Beel Fisheries of Assam: Community-based Co-management Imperative

U.K. Baruah, A.K. Bhagowati, R.K. Talukdar and P.K. Saharia

Abstract

The freshwater wetlands (*beels*) of Assam, India, cover an area of 101 232 ha. For the rural poor, the neighboring wetlands are the only source of fish. They depend on them for their daily consumption of fish as well as a source of livelihood. Ecoenergy studies indicate that these wetlands have a fairly high production potential. However, the current regulations and system of management are not conducive to sustainable production from these water bodies. It is resulting in overexploitation and degradation. It is imperative some form of co-management with local communities be established for the *beels* of Assam.

Introduction

The State of Assam in India has a population of 22.29 million with a density of 284 persons·km^{-2}. The literacy rate in the state is 53.42%. About 75% of the population depends on agriculture and allied activities for livelihood. These people are mainly smallholders. The average operational landholding is 1.37 ha in the plains. The highest operational landholding size is about 2 ha in the hills.

Rice and fish are the staple food in the state. Traditionally rice farming has been practiced in about 2.6 million ha of available floodplains and yields about 3.3 million t of rice. This is sufficient to meet the internal demand. The demand for fish is about 0.22 million t/year and production is only 0.14 million t annually from both culture and capture fisheries (Bhagowati et al. 1997). Besides the Brahmaputra and the Barak River systems (Fig. 1), *beels* are the major source of capture fisheries in Assam.

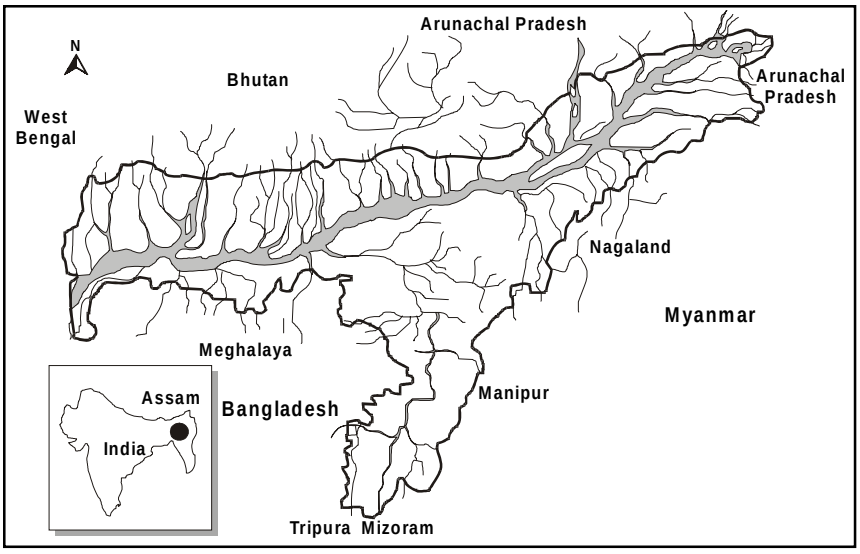

Fig. 1. Map of Assam showing its major river systems.

The *Beels*

Assam is gifted with many extensive water bodies commonly known as *beels* (Jhingran and Pathak 1987) that are the only source of fish for the poor people in the surrounding villages. The typical location of *beels* is shown in Fig. 2. Historically there have been three distinct groups of people involved in organized fishing in the *beels*: (i) those who catch fish for their own daily consumption; (ii) those belonging to the fisher community and depend on fishing for their livelihood; and (iii) rural

entrepreneurs (leaseholders). Ordinary people usually fish daily for food, while fishers are full-time operators working independently or under the lessees. The lessees further auction the leases to the fishers and provide capital at usurious rates of interest to them (Ahmed et al. 1992).

Classification

Beels are freshwater wetlands. No satisfactory general definition of wetlands exists (Barbier 1989). All natural wetlands are called *beels* in Assam. In 1992, the Assam Remote Sensing Application Centre, Assam Science and Technology Education Council, and the Space Application Centre of the Indian Space Research Organization developed a classification system for the wetlands in Assam that divided them into six categories: (i) lake/pond; (ii) oxbow lake/cut-off meander; (iii) waterlogged areas; (iv) swamp/marsh; (v) reservoir; and (vi) tank. The first four are natural water bodies while the last two are human-made.

Natural wetlands sometimes have feeder channels controlling the inflow and outflow of water. Lakes and ponds have a unique physiographic setting with undulating terrain, while oxbow lakes/cut-off meanders are crescent-shaped water bodies located along streams in abandoned oxbows after a net cut-off is formed. Areas where water stands near, at or above the land surface so that the roots of all plants except hydrophytes are drowned and the plants die are in the waterlogged category (Anon. 1997). These water bodies are perennial, irregular in shape and occur in low-lying areas. They normally have feeder channels and the water varies from season to season. During the monsoon, a number of waterlogged areas join together to form single big wetland. A swamp is an area intermittently or permanently covered with water, with shrubs and trees, but essentially without the accumulation of peat (Bates and Jackson 1980). A marsh is defined as waterlogged ground with a large mineral basin.

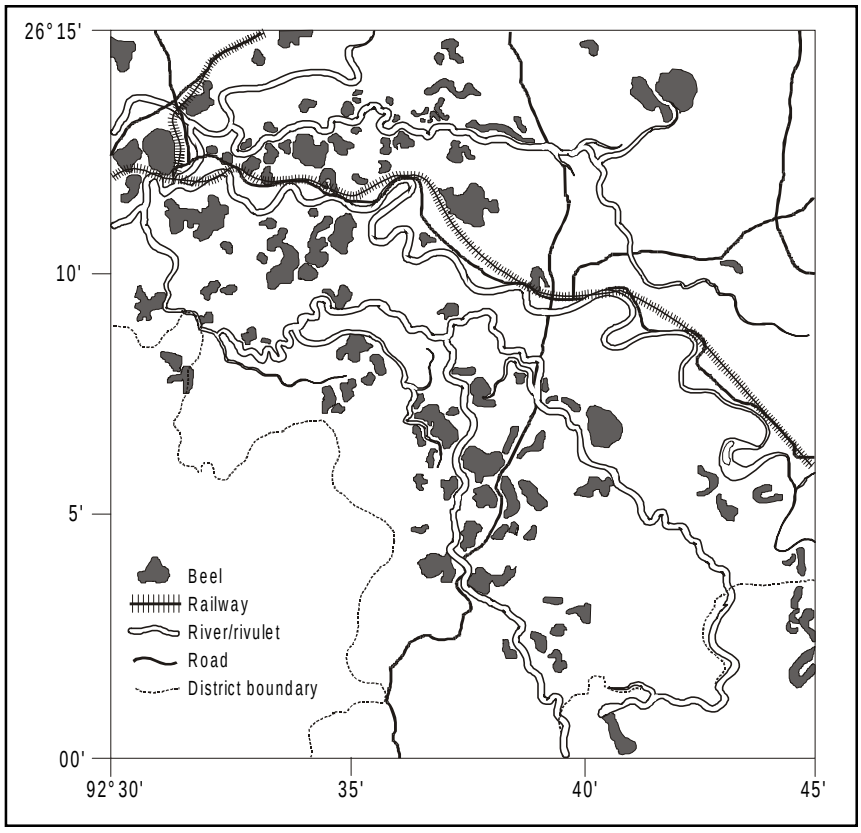

Fig. 2. Typical wetland map prepared from satellite imagery (1:50,000).

Resources

A total area of 101 232 ha is covered by 3 513 wetlands. This is close to 4% of the total floodplain area and 1.3% of the total area of the State. The lakes/ponds occupy an area of 15 494 ha and number 690. There are 861 oxbow lakes/cut-off meanders covering 15 461 ha. The waterlogged areas number 1 126 and occupy 23 436 ha (dry season satellite data). The swamps and marshes cover an area of 43 434 and number 712 (Table 1).

The resources of these wetlands are important for human nutrition and the economy as they provide a habitat for a number of aquatic flora and fauna, including migratory and indigenous birds. Fishing is the main economic activity in the *beels*. Rice and vegetables are farmed on

Table 1. Type and area of wetlands of Assam.

Type	Number	Area (ha)	%
Natural			
Lake/pond	690	15 494	15
Oxbow lake/cut-off meander	861	15 461	15
Waterlogged area	1 125	23 432	23
Swamp/marsh	712	43 434	43
Subtotal	3 388	97 821	96
Human-made			
Reservoirs	10	2 663	3
Tanks	115	750	1
Subtotal	125	3 413	4
Total	3 513	101 234	100

Table 2. Fish species commonly available in the* beels *of Assam.

1. *Chela laubuca*	37. *Labeo angra*	73. *Erethistes pussilus*
2. *Chela atpar*	38. *Chagunius chagunio*	74. *Glyptothorax cavia*
3. *Securicula gora*	39. *Tor tor*	75. *Glyptothorax telchitta*
4. *Salmostoma bacatla*	40. *Tot putitora*	76. *Clarias batrachus*
5. *Salmostoma phuto*	41. *Cirrhinus mrigala*	77. *Heteropneustes fossilis*
6. *Esomus danrica*	42. *Cirrhinus reba*	78. *Chaca chaca*
7. *Danio devario*	43. *Catla catla*	79. *Xenonthodon cancila*
8. *Rasbora elanga*	44. *Crossocheilus latius latius*	80. *Channa marulius*
9. *Rasbora daniconius*	45. *Noenacheilus botia botia*	81. *Channa striatus*
10. *Rasbora rasbora*	46. *Botia dario*	82. *Channa gochua*
11. *Aspidoparia jaya*	47. *Lepidocephalichthys guntea*	83. *Channa stewartii*
12. *Aspidoparia morar*	48. *Somileptes gongota*	84. *Channa panctatus*
13. *Barilius barila*	49. *Rita rita*	85. *Amphipnous cuchia*
14. *Barilius barna*	50. *Batasio* spp.	86. *Chanda nama*
15. *Barilius shacra*	51. *Chandramara chandramara*	87. *Chanda ranga*
16. *Barilius bola*	52. *Mystus cavasius*	88. *Badis badis*
17. *Barilius bendelistis*	53. *Mystus vittatus*	89. *Nandus nandus*
18. *Barilius tileo*	54. *Mystus bleekeri*	90. *Sicanugil cascasia*
19. *Barilius* sp.	55. *Mystus menoda*	91. *Rhinomugil corsula*
20. *Cyprinus carpio, communis*	56. *Mystus aor*	92. *Glossogobius giuris*
21. *Cyprinus carpio, specularis*	57. *Mystus seenghala*	93. *Anabas testudineus*
22. *Puntius chola*	58. *Ompok binaculatus*	94. *Colisa fasciata*
23. *Puntius sophore*	59. *Ompok pabo*	95. *Colisa latius*
24. *Puntius sarana*	60. *Ompok pabda*	96. *Colisa chuna*
25. *Puntius ticto*	61. *Wallago atu*	97. *Colisa baculis*
26. *Puntius gerius*	62. *Ailia cotla*	98. *Macrognathus aculeatus*
27. *Puntius conchonius*	63. *Ailia punctata*	99. *Mastacembalus armatus*
28. *Osteobrama cotio*	64. *Pseudeutropius atherinoides*	100. *Mastacembalus pancalus*
29. *Labeo rohita*	65. *Clupisoma garua*	101. *Tetradon cutcutia*
30. *Labeo gonius*	66. *Eutropitichthys vacha*	102. *Gadusia chapra*
31. *Labeo calbasu*	67. *Silonia silondia*	103. *Setipinna phasa*
32. *Labeo bata*	68. *Pangasius pangasius*	104. *Notopterus chitala*
33. *Labeo dyocheilus*	69. *Amblyceps mangois*	105. *Notopterus notopterus*
34. *Labeo nandina*	70. *Bagarius bagarius*	106. *Ambypharyngodon mola*
35. *Labeo dero*	71. *Gagata cenia*	
36. *Labeo pangusia*	72. *Nangra viridescens*	

***Table 3. Soil and water quality of a typical* beel.**

Parameters	Range	
Soil quality		
pH	5.10 -	5.80
Organic carbon (%)	2.80 -	5.90
Available nitrogen - N (ppm)	605.00 -	782.00
Available phosphorus - P (ppm)	40.00 -	170.00
Water quality		
Temperature (°C)	18.50 -	31.50
Transparency (cm)	48.00 -	121.00
Dissolved oxygen (ppm)	4.27 -	11.20
pH	6.40 -	7.60
Free carbon dioxide (ppm)	2.00 -	12.00
Bicarbonate (ppm)	15.00 -	40.00
Specific conductivity (mhos/cm)	34.90 -	73.10
Total hardness (ppm)	13.90 -	35.60
Calcium (ppm)	5.00 -	15.80
Magnesium (ppm)	3.00 -	6.80
Dissolved oxygen matter (ppm)	2.77 -	4.80
Phosphate (ppm)	0.02 -	0.10
Nitrate (ppm)	0.05 -	0.40
Silicate (ppm)	4.90 -	12.20

Source: Jhingran and Pathak (1987).

the catchment areas in the post-monsoon season. The fish species commonly available in the *beels* are listed in Table 2. Most of these are consumed as food by the local people. *Beels* are very rich in nutrients and have a great production potential. The soil and water of a typical *beel* are described in Table 3. Based on eco-energy studies, Jhingran and Pathak (1987) estimated the production potential of *beels* at 18 000 000 Kcal of energy/ha/year or 1 500 kg/ha/year. The productivity of oxbow lakes can be increased to 2 000-4 000 kg/ha/year by introducing extensive or semi-intensive aquaculture. In other wetlands, productivity can be increased significantly by strictly implementing the existing fisheries regulations.

The value of the environmental functions of *beels* has not yet been assessed. A complete valuation of

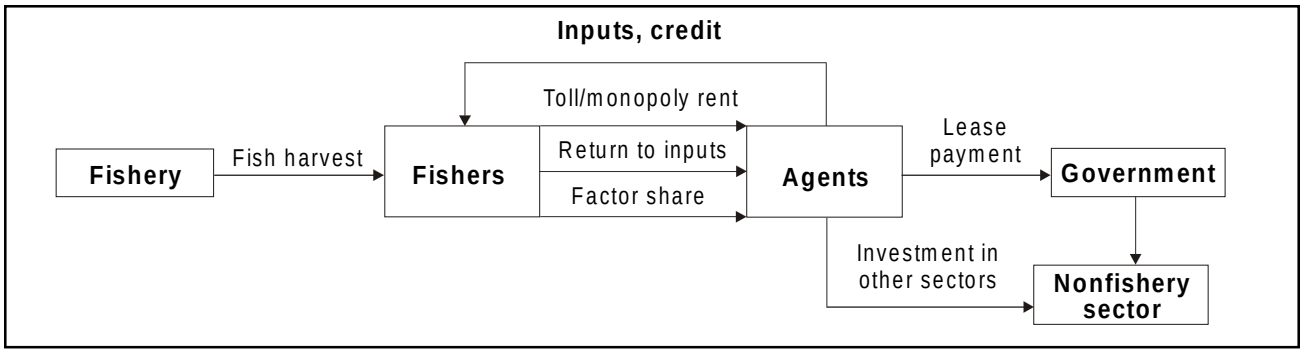

Fig. 3.* Beel *fisheries management systems in Assam (Ahmed et al. 1992).

the resources, services and attributes of *beels* will help in assessing their full potential and in planning their development. An evaluation of direct use value (the value derived from the economic use made of the wetland resources and services), indirect use value (indirect support and protection provided to economic activity and property by the natural functions or environmental services of the wetlands) and non-use/preservation values (the value derived other than current direct or indirect use of the wetlands) (Barbier 1989) is required to estimate the value of the potential benefits.

Management

In Assam, the *beels* are under the control of the Revenue Department (Settlement). Since 1977, a substantial number of *beels* have been handed over to the Assam Fisheries Development Corporation (AFDC) for maintenance. Under the present system of management (Fig. 3), both the Revenue Department and AFDC lease out the *beels* for a period of five years at a time. The prime objective is to earn revenue for the State's exchequer. The protection of the interests of the *Koiborta* (traditional fisherfolk) community is not given much attention under the existing policy. The system allows rich middlepersons to obtain the leases. The lessee hires fishers to do the fishing. In most cases, fishers of adjacent villages are employed at very low wages or on a share-harvest (60:40) basis. The marketing of the fish is totally controlled by the lessee. Fishers are not allowed to sell their share in the market. They have to sell it back to the lessee at a low price fixed by the lessee.

As the lease period is fixed, the lessee maximizes income by catching the entire stock of fish from the *beel*. To achieve this, the water level is often reduced by pumping it out. The fishers also help the leaseholder to maximize the catch, especially fishers working on the share-harvest system. The provisions of the Indian Fisheries Act 1897, enacted for the protection and conservation of fish biota, are meaningless under this management system.

Ecological Degradation

The ecological degradation of *beels* started with the arrival of the water hyacinth a century ago. Rampant growth of this fast-growing weed obstructs the penetration of sunlight, inhibiting planktonic growth and contributing to eutrophication by slowing down water currents and depositing debris at the bottom. The second phase of enhanced eutrophication resulted from the construction of embankments along almost the entire length of the river Brahmaputra and many of its tributaries after the devastating earthquake of 1950. These levees substantially reduced the periodic flushing by monsoon floods. The final onslaught on the wetlands has been from human activities such as buffalo and cattle rearing, agriculture and horticulture, and overfishing. These have resulted in further siltation and damage to the microflora and water quality. The injudicious use of pesticides in farming activities has resulted in the accumulation of residue through surface runoff, leading to the problem of biomagnification. Freshwater dolphins, crocodiles, winter monitor lizards and various species of turtles that were abundant in various *beels*, are either extinct or highly endangered. A number of fish species, such as *Puntius jerdoni*, *Begarius bagarius* and *Semiplotus semiplotus* are on the verge of extinction (Dubey and Ahmed 1995).

Biodiversity can be an important component in the economic valuation of the wetlands (Aylward 1991). The change in biodiversity has implications for the food security and livelihood of the population that depends on the *beels*. The economic value of the biodiversity has not yet been studied. Information on ecological interrelationships between changes in biodiversity and changes in the primary productivity of the *beels* is required to establish appropriate policies for *in situ* and *ex situ* conservation and for other environment-related initiatives.

Community-based Co-management

Assam is struggling to build its economy through efficient resource utilization, specially the *beels*. However, the current management strategy does not allow for the local fishing community to have a role in the management paradigm. Historically, village and community-based

Table 4. Household profile of Bhitor Kokila Koibara Gaon.

Parameters	Number	%
Households surveyed	100	19
Type of family		
Nuclear	40	40
Joint	60	60
Size of family		
1-5 members	22	22
5-10 members	68	68
10-15 members	20	20
Age distribution		
0-10 years	124	21
11-20 years	103	18
21-50 years	349	60
above 50 years	5	1
Educational status[@]		
Illiterate	223	49
Lower primary	82	18
M E*	101	22
HSLC**	51	11
Main occupation of the family		
Fishing	100	100
Subsidiary occupation		
Fish retailing	47	8
Animal husbandry	39	7
Vegetable retailing	11	2
Agriculture	35	6
Horticulture	24	4
Daily wage earner	17	3
Petty business	5	1
Landholding		
Below 0.5 ha	71	71
0.5 - 1.0 ha	22	22
1.0 - 2.0 ha	7	7
Assets		
Fishing nets	100	100
Hand cart	9	9
Bicycles	56	56
Radio	73	73
Television	6	6
Indigenous fish traps	100	100
Land use[#]		
Housing	-	60
Agriculture	-	11
Horticulture	-	20
Livestock raising	-	7
Others	-	2
Annual income		
<Rs. 5 thousand	65	65
Rs. 5 - 10 thousand	16	16
Rs. 10 – 11.5 thousand	19	19
> Rs. 11.5 thousand	0	0

[@] 10 years aged population (?)
* Middle English Standard (Class VII finished)
** High School Leaving Certificate
[#] 1.0 – 2.0 ha category is excluded

management of *beels* and traditional fishing rights have existed. However, for the most part, these systems have disappeared. Recognition of the need for sustainable development and the need to address the ecological, economic and social objectives, makes a change in the management policy for *beels* an imperative.

Biotope improvement is a must for the long-term optimum exploitation of the *beels* (Jhingran 1979), in terms of both environmental protection and productivity. The resources will dwindle in due course of time if biotope improvement is not made (Yadava 1987). Under the present management system no one is responsible for this aspect. Historical information shows that the *beels* were once the common property of the community and conservation ethics were followed. Catching and killing of broodfish and juveniles were prohibited. Such conservation practices still prevail among the *Tiwa* community of the Morigaon district in central Assam. Jon *beel* is a classic example of such management.

In most cases poor fishers are also under pressure to increase their income and easily fall prey to the lessee's interests. In a study (Paswan et al., pers. comm.) conducted at Bhitor Kokila Koiborta Gaon, a typical fishers village comprising 524 families, it was observed that none of the fishers abide by the Indian Fisheries Act 1897. The household profile of the respondents and their compliance with the Indian Fisheries Act are given in Tables 4 and 5, respectively. The study highlights the need for enforcement of the Act to conserve the rich aquatic biodiversity through community participation.

A number of fisher cooperatives exist but have no meaningful function. The members are often ignorant about their rights and roles. They work as wage labor for the lessee who is usually the leader of the cooperative. It is necessary to develop a community-based co-management model for the *beels* of Assam like those applied in the reservoir fisheries in northeastern Brazil (Christensen et al. 1995). The government must take the initiative and get scientists and development personnel to develop and establish community-based fisheries co-management for *beel* fisheries in Assam.

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Table 5. Compliance with fisheries regulations, % of respondents.

	Yes	No
Awareness of fisheries regulations	62	38
Obedience	0	100
Exposure to awareness campaign on fisheries rules and regulations	0	100
Lodge reports of violations of rules	0	100
Official monitoring of fishing in closed season	0	100
Official checking of mesh size to prevent catching of undersized fishes	0	100

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U.K. BARUAH, A.K. BHAGOWATI, R.K. TALUKDAR *and* **P.K. SAHARIA** *are from the Fisheries Research Centre, Assam Agricultural University, Jorhat – 785 013, Assam, India.*