beel* fisheries. Please mark yes/no.	(Yes/No)
	a)	Strengthening conservation measures for bio-diversity of the *beel* including habitat diversity.	(Yes/No)
	b)	Use of mass media such as TV, Radio, Newspaper, Drama, and Documentary for highlighting the issues related to wise use of *beel* fisheries, its values and importance.	(Yes/No)
	c)	Management of soil and water quality as well as macrophytes	(Yes/No)
	d)	Creating complete environmental awareness by different award campaigns.	(Yes/No)
	e)	Empowering local men and women communities through fisheries.	(Yes/No)
	f)	Effective utilization of *beel* fisheries through an integrated development approach (including agriculture, live stock rearing.)	(Yes/No)

	g)	Providing right and responsibilities of ownership of the *beel* to the local users through appropriate policy design.	(Yes/No)
	h)	Through community participation in planning, management, implementation and continuous monitoring.	(Yes/No)
	i)	Introduction of appropriate technology for development and management of *beel* fisheries by using locally available resources.	(Yes/No)
	j)	Gender neutrality approach through women empowerment in *beel* fisheries.	(Yes/No)
	k)	Introduction of bottom up community based fisheries management approach in *beel* fisheries.	(Yes/No)
	l)	Introduction of various aspect of fisheries enhancement including fisheries management options.	(Yes/No)
	m)	Need based training on effective management of *beel* fisheries for enhancing capacity building of fisheries and their sub sequent empowerment.	(Yes/No)
	n)	Introduction of environmental education for creating awareness especially school children.	(Yes/No)
	o)	Through proper procurement of inputs and marketing of produces.	(Yes/No)
v.		Do you use the land of the *beel* for growing agricultural crop ?	(Yes/No)
vi.		Do you use any insecticide / pesticide for protection of agricultural crop ?	(Yes/No)
vii.		What are the fish species available in the *beel* ? Do you think some species previously found are not found now-a-days ? What are the dominant fish species in the *beel*.	(Yes/No)
viii.	a)	Do you think there is no impact on soil and water quality by dumping unwanted material at the *beel* or its peripheral area ?	(Yes/No)
	b)	Do you think the discharge of agricultural effluents to the *beel* are harmful for *beel* eco-system ?	(Yes/No)

	c)	Do you think the discharge of domestic effluents on *beel* has no impact on soil and water quality of *beel* ?	(Yes/No)
	d)	Do you think people can contribute to maintaining the environmental analysis of *beel* ?	(Yes/No)
	e)	Do you think only the government should take necessary steps to maintain the *beel*'s environmental quality ?	(Yes/No)
ix.	a)	Do you feel that fisherwomen should not indulge in any fisheries activities ?	(Yes/No)
	b)	Do you feel that fisherwomen can not engage in fisheries activities due to their domestic work ?	(Yes/No)
	c)	Do you feel that fisherwomen should stay at home to take care of their family ?	(Yes/No)
	d)	Do you feel that fisherwomen can take active part in pre-stocking, stocking and post stocking management in *beel* fisheries ?	(Yes/No)
	e)	Do you agree that fisher women can suitably engage them selves for fish seed raising, making and repairing of nets?	(Yes/No)
	f)	Do you feel that fisherwomen can should not take part in any organization or social participation activities?	(Yes/No)
x.	a)	Do you agree that community based organization has positive impact in *beel* fisheries management?	(Yes/No)
	b)	Do you agree that community based organization is the first step toward sustainable development of *beel*?	(Yes/No)
	c)	Do you agree that awareness building, motivation, can easily be brought through community's involvement?	(Yes/No)
	d)	Do you agree that reward and punishment, proper demarcation of boundary, free interaction among the stake holders are must for successful community based fisheries?	(Yes/No)
xi.	a)	Do you agree that every body should be aware of the values and importance of *beel* ?	(Yes/No)
	b)	Do you agree that training is highly essential to get the knowledge of effective management of *beel* fisheries?	(Yes/No)
	c)	Do you agree that training can change attitude and behaviour of *beel* users for its sustainable management?	(Yes/No)
	d)	Do you agree that a good leadership with effective peoples organization is required for development *beel* fisheries?	(Yes/No)