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Article

Analyses of Protection and Conservation According to the Fish Act 1950 in Bangladesh's Kaptai Lake Fisheries Management

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Abstract: Kaptai Lake (KL), the largest inland watershed in Bangladesh (ca. 700 km²) and one of Southeast Asia's largest artificial reservoirs, features an abundant variety of indigenous fishery species. Moreover, it provides a plethora of ecological benefits to society. Nevertheless, the KL is suffering from multidimensional natural and anthropogenic stressors that threaten these wetlands' sustainability. Though the legal framework assures sustainable conservation of fisheries resources, the implementation scenarios of fisheries laws, regulations, and policies in the KL wetland are insufficient. This study aimed at assessing the fisher's perception of the regulation implementation efficiency of the Protection and Conservation Fish Act of 1950, while analyzing the effectiveness of the legal framework in the context of biodiversity conservation and the management sustainability of KL. By integrating qualitative and quantitative data collected through participatory Rural Appraisal (PRA) tools viz. 225 interviews with fishers, four focus group discussions, and 12 key informant interviews, the investigation was performed in four selected areas in KL. The findings show that fishers routinely disregard laws and restrictions of the Protection and Conservation of Fish Act 1950 due to various socioeconomic and political forces. Although the annual fish harvest rate from KL appears to be increasing, the lake is losing its charismatic biological diversity primarily due to inappropriate and ineffective enforcement of fishing regulations. Many fishers believe that they still follow the act's significant laws and regulations while being involved in several destructive and prohibited fishing practices. There is a link between community awareness, the scope of the act's provisions, the effectiveness of its enforcement, and the strength of its execution. One of the leading causes of biodiversity loss in the KL is inadequate and ineffective fishing regulations. Improvement in the enforcement of the fishing act may be the prominent option to ensure better biodiversity conservation and sustainable management of this wetland. This result calls for functional and policy attention to revising the regulations to account for socioeconomic and political elements contributing to environmental degradation. This study also highlights the urgent need for transdisciplinary collaboration initiatives and synchronous cooperation among the agencies in order to effectively implement the fishing laws and contribute to better conservation and sustainability of the Kaptai lake fisheries resources.

Keywords: Kaptai Lake; wetlands; biodiversity conservation; legal framework; noncompliance; governance

1. Introduction

Fisheries contribute significantly to providing food security, reducing poverty, increasing jobs, to foreign exchange earnings, and to the economy [1]. Fishing has always been an essential aspect of the lives of Bangladeshi people. This industry provides 60% of low-cost animal protein sources [2]. The fisheries sector contributes approximately 3.50% to the national GDP and 25.72% to the agricultural GDP, with an average growth rate of 5.01% [3]. Moreover, 12% of the population relies on the sector to maintain their livelihoods, either directly or indirectly [3]. Bangladesh has already reached fish self-sufficiency, with per capita fish consumption totaling 62.58 g/day, well over the established objective of 60 g/day [4]. Furthermore, the industry accounts for approximately 1.51% of overall export revenues [3].

Bangladesh has inland water areas of 6.7 million ha, of which 94% are open water capture fisheries [1]. Rivers (479,735 ha), estuaries (551,828 ha), Haor and Beel (114,161 ha), floodplains (5,486,609 ha), mangrove environments, and the Kaptai Lake (68,800 ha) are among the potential inland water resources. Amongst the country's natural resources, wetlands occupy a prominent position in poverty reduction and the livelihood of marginal communities. Bangladesh is one of the leading fish-producing countries, with 43.84 lakh metric tons (MT) of fish production in 2018–2019 [3]. Thus, Bangladesh is fortunate in possessing potential water resources. Furthermore, Bangladesh's inland fisheries are among the most significant fisheries resources, ranking third in inland fisheries production throughout the world [5]. More than two million people rely on inland capture fisheries for their livelihoods, either directly or indirectly [1]. There has been a move away from leasing water estates ('jalmohals') to promoting co-management. However, the open-access policy, which has led to severe competition for resources, has reduced the effectiveness of co-management [6].

The Kaptai Lake (KL) is the largest inland water body and is considered one of the largest artificial freshwater reservoirs in Southeast Asia, providing multiple services to society. It was built in 1961 by damming the Karnaphuli River near Kaptai, primarily to supply electricity through a hydropower plant [7]. Secondary benefits include fisheries production, flood control, navigation, and irrigation to crop fields [8]. The reservoir covers around 58,300 ha (68,800 ha with entire supply) and accounts for over 19% of the whole inland water body [9]. The Kaptai Lake's production is at 10,578 MT, with a 426 MT rise in production by 2018–2019 with an overall growth rate of 4.9% [3]. KL is one of Bangladesh's most diverse reservoirs [10]. It is well-known for its carp spawning grounds. The KL is home to 66 indigenous species from 17 different groups, two alien species, and two shrimp species. In addition, there are 36 commercially harvested fish species, including chapila (*Gudusia chapra*), kechki (*Corica soborna*), ayre (*Mystus aor*), kuncho chingri (*Macrobrachium lamarrei*), kajoli (*Ailia coila*), mola (*Amblypharyngodon mola*), tilapia (*Oreochromis mossambicus*), naitolica (*O. niloticus*), and bata (*Labeo bata*) [9]. Similarly, [11] found 49 fish species, with 10 generally available, 14 reasonably frequently found, 21 species less frequently found, and nine species rarely found. Productivity was previously primarily reliant on the primary carp species; however, two prominent clupeid species, chapila (*G. chapra*) and kechki (*C. soborna*), contributed more than 30% and 31% of total fish production respectively in the KL in recent days [11]. As a result, the output of the main carp species and high-value fish in the KL has been steadily diminishing over time [9,11,12]. Furthermore, [13] showed a progressive decline in KL biodiversity due to habitat degradation and for many artificial anthropogenic reasons.

Though Kaptai Lake (KL) delivers many ecological benefits to society and provides habitat for abundant aquatic biodiversity, biodiversity conservation is facing significant challenges, suffering from multidimensional natural and anthropogenic stressors that threaten the ecological and environmental sustainability of the KL wetland ecosystems. Due to environmental, socioeconomic, and governance constraints, KL's production performance has declined [8]. The lake fisheries sustain the livelihoods of a vast number of people. Even though the legal framework assures the fisheries' sustainability, evidence on the implementation of laws and regulations is inadequate to support sustainability. A few

studies [7,8,13] have focused on management elements. However, the efficiency of the fisheries governance system in the KL is still under-researched. This study aimed to assess fishers' perceptions of the regulation execution efficiency of the Protection and Conservation Fish Act of 1950 in the context of the biodiversity conservation and management sustainability of KL. Therefore, this study was conducted to demonstrate the present status of fishers and investigate the practical realities of the Fish Act's Implementation scenario.

2. Materials and Methods

The study covered four different upazilla (Rangamati Sadar, Naniarchar, Barkal, and Langadu) of the Rangamati district. These areas were selected for data collection, as most inhabitants located there are fishers by profession (Figure 1), and the field works were conducted for six months from September 2019 to February 2020.

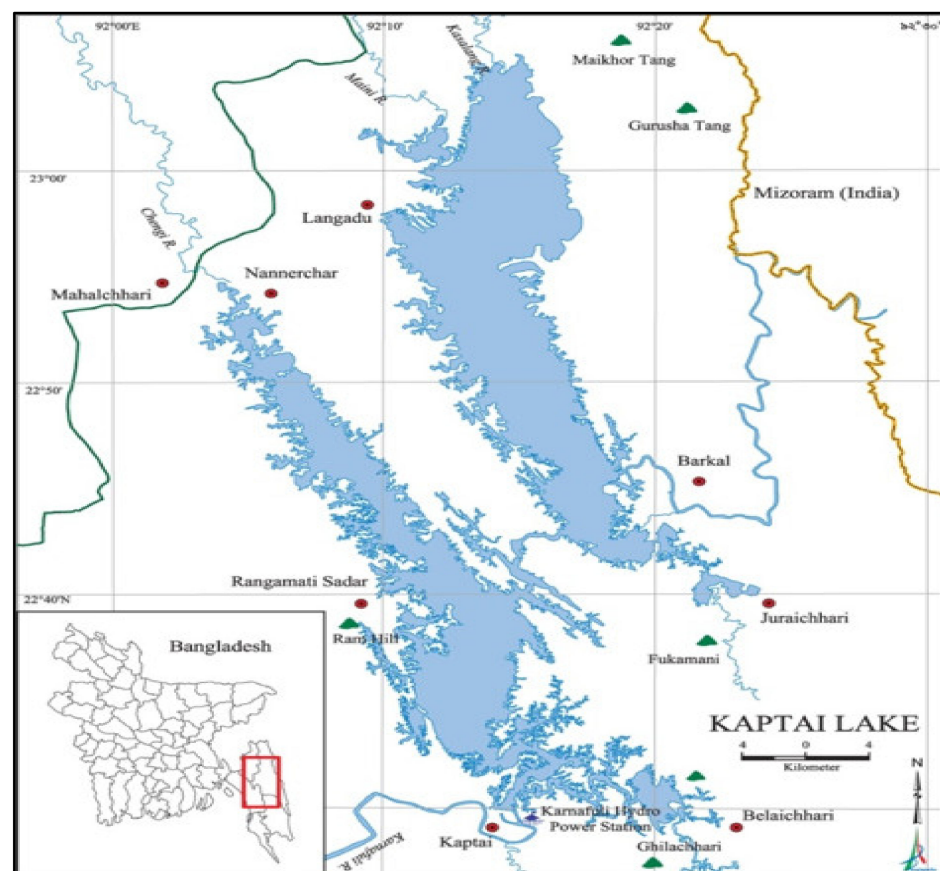


Figure 1. Study area: Location of Rangamati district in Bangladesh, location of Kaptai lake and location of the study sites. Source: [14].

We gathered data from both primary and secondary sources to meet the study goals. The primary data were gathered utilizing qualitative and quantitative data collecting methods. A semi-structured questionnaire was prepared earlier, pretested, and finalized for data collection. It contained basic qualitative questions related to fish conservation regulations designed to obtain primary data from the fisher to check compliance and noncompliance with regulations. Scheduled according to the fishers' convenience, there were 225 interviews with fishers (45–50 min each), mostly taking place in their houses, workplaces, and resting places (Table 1). We purposefully chose fishers for this study to better portray the perspectives of fishers who were direct victims and beneficiaries of noncompliance with regulations. Purposive sampling allowed necessary gathering information from specific, deliberately designated persons or events [15]. The interviews were conducted informally at the study site while fishing to avoid interrupting them and wasting their time. Four focus group discussions (FGD) were conducted, one at each study

site, consisting of 6–10 individual fishers (60–90 min each). In addition, 12 key informant interviews (KII) were performed to double-check the data's veracity (Table 1).

Table 1. Number of interviews in the study-surveyed areas.

Serial No.	Study Area	II	FGD	KII
1.	Rangamati Sadar	61	1	5
2.	Naniarchar	54	1	3
3.	Borokol	72	1	2
4.	Langadu	38	1	2
	Total	225	4	12

Secondary data was gathered from various agencies in Bangladesh, including government legal documents, directives, bills, and newspapers. In addition, through an Internet search, scholarly articles and related grey literature were found. Qualitative data analysis should ideally occur concurrently with data collection for investigators to better grasp the study questions, which informs both sampling and the questions asked.

Microsoft Excel was used to conduct the data analysis. For qualitative analysis, context analysis was employed, and quantitative data were compiled and analyzed using MS Excel 2016 and SPSS (Statistical Package for Social Science, Version 22) software. The tape recorder data and handwritten notes were transcribed on the evening of the same day. After the data was transcribed, the contents were examined, and themes were identified. The themes were grouped and denoted by variables, such as the causes of stakeholder conflicts, the causes of noncompliance with laws, and the gaps between laws and their implementation.

3. Results

3.1. *The Protection and Conservation of Fish Act, 1950*

The Fish Act's goal is to ensure that fishery resources are exploited and conserved sustainably. The Act is divided into nine sections: (1) definitions, (2) power to make rules, (3) power to prohibit the sale of fish, (4) prohibition of destructive fishing equipment, (4A) penalties, (5) power to confiscate, (5A) arrest without warrant for an offense under the act, (6) arrest without warrant for an offense under the act, (7) awareness, (8) officers to be deemed public servants, and (9) indemnity. The government may make rules regarding the conservation of fish resources described in Section 3 subject to that section. The government may also restrict the sale of fish under the stipulated size of any prescribed fish species for a certain length of time by notifying the public in the Official Gazette (Section 4). Section 5 lays out the consequences of breaking the regulations set out in Sections 3 and 4. Sections 6 to 9 deal with warrantless arrests, custody of an apprehended person, judicial proceedings, and the authority of fishery officers (Table 2).

Table 2. Major components of the Protection and Conservation of Fish Act of 1950 and relevant management for Kaptai Lake Fisheries management [16,17].

Protection and Conservation of Fish 1950	Related Provisions	Penalties against	Implemented by
Prohibition	<ul style="list-style-type: none"> Prohibit all actions related to use, manufacture, and marketing of current jal (Sec 3.3.a.IV) Prohibit erection of fixed engine (Section 3.3.a.I) Prohibit construction of permanent or temporary infrastructure such as dams, embankments. (Section 3.3.a.II) Prohibit use or method of any kind of destructive fishing net and nets below prescribed mesh size (Section 3.3. a. III) Prohibit catching of fishes by explosives, gun, bow, and arrow (Section 3.3.b) Prohibit destruction of fishes by poisoning of waters or pollution by trade effluents or otherwise (Section 3.3.c) Prohibit catching of all kinds of fishes prohibited in specific periods (Section 3.3.f) Prohibit catching and marketing of fish below prescribed size or any prescribed species (Section 4) Prescribe seasonal ban for breeding and conservation of fishes or restrict certain areas (Section 3.3.d) 	<ul style="list-style-type: none"> Any person breaking regulations under Sections 3 & 4 will be punished with a sentence for a term not less than one year and which may extend to two years, or with a fine which may extend to BDT 5000 or with both under (Section 5.1) Manufacture, fabrication, import, marketing, or storing of current jal by any person shall be punishable with imprisonment for a term of not less than three years. It may extend to five years and the person may be liable for a fine extending to BDT 10,000 (Section 5.2.a). 	<ul style="list-style-type: none"> Any fishery officer empowered by the govt.
Prescription	<ul style="list-style-type: none"> Prescribe a minimum size below which no fish is allowed to catch or sell (Section 3.3.e) 		

3.2. Management Regime of KL Fisheries

From 1961 to 1963 (see on Table 3), the Department of Fisheries (DoF) was responsible for KL fisheries management [7]. The government water body was leased for fishing. In 1963 the KL was leased by Bangladesh Fisheries Development Corporation for 99 years [12]. Since then, BFDC has been supervising and regulating fisheries along KL from five (05) substations: (a) Rangamati Sadar, Rangamati; (b) Kaptai substation, Rangamati; (c) Mahalchhari substation, Khagrachhari; (d) Langadu substation, Rangamati; and (e) Marisshya, Baghaichhari, Rangamati [9]. Kaptai Reservoir fisheries management pertains to implementing closed seasons by the prohibition of fishing from April to mid-August every year [13]; issuing fishing licenses, which were initiated in 1972 by BFDC, and gear licenses, which started in 1981 [13]; controlling undersized fishing by limiting fish length to not less than 23 cm or 9 inches (for all fishes); maintaining the mesh size of gill nets at not more than 7.62 cm/3 inches [6] and Fish Act implementation and fish stocking. To protect natural restocking, fishing is prohibited from April to mid-August every year because June–July is the peak-breeding season [13]. However, in distant places it is almost impossible to ban fishing completely during the breeding season. Subsistence fishers and tribal people fish at that time for their consumption and the local market.

Table 3. Management in place under the Fish Act 1950 in the Kaptai Lake.

Time Period	Management Regime	Managed under	Reference
From 1961 to 1963	Fishing is prohibited from April to mid-August every year (Section 3.3. d & f)	Department of Fisheries (DoF)	
From 1964 to present	To protect the mother stocks for facilitating natural spawning, fishing is strictly prohibited from the first week of April through mid-August. (Section 3.3.d & f)	Bangladesh Fisheries Development Corporation (BFDC)	
	The minimum legal size of fish caught is not less than 23 cm or 9 inches (for all fishes). (Section 3.3.e & Section 4)		[8,13]
	The minimum allowed mesh size for gill nets is 7.62 cm (3 inches). (Section 3.3.a.III)		
	Jal fishing is strictly prohibited in the reservoir to reduce the depletion of mother stocks. (Section 3.3. a. III)		
	Nursery grounds (stocking grounds) are declared sanctuaries, and fishing is banned (Section 3.3.d)		
	Illegal fishing and illegal catch transportation are prohibited (Sections 3 & 4)		

3.3. Socioeconomic Profile of the Fishing People in Kaptai Lake

The overall socioeconomic conditions of the studied fishing peoples are poor, with a low literacy rate and high dependencies on the KL natural resources with only a few livelihood alternatives, such as incentives and microcredit schemes.

3.3.1. Age Structure

The average age of respondents in the study locations was 36 (9.6) years in Rangamati Sadar and 41 (8.87) years in Naniarchar Upazila. In Barkal and Langadu, the average age of responders was 32 (9.7) years and 47 (11.2) years, respectively (Table 4).

Table 4. The average ages of the respondent fishers in four study areas in Kaptai Lake.

Attributes/Variable	Study Sites (Upazila)	Mean (\pm SD)
Age of the respondent (years)	Rangamati Sadar	36 (9.6)
	Naniarchar	41 (8.87)
	Barkal	32 (9.7)
	Langadu	47 (11.2)

3.3.2. Educational Profile

In Rangamati Sadar, 80.36% of fishers are illiterate, while only 16.39 and 3.25% had primary and secondary education, respectively. In the rest of the Upazilas, similar results were discovered. In Naniarchar, 83.06% of the 54 respondents were illiterate, 14.81% had gotten primary school, and 2.13% had attended secondary education. In Barkal Upazila, 75.75% of the population was illiterate, while 19.44% had completed elementary school and 4.81% had completed secondary school. The illiteracy rate was higher in Langadu Upazila, with 85.24% of 38 respondents being illiterate (Figure 2).

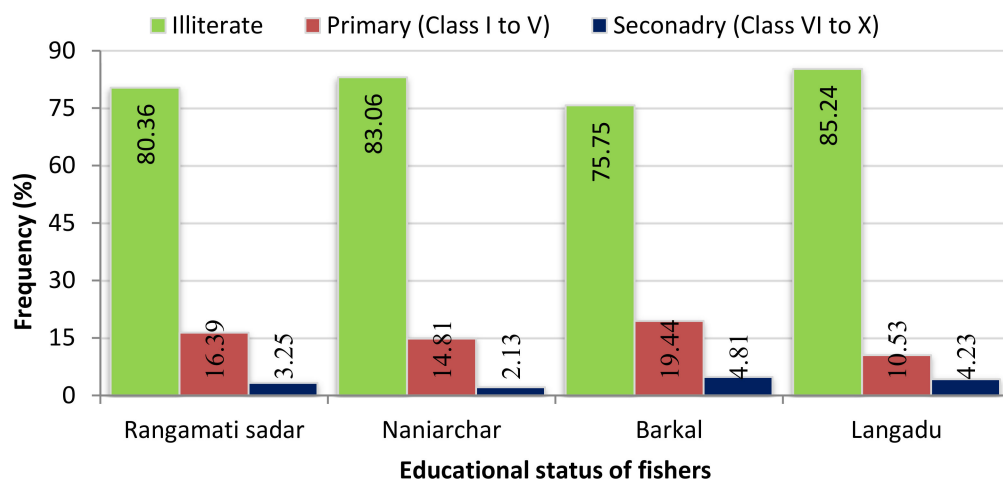


Figure 2. Educational status among the studied fishermen in the four study sites of Kaptai lake.

3.3.3. Marital Status

The percentage of married and unmarried fishermen varied among the study sites. In Naniarchar and Barkal Upazila, 44.44% and 51.26% were married, respectively, and 55.56% and 48.74% were unmarried. In Rangamati Sadar and Langadu only 29.31% and 27.34% of respondents were married, while others remained unmarried (Figure 3).

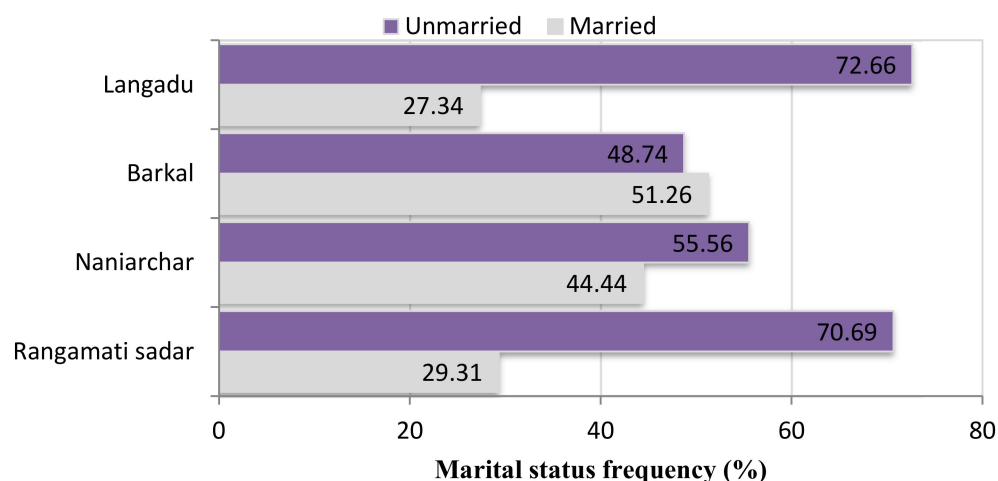


Figure 3. Marital status of the fishermen in the study areas of Kaptai Lake.

3.3.4. Fishing Experience of Respondents

The data regarding fishing experience showed that fishermen from the Naniarchar Upazila had the most fishing experience, with an average of 17.67 (8.29) years. On the other hand, anglers in Barkal had an average of 15.72 (8.42) years of experience. The average number of years of fishing experience in Rangamati Sadar and Langadu Upazila was 11.34 (6.08) and 13.11 (5.77) correspondingly (Table 5).

Table 5. Average fishing experience of the respondents.

SI No.	Study Sites (Upazilla)	Frequency Interviewed	Years Involved in Fishing (Mean ± SD)
1	Rangamati Sadar	61	11.34 ± 6.08
2	Naniarchar	54	17.67 ± 8.29
3	Barkal	72	15.72 ± 8.42
4	Langadu	38	13.11 ± 5.97

3.3.5. Status of Microcredit Access

Dadon, as it is known locally, is a typical occurrence in the fishing industry of KL. Fishers collect advance money from their money lender for their fishing instruments and livelihood, and they remain in debt for the length of their lives. According to the findings, around 83.61% of fishers in Rangamati Sadar were bound by the custom, while the rest were not. Similarly, in Naniarchar, Barkal, and Langadu, 92.59%, 96.17, and 68.42% of fisherfolk had access to microcredit, respectively (Figure 4).

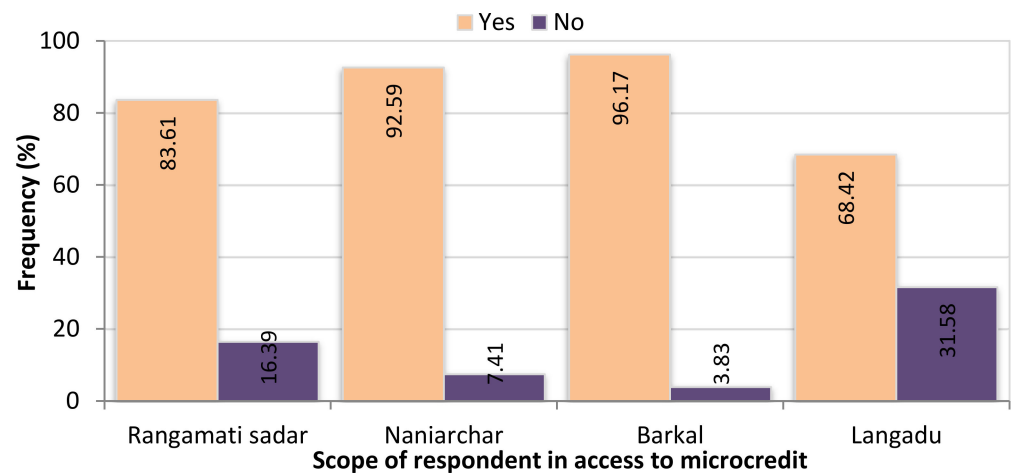


Figure 4. Status of access to microcredit in the studied areas of Kaptai lake.

3.3.6. Incentives Received by the Respondent Fishers

According to the analysis, 62.30% of fishers in Rangamati Sadar received incentives during the prohibition period. These figures were lower in Naniarchar, where the ratio was 44.44%, than in any other Upazila. Similarly, only 48.61% of fishers in Barkal were eligible for the incentive program. In that example, the incentive scheme covered 60.53% of the fishermen in Langadu Upazila. The majority of the fishermen who did not receive incentives blame local politicians for depriving them of their livelihood (Figure 5).

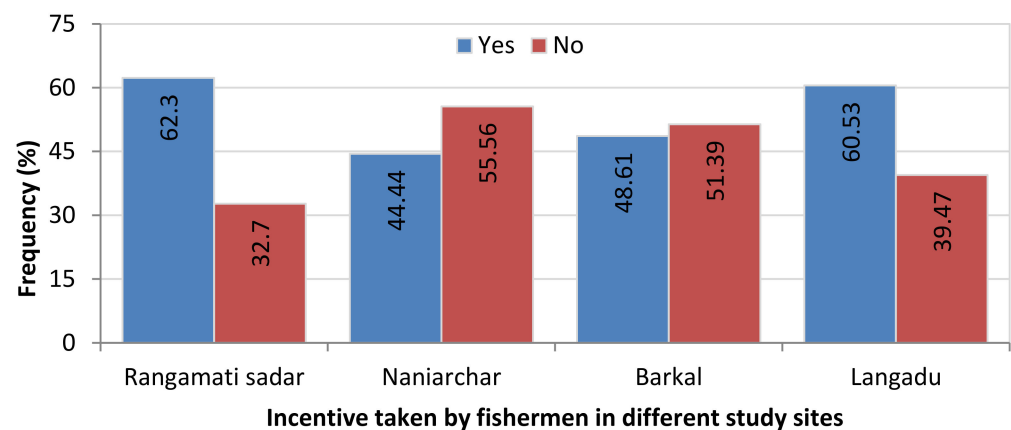


Figure 5. Incentives taken by fishers in different study sites of Kaptai Lake.

3.4. Diversity of Fishing Equipment Used in KL

In the study sites of KL, the questioned fishermen generally employed five types of gear: kechki jal (mosquito net), current jal (gill net), shuta jal, lining (hook and line), and chi (fish trap) (Table 6). In Rangamati Sadar, approximately 81.97% of fishers utilized kechki jal and 18.03% utilized current jal. Similarly, kechki jal were utilized by 83.33% of fishers in Naniarchar, whereas current jal were employed by the rest. The equipment used by fishermen in Barkal Upazila varied, with 44.44% using kechki jal, 8.33% using current jal,

12.50% using shuta jal, and 16.67% fishing trap, and 18.06% using hook-lining. In Langadu, 35.71% used current jal, 17.86% utilized fishing traps, and 46.43% used lining (Figure 6).

Table 6. Fishing equipment used in Kaptai Lake.

Name of the Gear	Category	Characteristics	Comments
Kechki jal	Mosquito seine net	The kechki jal is made of nylon fiber with a 2.5–4.5 mm mesh size. The average length varies from 105–320 m, and the width ranges between 5 and 12 m. The kechki jal is mainly used for catching kechki fish (<i>C. soborna</i>).	Net mesh too small, but not banned yet
Current jal	Gillnet	The current jal is made of monofilament synthetic nylon fiber of different mesh sizes. The length of the current jal used in KL ranges from 85 to 150 m and the width measures 2–4 m. Mesh size ranges from 25 mm to 50 mm.	Banned
Shuta jal		The shuta jal is a synthetic fiber net commonly used on the remote side of KL. The shuta jal is mainly used for catching carp species. The mesh size of the net ranges from 12 mm to 30 mm.	Small-meshed net destructive for fish fry and juvenile catch, but not banned
Bamboo chi	Fishing trap	The chai is mostly made of bamboo, wooden material, or plastics. The chai is mainly used for catching punti, tengra, chapila etc.	-
Handline	Hook and line	Hooks are manufactured in a wide range of sizes, and the gap between the point and the shank appears to be the dimension, which determines the size range of fish caught by a particular hook. The most familiar type of manufactured steel hook is “J” shaped.	-

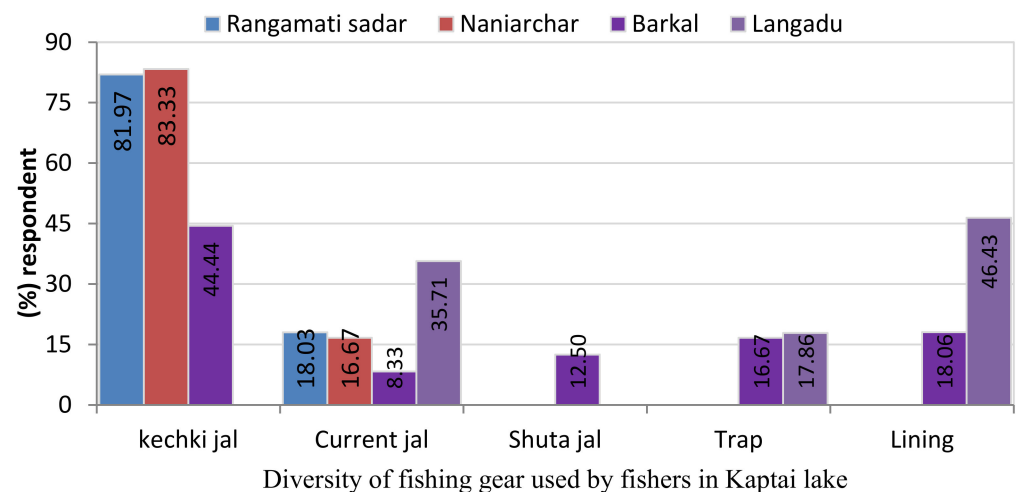


Figure 6. Status of fishing gear used by the fishers in the different study areas of Kaptai Lake.

3.5. Catch Size and Production Trends of Kaptai Lake Fisheries

According to the catch quantity data set in four study sites, Rangamati Sadar, 32.79% of respondents caught less than 5 kg of fish, 62.96% caught 5–10 kg, 4.92% caught 10–15 kg, and just 6.56% caught more than 15 kg. Naniarchar’s average catch was between 5 and 10 kg (62.96%), while just 14.81% caught less than 5 kg, 18.52% caught 10–15 kg, and 3.70% caught more than 15 kg. In Barkal, 13.89% of respondents caught less than 5 kg, 38.89% between 5 and 10 kg, 30.56% caught 10–15 kg, and just 16.67% caught more than 15 kg. In small-scale fishing, fishers in Langadu used fishing traps, hook-lining, and current jal

as their fishing equipment. The majority of their total catches were between 5 and 10 kg (68.42%), while the rest were less than 5 kg (31.58%). The number of fish caught in KL varies depending on the season (Figure 7).

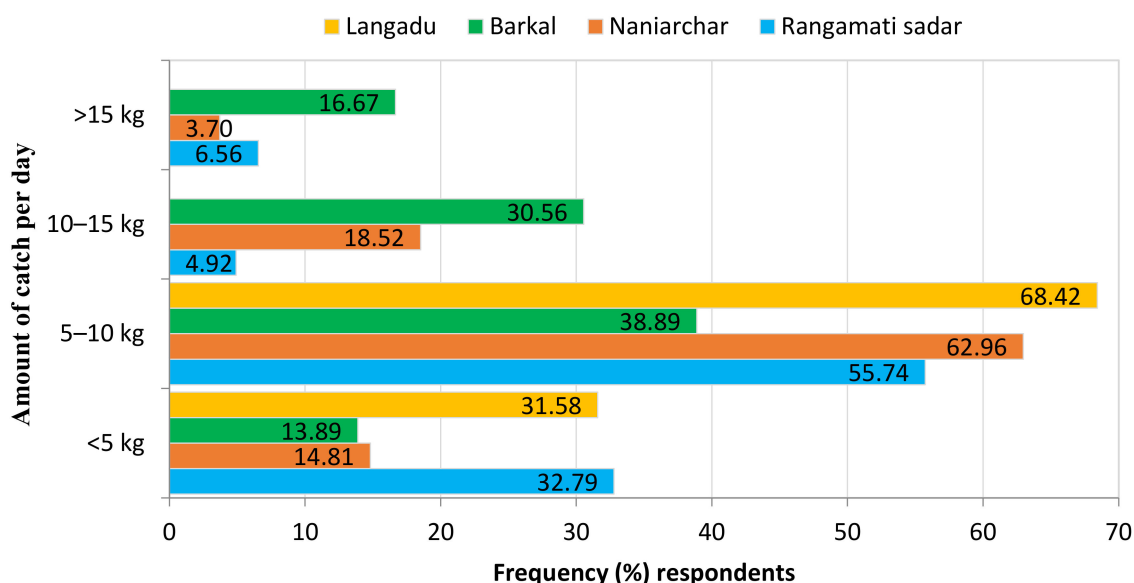


Figure 7. Status of catch/harvest per day by the individual fishers in the four studied Upazila of Kaptai Lake.

During interviews, respondents from the four study sites described the current output pattern as “slowly declining” and “moderately declining”. The value was highest in Langadu, while 84.21% of respondents described the production trend as slowly dropping. In Barkal and Naniarchar, 72.22% and 62.96% of respondents, respectively, said production was declining considerably, while 54.10% believed it was slowly declining (Figure 8). While the fishermen believe productivity is down, the government asserts that production is increasing.

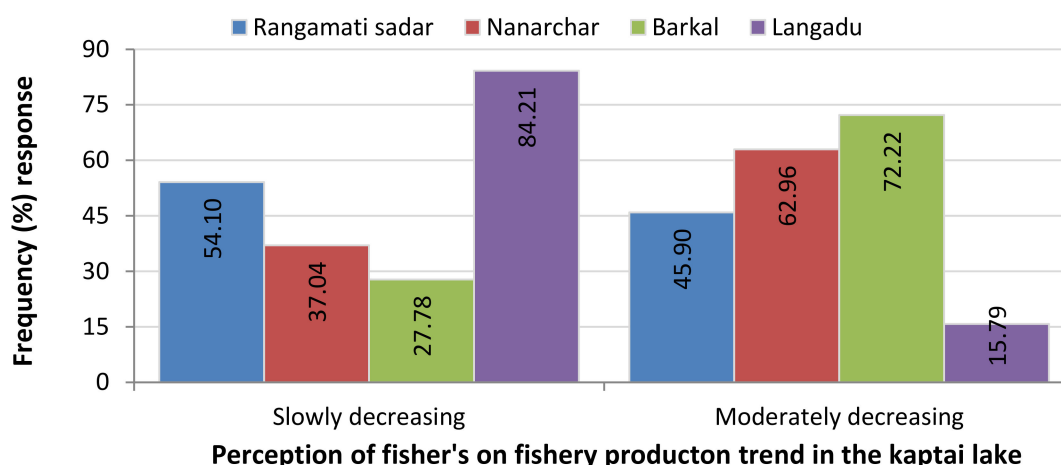


Figure 8. Fishers’ perceptions of the fishery production trend in Kaptai Lake.

3.6. Knowledge about the Protection and Conservation of Fish Act, 1950

According to the findings, fishers in Rangamati Sadar were more knowledgeable about fishing laws than those in any other Upazila. According to the data, 73.77% of fishers were aware of the 1950 Fishing Act. On the other hand, the percentages of persons who knew the law in Naniarchar, Barkal, and Langadu were 12.96%, 25.00%, and 7.89%, respectively. However, they were unaware because officials or high-ranking officials did not brief them (Figure 9).

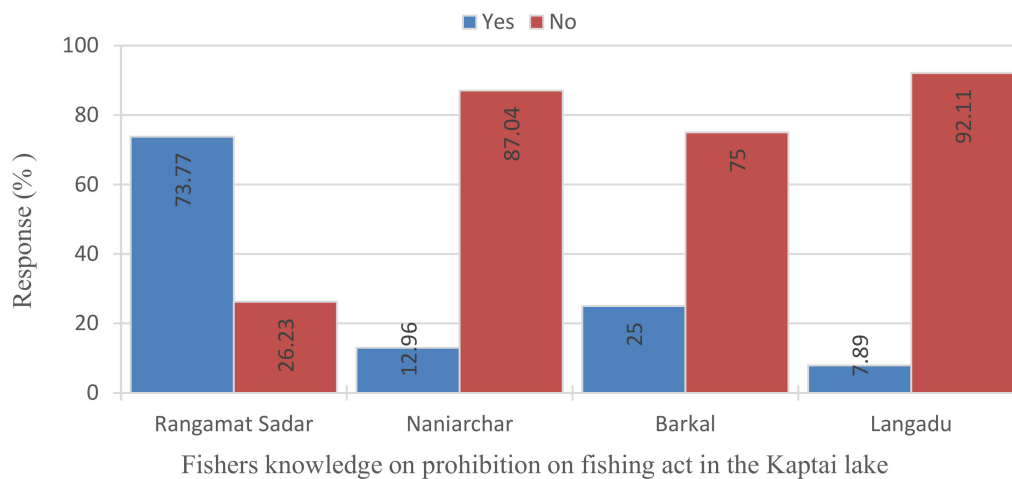


Figure 9. Fishermen's knowledge about fishing laws and prohibition of the fishing activities in the study areas.

3.7. Perceptions of Fishers on Implementation Effectiveness of the Fish Act 1950

Table 5 depicts the realities of the Protection and Conservation of Fish legislation of 1950, based on data analysis. Individual fishers still use poison and explosives to catch fish. Even if the percentage is small, it should not be overlooked. According to the findings, poison was used for fishing by 11.48% in Rangamati Sadar, 12.96% in Naniarchar, 8.33% in Barkal, and 26.32% in Langadu. Only 28 participants out of 225 agreed that there were barriers in the fish tunnels, implying that only 28 people out of 225 were aware of the fish passageways because most of the barriers are bridges, which are difficult to overlook.

Although it is against the law to dry out a waterbody for fishing during the dry season, 8.20% of fishers in Rangamati Sadar, 16.67% in Naniarchar, 15.28% in Barkal, and 10.53% in Langadu Upazilas did so. Manufacturing, fabricating, marketing, import, and sorting are part of the contemporary jal handling process. According to the findings, only 6.56% and 7.89% of Rangamati Sadar and Langadu fishers were involved in modern jal handling. In addition, 59.02%, 9.26%, and 11.11% of Sadar, Naniarchar, and Barkal respondents agreed that fishing small fish was a bad idea. They argued, however, that the small fish were captured by accident due to the use of kechki jal. 14.75%, 5.56%, 4.17%, and 13.16% of fishers in Sadar, Naniarchar, Barkal, and Langadu Upazilas were aware of fishing restrictions during the prohibition and in the sanctuary area. Despite this, fishers in Sadar, Naniarchar, Barkal, and Langadu reported fishing within the ban period and the sanctuary region, with 6.56%, 37.04%, 50.00%, and 10.53%, respectively. Because they were not covered in the incentive program, these fishermen accused the local government of breaking the rules. All Rangamati Sadar fishermen have a fishing license. However, the situations in other Upazilas are different. According to the findings, fishing licenses were held by 87.04% in Naniarchar, 87.50% in Barkal, and 52.63% in Langadu. It appears that respondents from four study sites were penalized in different ways: 31.15%, 11.11%, 5.56%, and 26.32%. Their sentences were based on the lack of a license, the use of current jal, and fishing during a prohibition period. Domestic garbage, engine oil and tourists, according to Rangamati Sadar and Langadu fishers, are fast polluting Kaptai lake. However, in Naniarchar and Barkal, 3.70% and 16.67% disagreed that the lake was polluted (see Table 7).

Table 7. Testing different sections of the Protection and Conservation of Fish Act 1950.

Questions Testing Different Sections of the Act	Rangamati Sadar		Naniarchar		Barkal		Langadu	
	Supported (if yes)	Denied (if no)	Supported (if yes)	Denied (if no)	Supported (if yes)	Denied (if no)	Supported (if yes)	Denied (if no)
Has any obstacle to the passage of fishes been noticed?	13.11	86.89	9.26	90.74	9.72	90.28	18.42	81.58
Is poison fishing available in the Lake?	11.48	88.52	12.96	87.04	8.33	91.67	26.32	73.68
Does the dry part of lake catch fish?	8.20	91.80	16.67	83.33	15.28	84.72	10.53	89.47
Are current <i>jal</i> often used to catch fish?	6.56	93.44	0.00	100.00	0.00	100.00	7.89	92.11
Are under-sized fish caught?	59.02	40.98	9.26	90.74	11.11	88.89	100.00	0.00
Is the ban period obeyed appropriately?	14.75	85.25	5.56	94.44	4.17	95.83	13.16	86.84
Is the sanctuary area strictly protected?	6.56	93.44	37.04	62.96	50.00	50.00	10.53	89.47
Is a license issued to ensure obedience of the regulations?	100.00	0.00	87.04	12.96	87.50	12.50	52.63	47.37
Is punishment given for a rule breach?	31.15	68.85	11.11	88.89	5.56	94.44	26.32	73.68
Are piranha fish responsible for production decreases?	11.48	88.52	11.11	88.89	9.72	90.28	10.53	89.47
Is pollution causing harm to KL fisheries?	100.00	0.00	96.30	3.70	83.33	16.67	100.00	0.00

4. Constraints and Challenges in Sustainable Management

4.1. Implementation

4.1.1. Inland Fisheries Acts Are Out of Date

The Protection and Conservation of Fish Act 1950 is generally known as the fisheries conservation Act 1950. Indiscriminate capture of larvae, juvenile fish, and broodfish is a significant barrier to fisheries' resource development. The government formulated this Act by imposing rules on fish size, reproduction, and roaming grounds. Since then, the Act has been amended several times due to different circumstances, yet there are still some loopholes. The Act defines fish, fishery officers, fixed engines, and private water only. The government must now include resource or fishery definitions, inland water, sanctuary, and fishing equipment. The BFDC found legal power in implementing the fish Act in the lake. However, they have limited capacity to implement it appropriately. Fisheries officers are not empowered as magistrates in this Act, and therefore face the difficulty of organizing a magistrate to be present when they are patrolling.

4.1.2. Limited Scope for Stakeholder Participation

The management of resources cannot be achieved by the government alone. This can only be achieved by involving the primary stakeholders who own the resources, i.e., equipment, boats, the input supply, and the marketing and processing facilities, or stakeholders who are entitled to the resource through leasing and user rights. To achieve this, the stakeholders must be supported by a framework of control and regulations and support services that can respond to their needs. To manage the KL resources, those reliant on the resource for their day-to-day livelihoods must be given use rights through leases that assert their right. Common property resources that do not currently have leases should come under a leasing system to determine use rights over the resource. However, these should be set at a low rate that recognizes that its function is to control access and not to levy government funds. Through leases, the community would be given the responsibility to ensure the

sustainable management of the resources. Continued access to these resources would be dependent on their ability to manage the resource effectively. This implies a degree of decentralized planning and decision-making. The strategy acknowledges that currently there is little practical movement toward decentralization but envisages that within the time frame of the strategy, pressures in this direction will rise, and increased decentralization is a likely development.

4.1.3. Massive Catches of Undersized Fish

Undersize fish catching practice is widespread in the lake. People usually catch fish using current jal and small-mesh nets (kechki jal), and by drying up parts of the lower lake during the dry season. Undersized fishes are caught all year round, especially with increasing effort during the breeding season. Moreover, kechki jal is the most widely used fishing gear in KL, but the mesh size (≤ 4.5 mm) is too small to allow the fry of other species to escape. Though the net is harmful to undersized fishes, it is legal in KL. While interviewing, some small-scale fishers complained that kechki jal deplete undersized fishes of all species.

4.1.4. Widespread Destructive Fishing Methods Applied

The appropriate fishing method or technique is an essential feature for the sustainability of a waterbody. In the case of the reservoir, biodiversity primarily depends on fishing method. As fish stocks decrease, fishing methods become increasingly extreme. Destructive fishing practices, including bottom trawling, bycatch, poison and explosives, and ghost fishing, devastate the environment. National legislations have identified and restricted some of these practices. The temptation to break the law is very high for small-scale fishers facing reduced fish stock. The use of poison and explosive fishing are the standard methods of destructive fishing in KL. As a fisherman testified, "some unscrupulous fishermen use poison for fishing when the water level is deficient in the remote area of KL." He added that "by poison fishing, every living being of that area is destroyed, and the amounts of fish are decreasing every year for that we starve."

4.1.5. Continuous Illegal Fishing Practices and the Use of Destructive Equipment

The use of illegal equipment is the main reason behind the loss of aquatic biodiversity. Different types of illegal equipment are used around the country, but in KL, of the current jal is the type most often seen. This monofilament synthetic fiber gill net is restricted due to its structure and mesh size. In remote areas, many small-scale fishers use current jal, although manufacturing, fabricating, selling, and carrying current jal are strictly monitored in Rangamati Sadar Upazila.

4.1.6. Pollution

Pollution at KL is taking a serious turn due to open defecation by slum dwellers, and unabated daily dumping of garbage and waste causes waterborne diseases. According to the statements of respondents, dumping of waste and open defecation by slum dwellers are the prime causes of pollution at KL. Sedimentation and landslides are some of the other significant polluting agents in KL. Due to intense sedimentation over the years, the lake water level has dropped abnormally. According to the SSO, the present lack of rainfall has added to the list of problems. A local respondent said, "*Repeated landslide is covering the lake bottom and polluting the water, for which the number of fish is decreasing.*" Agricultural and urban runoff is considered as another polluting agent. A local respondent stated, "*Farmers use poison in their fields that flow through the water and deteriorate water quality. Local environmentalists warn them about the consequences, but the fishers do not care about it.*"

Moreover, every year thousands of people visit KL to have a joy ride in the lake. They throw plastic bags, packets, plastic boxes, paper, masks, food waste into the lake. Touring vessels, such as mechanized boats, launches, and speed boats, spill engine oil that harms aquatic biodiversity.

4.2. Enforcement

4.2.1. The Paucity of Effective Enforcement

The days of large fish hauls in KL have lately become a rarity. Deterioration of the lake waters, overfishing, and the use of current nets to catch fish fry are also responsible for the decline in catch size and biodiversity. This has prompted the Rangamati district administration to enforce a 3-month ban on fish catching in KL from May 1. It is also a potent reason behind the forming of a large task force to enforce the ban. The task force has taken several preventive measures to obstruct illegal fish-catching, yet fishers of remote areas still use illegal and destructive fishing equipment. Apart from seizing various netting devices used for fishing during the prohibition period, the task force is said to be assigned to ensure that the ice factories in the lake area remain closed during the ban. Its members must also ensure that no transport can carry fish from Rangamati and Kaptai to different paces during the prohibition period. Illegal marketing of fish should be taken care of by the law enforcement agencies, but in reality, this is rarely conducted. The agency members should constantly patrol the lake to catch prohibition violators. As this does not occur, the volume of the annual average catch of fish in the lake has decreased alarmingly. Surprisingly, despite the yearly three-month ban on fishing to increase the fish population in the lake, there are no campaigns to sensitize the local people to the imperative of maintaining the water body as a sound environment, and thus fish-friendly.

4.2.2. Mismatch in Theory and Practice, and Corruption of Management Authorities

People rely on KL for fishing resources. However, they suffer from the prevalence of corruption. Corrupt activities in licensing are common during fishing season at KL. Such activities occur mostly between licensing and negotiation officials on one side and license applicants and access seekers on the other. The corruption happens due to a lack of enforcement at the point of monitoring and inspection during the catching period at the local level. The fishers stated that administrative authorities receive bribes, thereby allowing the breakage of rules by illegal fishing. The fishers blame dishonest political people, such as local chairmen, for not dispensing the incentives they receive from the government during the ban season. “The chairman gives the incentives to his kins and familiar persons, but we never get it”—these were the exact words of a deprived fisherman. This incentive program was instituted for the fishers; they must receive their incentives if we need them to obey the banning season.

4.2.3. Lack of Coordination and Cooperation between Institutional Bodies

The study revealed that the institutions involved in fisheries management in Bangladesh are poorly equipped to implement the act. The reasons behind this are workforce shortage, lack of logistics support, and dependency on other departments. In addition, Bangladesh has a top-down, centralized governance framework, rather than a bottom-up, decentralized administration. Integrated and interagency collaboration is also lacking within the present institutional structure. In Bangladesh, several agencies are involved in fisheries management in various capacities, either directly or indirectly. In principle, the Department of Fisheries (DoF) is the leading institution for managing Bangladesh’s fisheries resources, guided by centrally determined rules to obtain national targets. However, DoF’s role in administering and managing the country’s aquatic resources has been exercised only to a minimal extent. For DoF to take any development initiatives, particularly in the open water areas of the country, the first requirement is for it to take control of water bodies from the Ministry of Lands (MoL) and others. However, the lengthy bureaucratic process involved in doing so frequently causes undesirable delays.

4.2.4. Weak Enforcement of Laws

Some fishers still manage to catch using legal equipment in the lake and sanctuary areas. However, people who participated in FGDs suggested that in the KL area, a significant number of fishers disobey the ban on destructive equipment. The key informants and

FGDs reported that illegal fishing mainly occurs at night when law enforcement teams are less vigilant. This identifies a weakness in the way institutions are enforcing the Fisheries Rules of 1985; a more efficient arrangement is needed. A few key informants also said that sometimes fishers bribe local law enforcement officers to allow them to fish illegally, highlighting a weakness in local governance rooted in the institution.

4.3. Limited Support from Government

4.3.1. Limited Institutional Capacity

Four institutions with conflicting roles are involved in administering this reservoir. BFDC is responsible for the overall management, and is concerned with commercial exploitation of fish, marketing, declaration of the closed season, licensing, stocking, and guarding. BFRI provides research and technical support. However, DoF coordinates all extension and conservation activities except management, and implements the Fish Act. On the other hand, the Civil Administration (Deputy Commissioner) is responsible for final decision-making and enforcement of conservation and appropriate utilization of natural resources. In summary, the institution responsible for managing the reservoir is not equipped with enforcement capabilities, and the body with enforcement capabilities is not involved with management, which results in the poor enforcement of regulations. The total area of KL includes eight Upazilas of the Rangamati district. It is complicated for BFDC to control all the eight Upazilas due to workforce and capacity limitations. This significant distance causes a communication gap between the fisherfolk and the officials. Independent fishers are deprived of legislative knowledge. These organizations struggle to disseminate their regulation throughout Rangamati Sadar Upazila alone. As a result, fishers of other areas adopt illegal fishing methods (e.g., poison fishing, use of current jal, mesh size violation) for extra income.

4.3.2. Inadequate Incentive Sharing

BFDC enforces a fishing ban for three months every year from May 1 to July 30, to facilitate fish replenishment in the lake. During this period, fishers become jobless. Additionally, at this time most fishers cannot afford three square meals due to the lack of income and to the failure of authorities to include their names on the list of government aid recipients. The government provides 20 kg of rice per family to help fishermen suffering from the ban. However, although approximately 50–60% of fishing families receive food assistance, others are yet to receive this governmental assistance. Some receive this rice approximately a month after the beginning of the ban. Many fishers complained that they received nothing because their names did not appear in the government list for support, despite fulfilling all the conditions. Most of the fishers who received rice from the government said that it was not enough to support their families, as there was no cash assistance to meet other household expenses.

4.3.3. Scarcity of Training and Education Programs

The fishermen at the study sites were found to be socioeconomically incapable. A lack of education in these areas leads to fishers possessing poor knowledge of fishing laws and of the importance of complying with them. Furthermore, there have been no initiatives undertaken to date to train fishermen to increase compliance with the laws. Most fishers reported that they knew about the ban at the study sites, but they had no adequate knowledge about the laws to be observed.

4.4. Socioeconomic Limitations

4.4.1. Poor Socioeconomic Status of Fishers'

Traditional fishing communities live in villages in areas close to the banks of the lake, generally at the very edge of the landmass, where land is least productive and subject to erosion. Approximately 60–70% of fishers have no affordable home or adequate housing. Supplies of potable water at proximity are rare, while basic sanitation facilities are

inadequate, almost non-existent. With low income and education, fishing communities in the region generally have a low social status. They are regarded as socially inferior to those engaged in most other occupations. The incomes of the fishing communities are generally below the poverty line, especially during the lean period. They may fail to catch sufficient fish to survive, resulting in malnutrition and further indebtedness. Due to seasonality in fishing, incomes are not evenly spaced throughout the year. This uneven pattern of earnings leads to indebtedness. They cannot benefit from improved technology as it is beyond their reach; if this were not the case, they could benefit from income-generating activities such as agriculture, poultry, and cattle. Patterns of ownership and settlement vary widely for immovable property such as land and houses. Likewise, there are many variations in the ownership patterns of boats and fishing equipment, including individual ownership, part ownership, and cooperative ownership. It is believed that only a tiny portion of fishers own their boats—individuals not actively engaged in fishing own many of the larger, powered craft and equipment. Many members of the fishing community are hired employees. They possess no assets themselves and engage in fishing for wages or a share of the catch. The fishermen interviewed thought that a cooperative and loan system should be developed to help them acquire fishing gear and boats.

4.4.2. Scarce Alternative Livelihoods

The ban period had a tremendous effect on the livelihoods of fishers. During the ban, fishers barely managed to afford their necessary foods. They sought alternative income generation opportunities and were involved in various occupations such as day laboring, net making and mending, and agricultural work. Respondents reported that there was no available work even for bread to feed family members. A fisherman added, *“We are habituated in fishing; we do not know another work, have no skills. Therefore, we are helpless when any prohibition is implemented in fishing.”*

5. Discussion

The findings of this study indicated that, while the fisheries community does not strictly follow the implementation and enforcement of the Fish Act 1950 in KL, the significant rules and regulations of the Acts are followed to some extent. The study found that in the Rangamati sadar, implementation was effective for some rules of the Fish Act 1950, such as licensing, mesh size, catch size, and appropriate equipment. The fishing ban was more likely to be observed than in the other study areas (Naniarchar, Barkal, and Langadu Upazila), Rangamati Sadar Upazila evidenced a higher rate of law enforcement. Fishers in areas frequently visited by government officials rigorously obeyed rules regarding fishing nets. As a result, communities in these areas were more aware of the current jal and the Act. A relationship was discovered between law enforcement, public awareness, and law application in the study. This analysis supports the theory that the greater the level of law enforcement, the greater the level of implementation. In remote places, regulations were frequently broken. Though just a tiny portion of the fishing population uses current jal, it is not acceptable. Fishers utilize unlawful equipment designed for indiscriminate fishing to enhance catch units, including undersized and forbidden species. The kechki jal, which is used to catch kechki fish (*C. soborna*), is the most frequently used equipment in KL. The properties of kechki jal, according to the senior scientific officer (SSO) of BFRI, Rangamati substation, are detrimental to biodiversity survival. Production increased for 1987–2001 with an annual rate of 3.8%, but steadily declined from 1970 to 1990 [9]. Currently, production is decreasing at an alarming rate.

The average depth of kechki jal utilized in KL ranges from 105 to 320 m. As a surface feeder, the kechki fish does not require such depth. The SSO has stated that BFRI aim to outlaw this destructive equipment, but the BFDC opposes this because it would obstruct production. As a result, the BFRI wants to limit the standard length to 60 to 70 m and penalize those who use a deep net. Furthermore, the indiscriminate capture of undersized fish, the employment of prohibited equipment and methods, and fishing during closed

seasons and in spawning sites all have severe consequences for artisanal and commercial fisheries [2,15]. According to [17], mesh size regulation prohibits fishing using nets or gear with mesh sizes smaller than the prescribed size. The purpose of these restrictions is to keep small and immature fish from being caught, ensuring the long-term viability of fisheries.

The number of fishers in KL is rapidly expanding. According to the SSO of BFRI, the number of fishers in KL has doubled in the last ten years. People come to fish in Rangamati from Chottogram, Barisal, Khulna, and even Rangpur (North Bengal). These fishermen frequently work with the Mahajan to undertake industrial fishing in areas where most native fishers are traditional fishermen. This rapid population growth exacerbates tensions and adds to the complexity of the situation. The native fishers argue that these outsider anglers are a critical cause of the declining trend in KL fish stocks and their loss of legal rights. Conflicts among resource users exacerbate social tensions, making poor fishers even more destitute [2]. Enforcement is an essential intervention in the long-term management of fisheries resources [2]. However, existing fishing rules in Bangladesh are poorly administered, and where they are enacted, considerable noncompliance exists [2]. While enforcement is lacking in this situation, increasing the number of people involved in fish collecting applies additional pressure.

Furthermore, the socioeconomic position of KL fishers is precarious. The majority of traditional fishers live in poverty. Furthermore, fishermen's primary source of revenue is disrupted during the ban season. As a result, fishers continue to fish despite the ban, as poverty and a lack of alternative vocations encourage noncompliance [2]. Only 44.44–62.30% of KL fishers receive incentives (Figure 5), whereas most do not. Although incentive schemes have been shown to motivate fishers to follow fishing rules in hilsa fisheries [17], the inclusion of fishers in KL fisheries has yet to be considered for incentive provision, despite their limited capacity to cope with the temporal and spatial closure [18,19]. Despite their great socioeconomic value, only a few limited studies have focused on the socioeconomic aspect of fisheries [20–22].

Furthermore, the fishermen's displeasure was primarily due to inconsistencies in the distribution of government incentive schemes, such as nepotism, political bias, and corruption, which favored a small number of fishers over all other fishermen [23]. Small-scale fishers respond to poverty and a lack of alternative employment by increasing pressure on communal fisheries resources, regardless of the rules [24]. During the prohibition, fishers' alternative options for work included agriculture and day labor.

Despite having considerable fishing experience, some fishers battled poverty, lacking sufficient alternative income opportunities. With an increasing number of fishers highly dependent on KL natural resources over time, several anthropogenic problems have emerged. These include overexploitation, unregulated and destructive fishing practices, and insufficient enforcement of fishing regulation. Along with natural complications, e.g., siltation and changes in original river current flow, anthropogenic problems cause complex scenarios and significant challenges to the sustainability of this wetland. Human life is being undermined due to the destruction of natural resources and associated ecosystems [25]. As with most wetland ecosystems of Bangladesh, it is not always easy to resolve the concerns and priorities of natural resource management. The environment in developing countries will continue to degrade with a lack of natural resource management [26].

Another concern is microcredit, which, though intended as a boon to rural people, is frequently a curse for fishers, functioning as a catalyst for disobedience. Most fishers lack essential fishing equipment or the financial means to purchase items such as a fishing boat, a net, and labor. Because they may readily borrow money from Mahajan to purchase this equipment, they must give Mahajan a considerable amount of their catch in return. This money lending practice confines fishers' choices by binding them into long-term exploitative debt bondage [27]. As a result, many of the fishermen had spent the rest of their lives repaying their debts. In addition, around 14.7% of households in the sanctuaries that continued to fish for hilsa year-round (in violation of the restriction) owed

money to a middleman known as “dadon” [28]. Therefore, fair enlisting of fishers and open remuneration distribution should be guaranteed. In addition, funding for incentive programs should be raised to cover all fishermen. Another priority during the ban season is to create economic alternatives for career diversification outside of the fishing industry. Accordingly, this study indicates that before imposing any limits, a pre-assessment of the community’s socioeconomic profile and coping mechanisms should be emphasized. CBFM is suggested as a viable option for managing the Kaptai reservoir and should receive serious consideration [9].

The study also showed that fishers on the Kaptai Lake defy the regulations and restrictions on undersized fishing, fishing in the sanctuary region, fishing with poisoning, brush pile, and dewatering/drying. However, breaches occur mostly with undersized fishing, which is usually the indirect result of a planned production trend. Though most of the respondents knew the laws, there remained some gaps in their understanding of the Act and some gaps between the administrator and the fishermen. More regulation, enforcement, awareness, and familiarity with the rules are required for effective administration and implementation of the law if those constraints are removed.

The reduction in catch sizes made fishers intensify their fishing effort by whatever means necessary, typically by using illegal fishing equipment and violating the ban period [19]. As a result, it is critical to boost the fishing system’s productivity by establishing protected zones in the environmentally vulnerable KL. As a result, fishing stakeholders should be engaged and involved at all phases of the law’s development and implementation before establishing a new sanctuary. The government has established seven sanctuaries around the KL (Table 8). On the other hand, stakeholders and fishers were rarely engaged before these sanctuaries and breeding areas were established. As a result, fishers are unwittingly violating regulations [20]. Fishermen’s local expertise should be used when making decisions on fisheries management, as this could help avoid resource management conflicts. Fishermen’s ecological knowledge, for example, was not considered in regard to spawning time and the selection of locations for carp breeding in the sanctuaries, even though decisions proved to be contradictory to expert information in certain circumstances. Particular fisheries regulations in regard to matters such as mesh size, the destructive nature of specific fishing equipment, and the precise spawning time and place for carp species, have caused controversies between anglers and fisheries management. As a result, there is an urgent need for regulatory measures to be reviewed to better correspond with stakeholder knowledge and the characteristics of, and changes in, the natural system [25].

However, different carp spawning locations must be considered for spatial and temporal preservation. The lake’s carp spawning grounds are being destroyed as a result of ecological imbalance and artificial factors. According to the response, carnivorous animals also lay eggs on wooden logs or rocks. However, nets and low water levels destroy these grounds by eliminating underwater logs and rocks. Maynimukh, Kachalong River, Karnafuli River, Chengri, Bilaimukhi, and Rekhang Channel are key carp spawning sites, according to BFRI. The creation of protected zones will help fishers to be more resilient [2]. In achieving this goal, these places must be considered when declaring protected areas.

Furthermore, stakeholder involvement in lake management may decrease the incidence of illegal equipment use. Comanagement, particularly in sanctuaries, would make it easier for fishers to participate in fisheries management, potentially lowering costs for fisheries departments and law enforcement [29]. This is expected to significantly raise fishermen’s knowledge and motivation to conserve the resources they rely on for a living. Furthermore, the role of intermediaries in small-scale fishing administration should be considered in any policymaking [30]. According to the report, various concerns, such as gaps in legal documents, inadequate institutional capacity, corruption, and outdated laws, are primary drivers of noncompliance.

Table 8. Sanctuaries for fisheries protection in KL under the Fish Act 1950 [9].

SI No.	Sanctuaries	Upazilla
1	Adjacent area of DC Banglo	Rangamati Sadar
2	Adjacent lake area of BFDC office	Rangamati Sadar
	Rajbon bihar	Rangamati Sadar
3	Adjacent beel area of Kattli market	Longodu
4	Choykori beel	Naniarchar
5	Naniarchar lake area	Naniarchar
6	Adjacent lake area of an army camp	Naniarchar
7	Ringkkhai river of chukrachhari	Balaichhari

Furthermore, there exist legislative and communication gaps across law enforcement authorities. Fisheries are inadequately managed due to a lack of staff, infrastructure, and funding and because rules are not adequately enforced [31]. Because of the high illiteracy rate among fishers, small-scale fishers have a limited understanding of fishing regulations. Furthermore, most rules and regulations are outdated; changes are usually made to adapt laws to new circumstances. As a result, due to a lack of adequate laws, enforcement organizations, which are confined by limited resources, have inadequate awareness of emerging scenarios. The various types of noncompliance identified by this research may help legislators create more stringent rules, such as requirements for pollution control and fisherman safety.

There are several factors responsible for habitat degradation and biodiversity loss in the Kaptai lake fisheries, among which noncompliance with several fishing regulations (articles) of the Fish act 1950 is one of the focal problems in the study areas. For example, destructive fishing practices using fishing equipment, such as the monofilament nylon nets (current jal), small-meshed mosquito nets, fine-meshed cloth nets (chot jal), seine nets with small-meshed cod ends (tangra jal), purse seine nets (ber jal), and brush pile (khata/zaak), are used for harvesting fishes of all sizes while destroying enormous numbers of non-target species, and harvesting during the ban period (illicit fishing) is widely spread in the study areas. Therefore, one of the focus cases for the risk of fishery biodiversity loss in the lake is the inadequate and ineffective application of the fisheries Acts.

Unregulated access to fisheries and overexploitation pose severe threats to the aquatic resource of the KL [32]. As the overall population increases in the catchment area of Kaptai lake, more people become engaged in fishing activities, increasing pressure on resources, as fishers have minimal alternative income-generating activities. The poverty of fishers who are highly dependent on the natural resources of the Kaptai lake, with few or no alternative livelihood options, leads to overexploitation of the lake's resources. Little space has been designated for sanctuary purposes, and the three established sanctuaries covering only (12 km²) are minute and insufficient compared to the 700 km² of lake water. This is another failure to protect the biodiversity of the KL wetland. Water pollution, siltation of the lake basin, and manual water reduction and control for hydroelectricity generation during the monsoon–peak breeding season, restrict water spread and prevent fish migration as well as hampering the natural breeding of fishes in the Kaptai lake. As with most wetlands of Bangladesh, Kaptai lake also suffers from several threats and stressors responsible for the biodiversity loss and management sustainability failures of this wetland [2,15,20,33,34].

6. Conclusions

The KL Reservoir is one of Bangladesh's largest fisheries reservoirs, with significant changes in catch composition since impoundment; however, production records show a declining trend in high-value fish productivity due to ineffective implementation of existing rules and regulations. The overall results showed that due to weak enforcement with inadequate surveillance and poor implementation of the legal framework, there was

a high level of noncompliance with fishing laws, rules, and policies in KL. Destructive and prohibited fishing practices, e.g., the use of small current jal, small-meshed mosquito nets, fine-meshed cloth chot jal, seine nets with small-meshed cod ends, tangra jal, and ber jal, as well as brush pile fishing and harvesting during the ban period were deployed extensively in the study areas. Catching undersized fish, fishing at the restricted sanctuary areas, fishing during spawning seasons occurred most often. Therefore, improvement in the enforcement of fishing regulations may be the most important option to ensure better biodiversity conservation and management sustainability of this wetland. A comprehensive legal and policy framework contextualized to local situations, identifying the gaps in understanding and practice, ensuring proper implementation of the fishing laws and regulations, increasing the managerial efficiency of enforcing agencies, ensuring livelihood support during the fishing ban, and offering sufficient alternative income options are still major issues to be addressed in order to achieved sound resource management in the Kaptai Lake area.

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