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## **Impact of Changes in Management Regime on Fisheries: A Temporal Case Study of Dhir Beel in Assam**

**N. K. Barik, B. K. Gorai and M. Choudhury**

### **Abstract**

The floodplain wetlands (beels) constitute important fisheries resources of Assam. These resources are managed through a complex social framework. The state of this management regime determines the level and sustainable utilization with implications on fisheries and livelihoods. To find the impact of such management regime, a case study has been undertaken in the Dhir beel of Assam. The impact of the change in the management regime on the sustainability of fisheries and livelihoods of fishers has been evaluated. This change in the management regime has been due to immigration of a large number of people from the nearby areas since 1985. The study has compared the scenario that existed 'before 1985' (data of 1982-84) and "after 1985' (data of 2004). There has been a significant increase in the fishing pressure with new fishing practices (1.5 to 5 times) as well as intensity of effort (3 to 7 times). The weakening of the regulating institutions has led to irrational practices which in turn, have resulted in a decline (22.32%) in the production and productivity of the beel. The decline has been more (31.79%) in terms of value than production of fish, indicating a definite decline in the quality of the fish available in these resources. In the changed scenario, the economics of the management has gone against the resource managers as they are to spend more money on monitoring and enforcing the rules. The livelihood of the fishers has also declined with the high degree of sharing of fish among the fishers.

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Central Inland Fisheries Research Institute, Barrackpore, West Bengal- 700 120;  
Email: [nageshbarik@rediffmail.com](mailto:nageshbarik@rediffmail.com)

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## **Introduction**

The Dhir beel is a water body situated in the Dhubri district of Assam. It is characterized as a floodplain wetland, covering an area of 689 ha and has a connection with the river Brahmaputra through a 11-km long channel. Three villages, viz. Satyapur, Mowatari and Santipur with inhabitations of about five thousand people surround this water body. Traditionally, these villages were inhabited by local Hindu fishers in which 500 people were exclusively dependent on the Dhir beel. In 1985, people (mostly Muslim migrants) from the neighbouring areas started migrating to the area around this water body, causing a conflict with the local fishers. Over a period of time, social dynamics has resulted in the changes in stakeholders, institutions governing regulatory regimes and management system. The present study has attempted to understand the dynamics of the fisheries management regimes and its impact on fisheries and livelihoods in the Dhir beel. Such a study is particularly important as no such study has been made in India so far due to lack of comparative data about the 'before and after' 1985 situation. The present study has been undertaken in the Dhir beel as the case study with the specific objectives of (i) studying the process and content of the change in regulatory regimes, (ii) finding its impact on the fisheries and the livelihood of the fishers, and (iii) highlighting the sustainability implications of the change.

## **Materials and Methods**

The present study used the 'before and after 1985' approach to evaluate the impact of the changes in the management regimes in the Dhir beel fisheries. The scenario of 'before' and 'after' was created for a comparison. The period prior to immigration (1985) was taken as 'before' and the year 2004 as 'after' scenario. The primary data were collected by survey method in the year 2004 from the fishers and managers for building the 'after'-scenario. For collection of data, schedules, personal interviews and group discussions were used as tools. For building the 'before'-scenario, the data generated by CIFRI during 1982-84 for the fisheries study were used (Choudhury, 1987; Yadava and Choudhury, 1984; Yadava, 1986). The changes in the management regimes on temporal basis were documented by collecting information through discussions with the lease holders and senior fishers of the area. For analytical purpose, changes in the exploitation were assessed through changes in population pressure, fishing practices, fishing effort, etc. The implications of the changes were observed on fisheries of the Dhir beel and livelihoods of the people. The fishery was evaluated in terms of production, productivity, and quality of fish and economics of fisheries.

The livelihood changes were measured through the decline in the catch per day and change in the sharing arrangements.

## **Results and Discussion**

### **(A) Management Regime and Temporal Change**

The water body owned by Assam Fisheries Development Corporation (AFDC) has been leased out to a private person for 5 years (2002 to 2007). The fisheries management involves facilitation of inward flow of the fish seed through connecting channel, observation of fishing closure during the rainy season, non-use of destructive gears like very small-meshed net, catching the fish of economic size, monitoring and collection of information (e.g. flow fish seed, who is fishing, number of people fishing, types of gear used, amount of catch, type of fish, size of fish, price of fish, etc.), etc. These management measures require the cooperation, participation and compliance of the people living around the beel. Therefore, social and institutional environment is important for beel fisheries management. Due to influx of a large number of people from the neighbouring areas, the emigrants replaced the traditional fishers around the beel. Consequently, the whole set of social and institutional environment has undergone a dramatic shift. The immigrants had different sets of values and norms, and have disregard for the traditional institutions of self-regulations and rule compliance. Consequently, the regulation regimes weakened over a period of time. Now, the rules and management schemes made by the manager are frequently breached, leading to poor management of the beel.

### **(B) Impact on Exploitation of Fisheries**

#### **(i) Population Pressure for Fishing**

In the 'before'-scenario, 500 fishers were completely dependent on the Dhir beel. These people belonged to the scheduled castes community. But, they were compelled to leave the area (since 1985) due to conflicts with the immigrants. Presently, only a few original fishers were fishing in the beel. A majority of them had migrated to the urban centres for their livelihoods. They were engaged in activities like urban industrial labour, wage earner, etc. At present, around 3000 migrated people were dependent partially on the beel for their livelihood; working as wage earners, and agricultural labourers. The fishing was seen as the last resort for livelihood, as they go to fishing when there are no other alternatives. These types of fishings are particularly important during the monsoon season (May-August), when there are limited agricultural activities in the area due to flooding.

**(ii) Fishing Methods**

The fishery was completely dependent on the natural stocking from the river Brahmaputra through a connecting channel. A wide variety of fishing practices were followed in the beel, depending upon the species, size and season. These fishing practices were the important capture technology, which had undergone changes across the time. The fishing practices of ‘before’ and ‘after’ scenario have been depicted in Table 1.

**Table 1. Types and number of fishing gears and practices in the Dhir beel**

Types of fishing practices	Period	No. of gears		
		Before 1985	After 1985 (2004)	Change, %
Brush park	Oct.-Jan.	12	18	50
Barrier	Aug.-Oct.	1	1	0
Drag net (big-mesh)	Oct.-Nov.	5	12	140
Drag net (fine-mesh)	July-Sept.	0	25	-
Gill net	Sept.-Oct.	50	200	300
Cast net	Sept.-Oct.	5	10	100
Scoop net	Sept.-Oct.	10	50	400
Traps	Sep.-Feb.	50	200	300
Dip net	Sep.-Dec.	10	20	100
Hook and line	Mar.-June	10	50	400
Pen fisheries (ha)	July-Nov.	0	30	-

In the ‘before’-scenario, brush park (*katal*) fishing was the major fishing practice in the beel (Yadava and Choudhury, 1981a) during October-January. During pre-monsoon and monsoon seasons, hook and lines, dip nets and traps were important. The barrier fishing (*banas* fishing) was predominant from August to October (Yadava and Choudhury, 1981b). In the ‘after’-scenario, the *katal* fishing was found continuing as the dominant fishing practice; but, the fishers were setting the *katal* by themselves in addition to that by the manager. The manager had 6 numbers of *katal*, while 12 were from fishers and each *katal* was operated four times in a year. In the ‘after’-scenario, 18 *katal*s were being operated four times, while earlier these were 12 and were operated only twice. Hence, the operation of the *katal* increased from 24 to 72 in a year. One *banas* fishing was in operation as before for about 3 months in a year.

A new fishing gear, observed during the study, was the fine-meshed drag net called *Masuri Jal* and was considered as the destructive fishing gear if operated during the breeding season. Ten-to-twelve such nets were being operated during October-November and 25 during July-September. Use of this gear was observed intense during the breeding (rainy) season, which was responsible for the killing of juveniles. A total of 10 cast nets

(*Khora jal*) were being operated during September-October, which were 5 before 20 years. There were 150 – 200 gill nets (*Fasi jal*) of 2-inch mesh size, which were around 50 in the ‘before’ period. The number of scoop nets (*Thela jal*) operated during Sep.-Oct. had increased to 50 from 10. The number of dip nets operating in the channel had increased from 10 to 20. The fishing in the margins of beels by erection of enclosures called *pen fisheries*, was a new development. A portion of marginal areas (total area of 30 ha) was covered by 10 number of pens. These fishers had forcedly asserted their rights over these areas owing to the proximity to their dwellings.

In terms of the percentage change, the operations of the various gears increased in the range of 50 per cent to 400 per cent over past two decades. The highest increase of fishing nets was observed in the case of gill nets, drag nets, scoop net and hook and line (Table 1).

### (iii) Fishing Effort

The fishing effort increased by the number of gears as well as intensity of their use. This increase was from 100 per cent to 650 per cent. The total effort was the combined effect of the number of gears and intensity of their use. The net rise in effort through *katal* was 200 per cent, drag net 140 per cent, gill net 300 per cent, and cast net 100 per cent. The increase was higher in the smaller gears like scoop net (400%), traps (300%), hook and line (650%), than in others, indicating an increase in the unorganized fishing activities. In the ‘after’-scenario, the introduction of new fishery practices like use of small-mesh nets during rainy season and pen fisheries in the marginal areas was observed. These trends reflected high increase in the fishing efforts and over-fishing in the beels (Table 2).

**Table 2. Change in the intensity of fishing in the beels**

Fishing methods	No. of days/year			Total effort/year		
	‘Before’	‘After’	Change, %	‘Before’	‘After’	Change, %
Brush park	2	4	100	24	72	200
Barrier fishing	90	90	0	90	90	0
Drag net	50	50	0	250	600	140
Drag net (small-mesh)		90	-	0	2250	-
Gill net	40	40	0	2000	8000	300
Cast net	50	50	0	250	500	100
Scoop net	60	60	0	600	3000	400
Traps	60	60	0	3000	12000	300
Dip net	100	100	0	1000	2000	100
Hook and line	100	150	50	1000	7500	650

**(C) Implications on Fisheries Output****(i) Production, Productivity and Value**

In the 'before'-scenario, the annual production was 121.1 t in 1982, 77.9 t in 1983 and 108.4 t in 1984 (Yadava and Choudhury, 1984), with an average of 102.5 t/yr. The total value of fish catch was approximately Rs 53.22 lakh based on the current price (Table 3). In the 'after'-scenario, the fish harvest was estimated to be 78.58 t with the value of Rs 36.30 lakh (Table 4)

**Table 3. Fish production in the 'before'-scenario in the Dhir beel**

Fish species	Fish harvest (t)	Price (Rs/kg)	Value (lakh Rs)
<i>Labeo rohita</i>	14.53	70	10.13
<i>L. gonius</i>	0.13	60	0.08
<i>L. calbasu</i>	0.68	50	0.34
<i>L. bata</i>	0.39	50	0.20
<i>Catla catla</i>	3.60	70	2.52
<i>Cirrhinus mrigala</i>	1.23	60	0.74
<i>C. reba</i>	0.47	50	0.24
<i>Wallago attu</i>	8.24	60	4.95
<i>Mystus seenghala</i>	1.32	50	0.66
<i>Mystus aor</i>	0.18	50	0.09
<i>Hilsa ilisha</i>	0.26	80	0.21
<i>Gadusia chapra</i>	34.57	50	17.28
<i>Eutrophichthys vacha</i>	0.36	50	0.18
<i>Notopterus notopterus</i>	0.95	40	0.38
<i>Notopterus chitala</i>	3.535	70	2.47
Live fishes	10.44	60	6.26
Miscellaneous	21.63	30	6.49
Total	102.48		53.22

A perusal of Table 5 reveals a decline in both fish production (from 102.48 t to 78.58 t) and productivity (from 148.74 kg/ha to 114.05 kg/ha) with the percentage decline of 23.32. The value of the produce declined from Rs 53.22 lakh to Rs 36.30 lakh, with a percentage decline of 31.79. The value of fish per ha declined from Rs 7.72 thousand to Rs 5.27 thousand. Thus, the decline was higher in monetary terms than in production or productivity, indicating a deterioration in the quality-composition of the fish stock. In the 'after'-scenario, fish catch consisted of low-value fishes, as examined in the next section.

**Table 4. Fish production in the ‘after’-scenario in the Dhir beel\***

Fishing practices	Fish harvest (t)	Price (Rs/kg)	Value (lakh Rs)
<i>Katal</i> (manager)	5.71	70	4.00
<i>Katal</i> (fishers)	10.00	70	7.00
<i>Bandha</i>	12.00	50	6.00
Drag net	6.25	40	2.50
Drag net (small-mesh)	14.40	25	3.60
Gill net	12.50	40	5.00
Cast net	1.71	35	0.60
Scoop net	5.00	35	1.75
Traps	2.00	35	0.70
Dip net	2.29	35	0.80
Hook and line	1.00	35	0.35
Pen fisheries	5.71	70	4.00
Total	78.58		36.30

\*The species-wise production data were not collected, hence the practice-wise production has been presented

**Table 5. A comparison of production, productivity and value in the Dhir beel**

Scenario	Production (t)	Productivity (kg/ha)	Value (lakh Rs)	Value per ha (thousand Rs)
‘Before’-scenario	102.48	148.74	53.22	7.72
‘After’-scenario	78.58	114.05	36.30	5.27
Change, %	(-)23.32	(-)23.32	(-)31.79	(-)31.79

**Table 6. Average size of selected fish harvested in the Dhir beel**

Species	‘Before’ (size in mm)	‘After’ (size in mm)
<i>L. rohita</i>	200-250	150-200
<i>C. catla</i>	250-300	100-200
<i>C. mrigala</i>	250-300	150-250
<i>W. attu</i>	400-450	200-300
<i>G. chapra</i>	100-150	30-70
<i>N. Chitala</i>	500-550	200-600

### (ii) Quality and Composition of Fish Catch

The impact of over and irrational fishing can be assessed through the decline in the share of commercially important fishes. The fish-catch composition and the average size of dominant fish species are the important indicators of the quality of fish catch. The average size for various fish species had declined over the study period (Table 6). In the ‘after-scenario’, the fish was caught at the juvenile stage/small-size due to a weak regulatory mechanism.

**(iii) Economics of Fisheries**

In the 'after'-scenario, the economics of the fisheries had undergone a change and were analyzed in terms of cost, return and sharing arrangements.

*Cost Composition:* In the Dhir beel, three major components of cost were: lease-rent, transactions cost, and fishing activities. The lease-rent was paid to Assam Fisheries Development Corporation towards the fishing rights. The transaction cost was the cost on collecting information, monitoring and enforcing rules, etc; it constituted a large share (Rs 5.75 lakh) of the total cost. It included Rs 2.50 lakh on monitoring and watch and ward; Rs 0.25 lakh on managing work at landing centre; Rs 1.50 lakh on village community and other charitable purposes like *puja*, school, road repairing etc; Rs 1.00 lakh on the local police for protection and enforcing the rules; and Rs 0.50 lakh on the diesel for operating motor boat for monitoring. The operation cost of one big brush park was Rs 4000 and one small brush park was Rs 2000. The manager spent about Rs 18,000 towards fishing on his brush parks. The fishers incurred cost of operating their brush parks. A sum of Rs 60-70 thousand was spent on *banas* fishing and Rs 30 thousand on the nets, gears and trap maintenance per year (Table 7).

**Table 7. Cost composition and cost-sharing in the Dhir beel**

Cost components	Cost sharing (thousand Rs)			Cost sharing, %		Percentage distribution	
	Total	Manager	Fisher	Manager	Fisher	Manager	Fisher
Lease-rent	367	367	0	100.0	0.0	35.6	0.0
<i>Katal</i> (manager)	18	18	0	100.0	0.0	1.8	0.0
<i>Katal</i> (fishers)	36	0	36	0.0	100.0	0.0	12.2
<i>Banas</i>	50	50	0	100.0	0.0	4.9	0.0
Others	50	10	40	20.0	80.0	1.0	13.5
Transaction cost	675	575	100	85.2	14.8	55.8	33.8
Pen fisheries	60	0	60	0.0	100.0	0.0	20.3
Drag nets	50	10	40	20.0	80.0	1.0	13.5
Total	1326	1030	296	77.7	22.3	100.0	100.0

The cost-sharing arrangement indicated that a large part of management cost was borne by the manager (77.7%). In terms of percentage composition of total cost, the transaction cost was maximum (55%), followed by lease rent (35.6%). Therefore, cost on maintenance of the fishing rights and monitoring of fisheries was quite high. The fishers shared only a small percentage (22.3) of the management cost.



*Sharing of Output:* The return analysis indicated that the share of the manager was Rs 15.47 lakh, whereas the fishers got Rs 20.8 lakh out of a total return of 36.3 lakh. This also indicated that fishers shared 22.3 per cent of cost but received return of 57.3 per cent. On the other hand, the manager paid 77.7 per cent of cost and got only 42.7 per cent return. This revealed that the higher benefits were obtained by fishers than a manager (Table 8).

**Table 8. Sharing of returns from the Dhir beel**

Fishing practices	Returns, in thousand Rs			Returns, %	
	Manager	Fishers	Total	Manager	Fishers
<i>Katal</i> (manager)	400	0	400	100	0
<i>Katal</i> (fishers)	210	490	700	30	70
<i>Banas</i>	600	0	600	100	0
Drag net	63	188	250	25	75
Drag net(small-mesh)	90	270	360	25	75
Gill net	50	450	500	10	90
Cast net	12	48	60	20	80
Scoop net	35	140	175	20	80
Traps	7	63	70	10	90
Dip net	20	60	80	25	75
Hook and line	0	35	35	0	100
Pen fisheries	60	340	400	15	85
Total	1547	2083	3630	42.7	57.3

#### (iv) Sharing Arrangements of Output between Fishers and Managers

The sharing arrangement can also be considered as an indicator of sharing of costs and returns. It affects the economics of operations. A higher share of a manager has a negative impact on the livelihood of fishers, and a high share of fishers results in lower returns to the managers for investing in the beel. For a comparison, the sharing arrangements in the 'after'-scenario were compared with the 'past' through questioning the elder fishers and managers who managed the beel during 1982-84 (Table 9). On temporal perspective, the share of managers had declined drastically across all fishing practices. The decline was higher in the case of large gears like brush park, drag nets, etc. But, the share of the managers remained almost unchanged for the smaller gears like traps, dip nets, etc. This points towards enhanced bargaining capacity of the fishers vis-à-vis managers. In general, it could be inferred that the fishers received a higher share in the 'after' than 'before' scenario.

**Table 9. Sharing arrangements between manager and fisher**

(in per cent)

Fishing practices	In 'after'-scenario		In 'before'-scenario	
	Manager	Fisher	Manager	Fisher
Brush park	30	70	70-75	25-30
Drag net	25	75	60-70	30-40
Gill net	10	90	60-75	25-40
Cast net	20	80	50-60	40-50
Scoop net	20	80	25-40	60-75
Traps	10	90	10-20	80-90
Dip net	25	75	20-30	70-80
Hook and line	0	100	0	100
Pen fisheries	15	85	-	-

**(d) Impact on Livelihood of Fishers****(i) Income**

The results revealed that the fishers had a larger share in the fish catch in the 'after'-scenario due to weakening of control of the managers over the beel management. But, in terms of the returns, a fisher got an average of Rs 3.50 to Rs 95.20 per day in the 'after'-scenario. The average wage of an agricultural labourer was Rs 50 and of a general labour was Rs 70 in 2004. Thus, the fishers were receiving returns lower than those prevailing for the alternative wages available to them. It revealed the distress fishing and a last resort under the situation of non-availability of alternative employment (Table 10). In the 'before'-scenario, the traditional fishers were exclusively dependent on fishing for their livelihood, but the immigrant fishers were only partially dependent on it. Therefore, the structure of the fisheries as livelihood source has undergone a change over the period of time.

**Conclusions and Policy Implications**

The study has revealed that the management regimes and institutional arrangements governing fisheries have undergone a change in the Dhir beel. In the 'after 1985'-scenario, the management has a limited control over the access and use of the beel fishery resource. The efforts and irrational fishing practices have increased, resulting in a decline in the production, productivity and value of the fish catch. The decline has been predominant in the composition and quality of the fish stock, as evident from the reduction in average size of the fish catch. It has also indicated an increased fishing pressure on juveniles. The weakening of the regulatory regime has led to

**Table 10. Analysis of return to fishers in the Dhir beel**

Fishing practices	Total effort	No. of fishing days	Average catch/day (kg)	Average price (Rs/kg)	Catch per day (Rs)	Share of fishers (%)	Value of fishers share ('000 Rs)	Return per fishing day (Rs)
Dragnet	600	5	10.4	40	416	75	312	62.40
Dragnet *	2250	5	6.4	25	160	75	120	24.00
Gill net	8000	2	1.6	40	64	90	57.60	28.80
Cast net	500	1	3.4	35	119	80	95.20	95.20
Scoop net	3000	1	1.7	35	59.50	80	47.60	47.60
Traps	12000	0.2	0.2	35	7	90	6.30	31.50
Dip net	2000	1	1.1	35	38.50	75	28.88	28.90
Hook and line	7500	1	0.1	35	3.50	100	3.50	3.50

\*small-mesh

unsustainable use of the resource. The implications are more predominant in the case of economic sustainability, as the share of management in the return has reduced, while the cost of management has increased; particularly the transactions cost on monitoring and maintaining of information system. The collapse or weakening of the regulatory system has shown an adverse impact on the biological and economic sustainability of the beel. The increased access and efforts in fisheries have implications on return from the effort, as fishers earn less than the minimum labour wage prevailing in the area; contributing negatively to the livelihood of the fishers.

The increased access has led to the situation of 'open access' in which no one gains in the long-run. There is a need for the policy interventions to avert the collapse of the regulatory regime in this beel. Such collapse was primarily caused by the inefficient institutions and lack of enforcement mechanism for compliance of the legal and institutional restrictions. The efforts need to be intensified on enforcement of these rights, e.g. the right of the managers to manage and receive legitimate shares in fisheries. There is also a need to establish a mechanism for conflict resolution through negotiations, and participation of the fishers in management. The community-based management needs to be encouraged. In the 'after'-scenario of increase in the population pressure and fisheries being taken as the last resort, the rights and access to the fisheries are to be prioritized, so that the groups within the dependent population can be identified and provided access on priority basis.

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