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## Present status of oxbow lake fisheries: Cases from south-western Bangladesh

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### Abstract

Oxbow lakes are semi-closed water bodies (locally called *Baor*) occupied by dead channels of rivers. To evaluate the existing status of *Baor* fisheries two *Baors* (Baluhor and Nasti *Baor*) of different management practices in south-western Bangladesh was selected. Both primary and secondary data were collected from March to December 2018. Management of Baluhor and Nasti *Baor* were enforced by the Department of Fisheries (DoF) and fishers' community themselves (CBFM) respectively. Fishers' involvement with fishing activities had restricted access to both study *Baor* areas. The commonly cultured species were *Labeo rohita*, *Catla catla*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella*, *Cirrhinus cirrhosus*, *Mylopharyngodon piceus*, and *Cyprinus carpio*, locally called "*Raja Mach*". Various non-stocked fishes were also found in both *Baors* that reproduced naturally, locally called "*Rani Mach*". In Nasti *Baor*, fish was harvested (Both *Raja* and *Rani Mach*) three to four times a year while it was two times in Baluhor *Baor*. Furthermore, fishers had access to harvest "*Rani Mach*" round the year in Baluhor *Baor* while there was no access in Nasti *Baor*. Annual production rate of *Raja Mach* (Kg/hectare) in Baluhor and Nasti *Baor* was 471.45 and 1806.45 respectively while in the case of *Rani Mach* the production rate (Kg/hectare) was 373.04 and 327.06 respectively in Baluhor and Nasti *Baor*. The current study also found a range of managerial, natural, economic, and social obstructions in *Baor* fisheries management.

**Keywords:** *Baor*, fisheries, culture, capture, management, obstructions

### 1. Introduction

Oxbow lakes, locally called *Baors* are semi-closed water bodies, which are occupied by the dead channels of the river in the moribund delta of the Ganges [1]. About six hundred natural *Baor* covering 5,488 hectares exist in south-western districts of Bangladesh (Khulna division: Jessore, Jhinaidah, Chuadanga and Kushtia and Dhaka division: Faridpur) with a significant potentiality of fish culture [4, 6]. It also considered as the natural habitat and breeding ground of different indigenous fishes [1].

Before 1951, *Baors* were the properties of Landlords and became government property after the abolition of the Landlords (Jomidari) system through a land settlement act in 1951 [8]. To increase fisheries production six *Baors* were brought under culture-based fisheries management during 1979-1985 through the Oxbow Lakes Project 1 (OLP-1) [1]. After successful completion of the project, Oxbow Lakes Project 2 (OLP-2) had been started and institutionalized the fisheries management to the fishers themselves by ensuring their participation in the management process during 1988 to 1997 [11, 2]. Under this project, there were 23 *Baors*. Though both the project have been completed, currently these 29 *Baors* are being cultured and managed under "Oxbow Lake Project 1 programme (6 *Baors*)" and "Oxbow Lake Project 2 programme (23 *Baors*)" for increasing fish production and to uplift the socio-economic condition of the fishers.

### 2. Material and Methods

#### 2.1 Selection of the Study area

The present study was conducted in two *Baors*, 'Baluhor *Baor*' and 'Nasti *Baor*' at Kotchandpur and Maheshpur Upazila respectively of Jhenaidah district. The total area of Kotchandpur and Maheshpur upazila are 165.66 km<sup>2</sup> and 419.53 km<sup>2</sup> with GPS at 23°24'N89°1'E and 23°21'N 88°54.8'E respectively (Figure 1). Both *Baors* are de-functioned part of the Kapotaksha river.

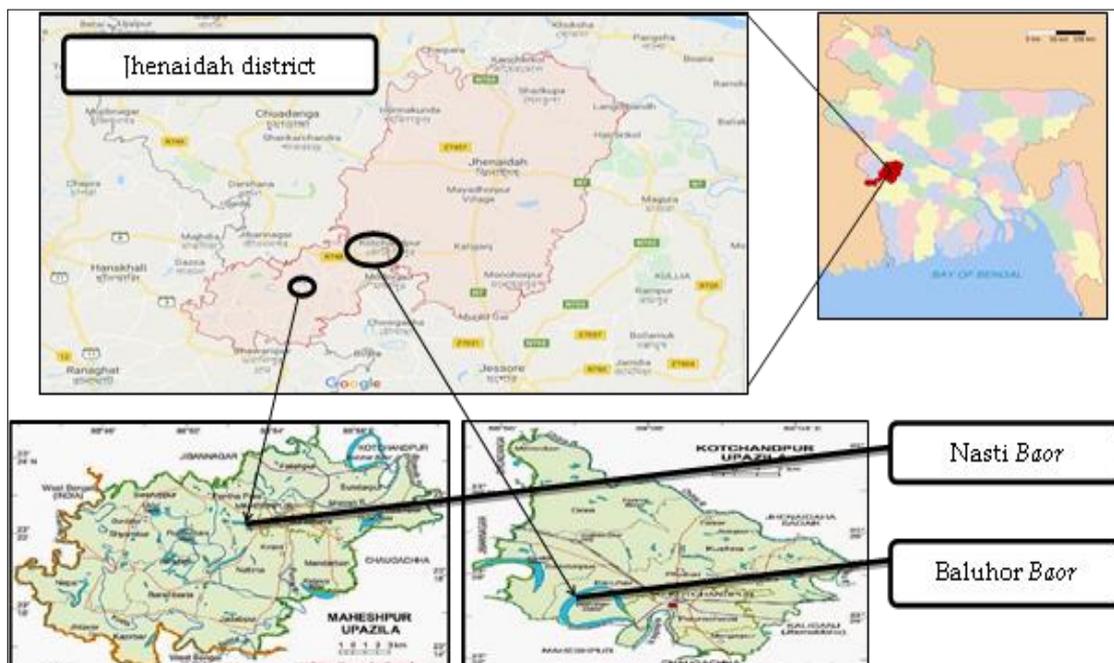


Fig 1: Map showing the location of two study areas (Baluhor and Nasti Baor)

**2.2 Data collection methods**

Both primary and secondary sources were considered during data collection. A total of 110 face-to-face semi-structured interviews (55 from each *Baors*), 10 FGDs (6 from Baluhor *Baor* and 4 from Nasti *Baor*), 9 key informant interviews (5 from Baluhor *Baor* and 4 from Nasti *Baor*) were performed to collect data. Secondary data were collected from different literature review, various policy reports, local fisheries office, various NGOs, district commissioner office and other relevant organizations.

**2.3 Data processing and analysis**

All the collected data were summarized and scrutinized carefully before the actual tabulation. MS Excel software has been used for possible data processing and analysis. Finally, resulting data presented in tabular and graphical form in results and discussion sections.

**3. Results and Discussion**

**3.1 Fishers participation**

Fishers’ involvement with fishing activities has restricted access to both study *Baor* areas. There were 288 fishers in Baluhor *Baor* and they were divided into 18 sub-groups under 18 group leaders. This study has showed that 49 of these fishers were from Baluhor village, 47 from Ramchandrapur village, 67 from Shingia village, 60 from Bazrapure village and 65 from Kagmari village (Figure 2). There was also a local fishers association named “Baluhor Matsajibi Samiti” with 378 members.

Nasti *Baor* was managed by “Nasti *Baor* Management Association” which had 12 executive members and total of 137 fishers. It was found that 126 of these fishers were from Nasti village, 8 from Uzzolpur village, 3 from Padmarajpur village (Figure 2).

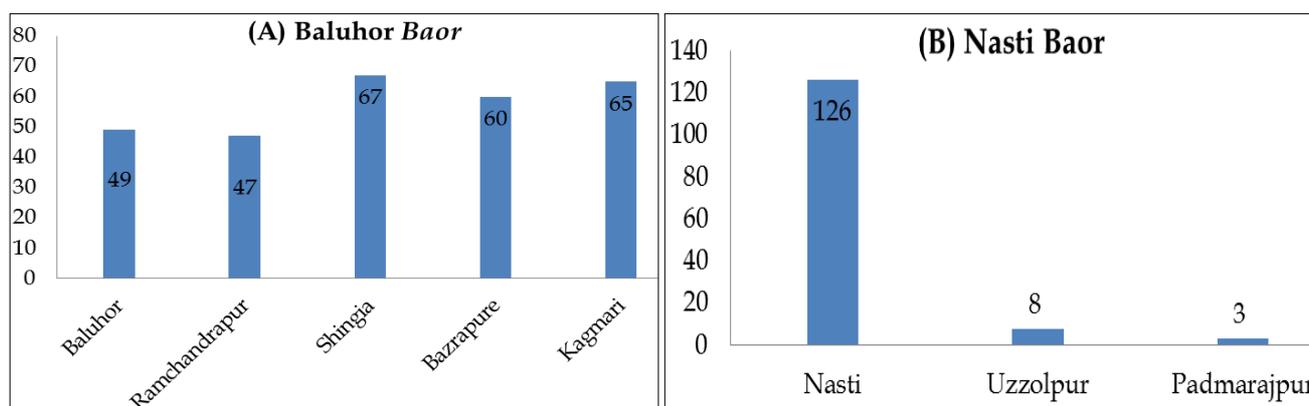
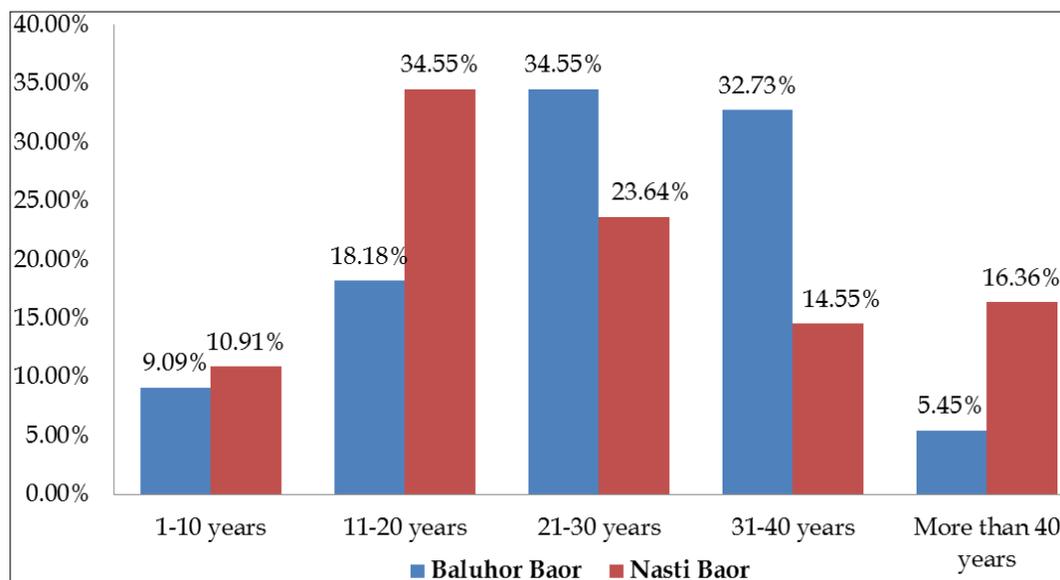


Fig 2: Number of fishers from different villages at Baluhor (A) and Nasti Baor (B)

**3.2 Fishers’ fishing experience**

Maximum fishers in both study areas had been involved with the fishing profession for a long time. The fishers mean year of involvement with fishing at Baluhor *Baor* was  $27.75 \pm 11.662$  ranging from 3 to 55 years where it was  $25.83 \pm 12.787$  ranging from 2 to 50 years for the fishers of Nasti *Baor*. It was also found that in Baluhor *Baor* 9.09% fishers

had been involved with fishing for 1-10 years, 18.18% for 11-20 years, 34.55% for 21-30 years, 32.73% for 31-40 years and 5.45% for more than 40 years (Figure 3). On the other hand, in Nasti *Baor* 10.91% fishers had been involved with fishing for 1-10 years, 34.55% for 11-20 years, 23.64% for 21-30 years, 14.55% for 31-40 years and 16.36% for more than 40 years (Figure 3).



**Fig 3:** Distribution of fishers (%) based on experience at Baluhor and Nasti Baor

### 3.3 Cultured and non-stocked fishes

According to 5 years production data and FGDs information, it was found that 5 types of carp species (locally known as

'Raja Mach') were used to culture (fry are released and then harvest when these are the marketable size) in Nasti Baor where it was 7 types in Baluhor Baor (Table 1).

**Table 1:** Species of 'Raja Mach' stocked for culture in Baluhor and Nasti Baor

Cultured fish (Raja Mach)	Stocked in Baluhor Baor	Stocked in Nasti Baor
Rui ( <i>Labeo rohita</i> )	√	√
Catla ( <i>Catla catla</i> )	√	√
Silver carp ( <i>Hypophthalmichthys molitrix</i> )	√	√
Grass carp ( <i>Ctenopharyngodon idella</i> )	√	
Mrigal ( <i>Cirrhinus cirrhosus</i> )	√	√
Black carp ( <i>Mylopharyngodon piceus</i> )	√	
Common carp ( <i>Cyprinus carpio</i> )	√	√

Hasan and Bala (1999) [7], Biswas *et al.* (2009) [3] and Abdullah-Bin-Farid *et al.* (2013) [11] also mention that three species of Indian major carps (rohu, catla and mrigal) and three Chinese carps (silver carp, grass carp and common carp)

are regularly stocked and harvested from Baor. Furthermore, various types of non-stocked fishes were found in both Baors which were reared and reproduced naturally (locally known as 'Rani Mach') (Table 2).

**Table 2:** Species of 'Rani Mach' found in Baluhor and Nasti Baor

Non-stocked fish (Rani Mach)	Found in Baluhor Baor	Found in Nasti Baor
Shol ( <i>Channa striata</i> )	√	√
Taki ( <i>Channa punctata</i> )	√	√
Gozar ( <i>Channa marulius</i> )	√	√
Shing ( <i>Heteropneustes fossilis</i> )	√	√
Magur ( <i>Clarias batrachus</i> )	√	√
Koi ( <i>Anabas testudineus</i> )	√	√
Punti ( <i>Puntius spp</i> )	√	√
Chela ( <i>Salmophasia acinaces</i> )	√	√
Mola/Maya ( <i>Amblypharyngodon mola</i> )	√	√
Kholisha ( <i>Trichogaster spp</i> )	√	√
Bheda/Meni ( <i>Nandus nandus</i> )	√	√
Bele ( <i>Glossogobius giuris</i> )	√	√
Chingri ( <i>Macrobrachium malcolmsonii</i> )	√	√
Kachki ( <i>Corica soborna</i> )	√	√
Chapila/Khoyra ( <i>Gonialosa manmina</i> )	√	√
Chanda ( <i>Chanda nama</i> )	√	√
Air ( <i>Sperata aor</i> )	√	
Baim ( <i>Anguilla bengalensis</i> )	√	√
Guchi baim ( <i>Macrornathus pancalus</i> )	√	√
Tara baim ( <i>Macrornathus aral</i> )	√	√
Bajramoni/Dhela ( <i>Osteobrama cotio</i> )	√	√

Haque *et al.*, 1999 <sup>[5]</sup>, Hasan and Talukder, 2004 <sup>[9]</sup> also found the similar findings that non-stocked indigenous fishes available in oxbow lakes consist mainly of clupeids, catfishes, goby, perches, minor carps, minnows, snakeheads, mullets, pipe fishes, loaches, eels, freshwater prawns etc.

### 3.4 Production

#### 3.4.1 *Raja Mach* production

From the key informant interviews and FGDs it was found the

annual production rate of *Raja Mach* from last 5 years in Baluhor *Baor* were 460.99 kg/ha, 339.80 kg/ha, 468.34 kg/ha, 568.26 kg/ha and 519.86 kg/ha for 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18 fiscal years respectively wherein Nasti *Baor* 1781.47 kg/ha, 1958.44 kg/ha, 2015.84 kg/ha, 1393.16 kg/ha and 1883.32 kg/ha for 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18 fiscal years respectively (Figure 4).

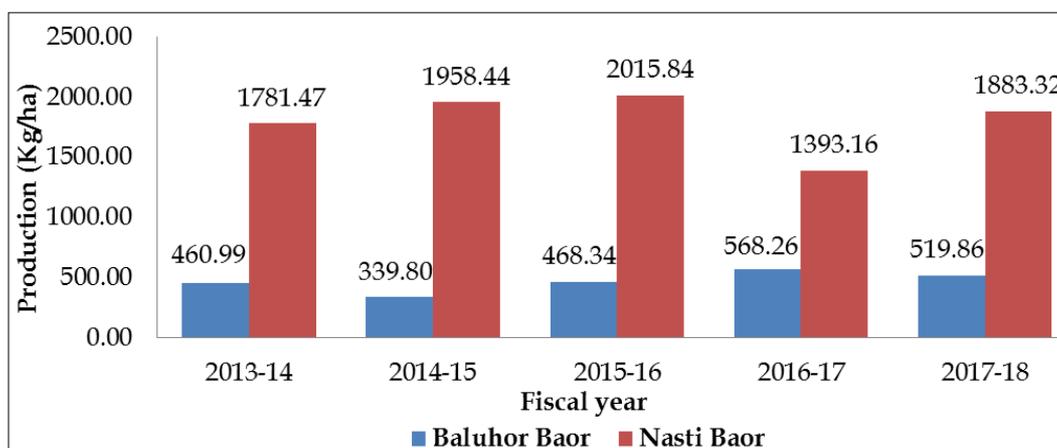


Fig 4: Annual production rate of *Raja Mach* in Baluhor and Nasti *Baor*

There was vastly difference between the *Raja Mach* production rate of Baluhor and Nasti *Baor*. Findings indicate the lack of proper management in the production system of Baluhor *Baor*.

#### 3.4.2 *Rani Mach* production

Present study also found that the annual production of *Rani*

*Mach* from last 5 years in Baluhor *Baor* were 531.91 kg/ha, 240.82 kg/ha, 276.88 kg/ha, 425.53 kg/ha and 390.07 kg/ha for 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18 fiscal years respectively wherein Nasti *Baor* 220.72 kg/ha, 348.54 kg/ha, 156.92 kg/ha, 496.46 kg/ha and 412.68 kg/ha for 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18 fiscal years respectively (Figure 5).

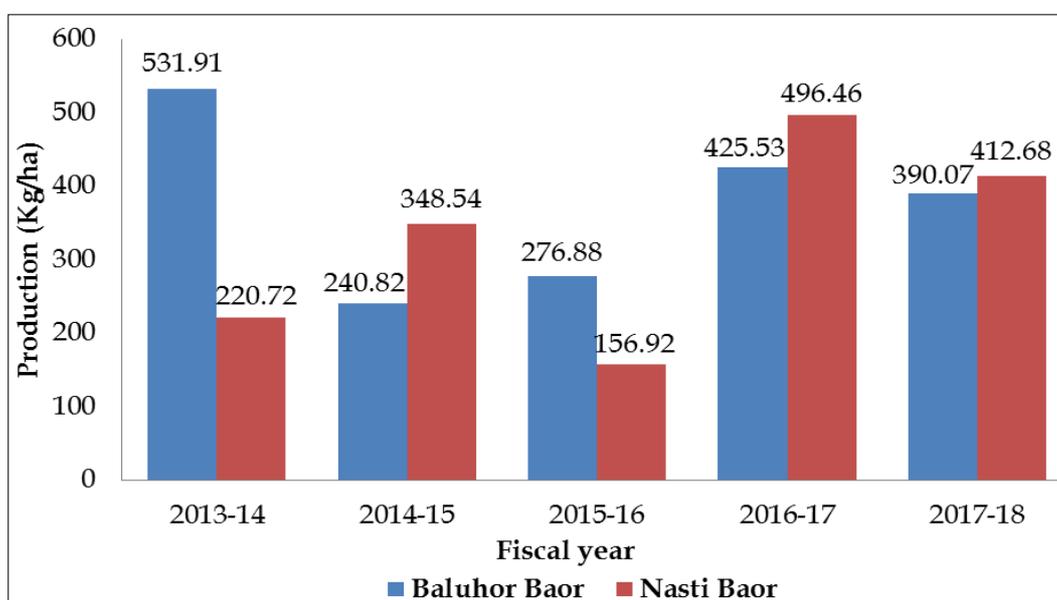


Fig 5: Annual production rate of *Rani Mach* (Kg/hectare) in Baluhor and Nasti *Baor*

### 3.5 Fishing access

Both *Baors* had abundant cultured (*Raja Mach*) and non-stocked natural (*Rani Mach*) fish but only restricted people had permission to harvest fish from both of two *Baors*.

In Baluhor *Baor* 288 fishers had permission to harvest both *Raja* and *Rani Mach* and for that reason, they had to pay TK. 460 (TK. 400 + vat TK. 60) as license fee annually. Besides, fishers (who were members of “Baluhor Matsajibi Samiti”)

had permission to harvest only *Rani Mach* and for that reason, they had to pay TK. 345 (TK. 300 + vat TK. 45) as license fee annually. Fishers have got about 40% share of the harvested *Raja Mach* and the other 60% has gone to the government. Among that 60% share department of fisheries has got 35% where the Ministry of Land has got 25% of that share. On the other hand in Nasti *Baor* only 137 fishers had permission to harvest both *Raja* and *Rani Mach*. All fishers of

“Nasti *Baor* Management Association” had been harvested fish together in Nasti *Baor*. Fishers have got 100% share of the harvested fish.

### 3.6 Harvest method

#### 3.6.1 Harvest method in Baluhor *Baor*

Generally, *Raja Mach* was harvested two times in a year (November-December and May-June). Fishing date was fixed by *Baor* authority. After fixing the date, a fishing schedule was prepared for fish harvesting which was approved by the project director. After approval, all fishing activities were controlled by *Baor* manager. Two types of fishing methods were implemented in Baluhor *Baor* for *Raja Mach* harvesting namely, (a) Kochal fishing and (b) Komor fishing.

Kochal fishing was done before komor fishing. That fishing was mainly used for fishing the *Raja Mach* stock. Initially, the kochal jal (seine net) is operated for 5 to 10 days and by this time the runaways fish took shelter into komor that set in nearby areas. At that stage, the fishers were stopped operating the kochal jal and started fishing in the komors by encircling those with komor jal (drag net). Maximum fishers had pieces of kochal jal and komor jal (2-5 pieces) and those were jointed together (each of 18 fishers groups separately work) during the harvesting period.

Komor fishing (drag netting) was principally adopted as a method to catch the remaining fishes in the *Baor* after kochal fishing. The remaining fishes after driven by kochal operation took shelter in the bush parks (locally called komor). Then komors were encircled by komor jal (drag net) and komor fishing was started.

*Rani Mach* was harvested around the year in Baluhor *Baor*. Different fishing gears such as entangle net of selective mesh size, borshi, ghuni/brittii etc. were used for *Rani Mach* harvesting.

#### 3.6.2 Harvest method in Nasti *Baor*

In Nasti *Baor*, fish was harvested at least three times (sometimes it maybe three or four times) in a year. The fishing date was fixed by ‘Nasti *Baor* Management Association’ after discussed with upazila fisheries office. Two types of fishing methods were implemented in Nasti *Baor* namely, (a) Kochal fishing and (b) Net fishing.

Kochal fishing was done before net fishing. That fishing was generally used for fishing the *Raja Mach* stock. Initially the kochal net (seine net) is operated by 9 groups of fishers under 9 team leaders. Maximum fishers had pieces of kochal jal (2-4 pieces) and those were jointed together during the harvesting period.

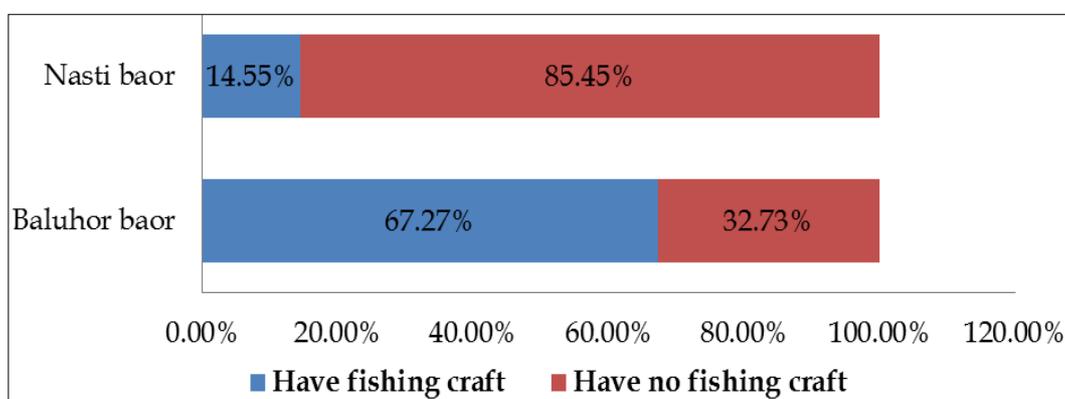
After completing kochal fishing all fishers were divided into 3 groups for net fishing (small mesh size net/ mosquito net was used). Net fishing was used to catch the remaining small fishes in the *Baor* after kochal fishing. Mosquito net was borrowed from the market at taka 4500 per day for 600 biya (1 biya = 6 foot).

### 3.7 Fishing purpose

Fishers from both *Baors* harvest fish generally for sale. Only fishers of Baluhor *Baor* harvest *Rani Mach* for both sale and household consumption. This study showed that in Nasti *Baor*, 100% fishers harvest both *Raja* and *Rani Mach* for sale where in the case of Baluhor *Baor* 100% fishers harvest *Raja Mach* only for sale and 69.09% fishers harvested *Rani Mach* for both sale and household consumption.

### 3.8 Status of fishing crafts

This study showed that in Baluhor *Baor* area 67.27% fishers had their own fishing craft (dingi nouka) where 32.73% had no (Figure 9). On the other hand in Nasti *Baor* area, only 14.55% fishers had their own fishing craft where 85.45% had no craft (Figure 6).



**Fig 6:** Fishers distribution (%) based on craft ownership at Baluhor and Nasti *Baor*

The field study also showed that 192 and 20 fishing crafts were present in Baluhor *Baor* and Nasti *Baor* respectively (Table 3).

**Table 3:** Number of fishers and fishing crafts in different villages of Baluhor and Nasti *Baor* areas

<i>Baor</i>	Village	Fishers number	Fishing crafts number
Baluhor	Baluhor	49	30
	Ramchandrapur	47	25
	Shingia	67	62
	Bazrapure	60	35
	Kagmari	65	40
Nasti	Nasti	126	20
	Uzzolpur	8	
	Padmarajpur	3	

### 3.9 Status of fishing gear

In Baluhor *Baor* area 92.73% fishers had komor and kochal jal whereas only 7.27% fishers had no. But in Nasti *Baor* area 100% fishers had kochal jal.

There were various kinds of fishing gears that were used for harvesting *Rani Mach* round the year in Baluhor *Baor* namely, entangled net of different mesh sizes, borshi, ghuni, thela jal, spear etc. (Table 4).

**Table 4:** Number of fishing gear used for harvesting *Rani Mach* in Baluhor *Baor*

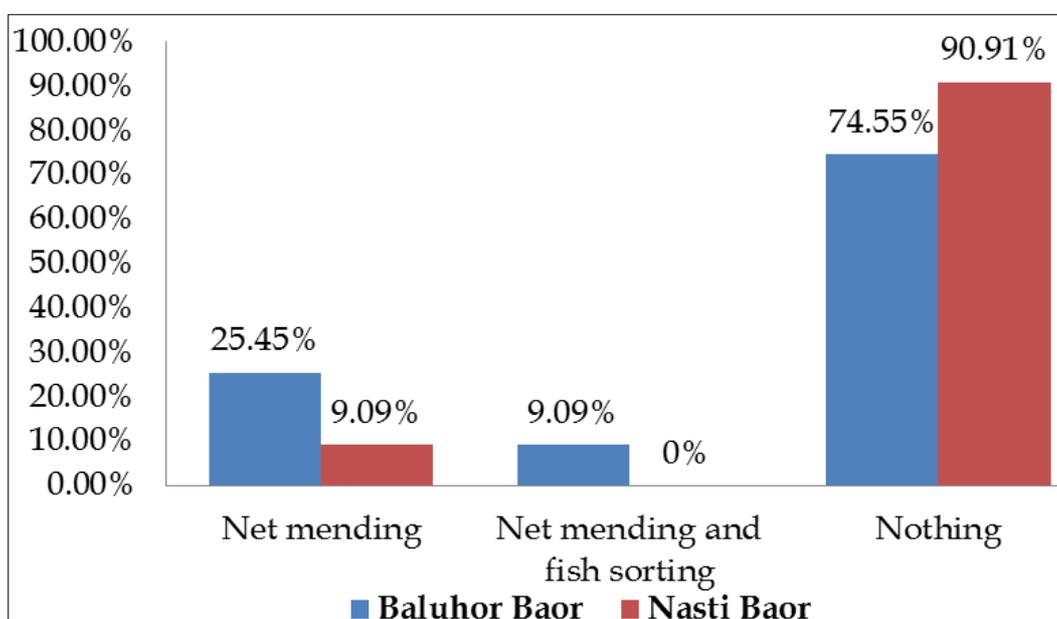
Village	Entangled net of different mesh size	Borshi	Ghuni/Britti	Others (Thela jal, Spear etc.)
Baluhor	120	2	8	10
Ramchandrapur	144	2	3	10
Shingia	190	3	10	14
Bazrapure	130	4	8	8
Kagmari	150	2	9	14
Total=	734	13	38	56

\*Source: Assistant Hatchery Officer, Baluhor *Baor*

### 3.10 Women role in fishing activities

Present study showed that women had no role in fishing activities in both Baluhor and Nasti *Baor*. Only 25.45% and 9.09% women were involved in net mending activities from Baluhor *Baor* and Nasti *Baor* area respectively where 9.09%

women from only Baluhor *Baor* were involved in both net mending and fish sorting activities to help their husband. The study also showed that 74.55% women from Baluhor *Baor* area and 90.91% women from Nasti *Baor* area had no role in *Baor* fisheries activities (Figure 7).

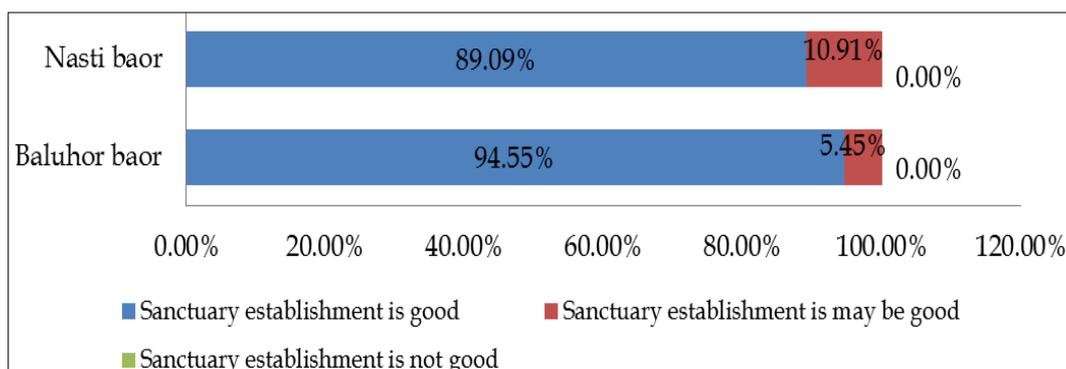


**Fig 7:** Women involvement (%) in fisheries activities at studied *Baors*

### 3.11 Fishers' perception about sanctuary

In Baluhor *Baor* there was a permanent sanctuary where fishers couldn't catch fish even in harvest period but in Nasti *Baor* there was no single sanctuary. In the present study, it was found that 94.55% fishers from Baluhor *Baor* area and

89.09% fishers from Nasti *Baor* area thought that sanctuary establishment is a good thing where 5.45% and 10.91% fishers from Baluhor and Nasti *Baor* respectively thought that sanctuary establishment is maybe a good thing (Figure 8).



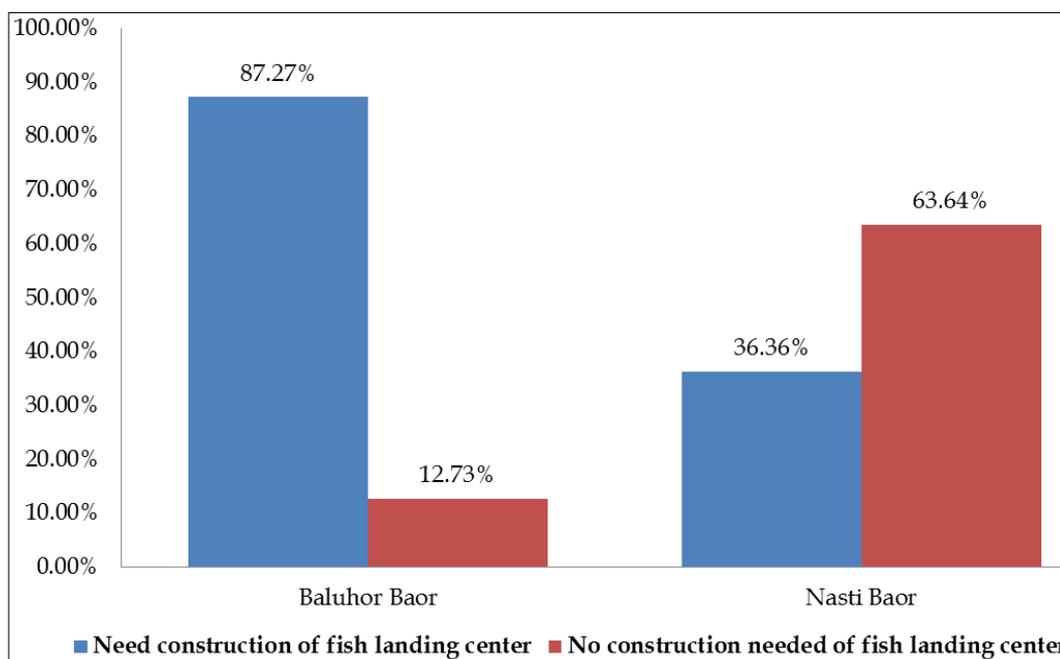
**Fig 8:** Distribution of fishers (%) according to their concept about sanctuary establishment

### 3.12 Fishers' perception about fish landing center

There were several fish landing centers in Baluhor *Baor*

whereas only one in Nasti *Baor*. But the conditions of fish landing centers were poor. The study found that 87.27% fishers from Baluhor *Baor* area and 36.36% fishers from Nasti *Baor* area thought that these landing centers need to be

reconstructed while 12.73% and 63.64% fishers from Baluhor and Nasti *Baor* respectively thought that there was no need of reconstruction for those landing centers (Figure 9).



**Fig 9:** Distribution of fishers (%) according to their opinion on the construction of fish landing center

**3.13 Obstructions to *Baor* fisheries management**

The present study found some managerial, natural,

economic and social obstructions of *Baor* fisheries management (Table 5).

**Table 5:** Obstructions with its probable reasons and effects found in Baluhor and Nasti *Baor*.

Key obstructions		Obstructions found in <i>Baor</i>		Probable reasons	Effects
		Baluhor	Nasti		
Managerial obstructions	Leasing system	√	√	Jalmahals are belong to the Ministry of Land	DoF/fishermen have to follow conditions given by the Ministry of Land that creates unsure conditions in fish culture
	Insufficient fry release	√		Lack of attention and due care of the <i>Baor</i> management authority	Decrease production
	Capture small size fish	√	√	Lack of attention and due care of the <i>Baor</i> management authority	Get less price of captured fish
	Absence of sanctuary		√	Fishers can't agree with each other in point of sanctuary establishment	Decrease species diversity of non-stocked fishes
	Insufficient guard	√		Lack of attention and due care of the <i>Baor</i> management authority	Poaching of fishes
	Pollution	√	√	Agricultural fertilizer mixing into <i>Baor</i> water and jute retting	Fish mortality
Natural Obstructions	Insufficient rainfall into monsoon period	√	√	Seasonal disturbance	Hamper reproduction of non-stocked fishes
	Decreasing water depth	√	√	Siltation	Decrease fish stock abundance
	Decreasing water area	√		Take control of edges of <i>Baor</i> by the public due to jute and rice cultivation	Decrease fish stock abundance
	Aquatic weed	√		Decrease of water depth & lack of proper steps to control weed	Decrease water quality
Economic obstructions	Low income	√		Income from <i>Baor</i> is still low and less interest in a secondary occupation	Poor livelihood conditions and can't invest more money into <i>Baor</i>
	Loan system	√	√	A high interest rate of loan taken from bank and NGOs	Can't invest more money into <i>Baor</i>
Social obstructions	Poaching	√		Insufficient guard and poor conditions of local people	Less production of fish
	Conflict	√		Local politics	Less income for some fishes

Islam *et al.* (2018) <sup>[10]</sup> also mention some barriers to *Baor* fisheries namely flood, siltation, rainfall pattern, leasing

system, poaching, conflict, illiteracy, and low income.

#### 4. Conclusions

In Bangladesh, aquaculture production systems are mainly extensive and extended extensive, with some semi-intensive and in very few cases intensive systems. It is supposed that *Baor* fisheries are mainly extended extensive culture system. This study also found that both aquaculture and capture fisheries are present in both *Baors*. It can be possible to improve the system as a semi-intensive culture system by taking proper management strategies as well as providing modern culture technologies. The study revealed that the management practice of Nasti *Baor* was better than that of Baluhor *Baor* and from the study, it can be recommended that all *Baors* should be brought under community-based fisheries management to maximize sustainable production.

#### 5. Acknowledgements

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