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Analyses Implementation Realities of Legal Frameworks for Sustainable Management of Tanguar Haor Fisheries Resources in Bangladesh

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Abstract: Tanguar Haor (TH) is considered one of the Ecologically Critical Areas (ECAs) of Bangladesh and is internationally recognized as RAMSAR wetland (2nd Ramsar site) known to provide multiple ecosystem services to the society. Nevertheless, multidimensional threats and stressors, the capacity to supply ESs, and the biodiversity of the TH significantly degrades and threatens this wetland's conservation and sustainability. Although the legal framework promises the sustainable conservation of fisheries resources, information on the implementation scenarios of fisheries laws, regulations, and policies in the TH Ramsar are scant. By merging qualitative and quantitative data of primary and secondary sources, this research aimed to analyze the legal framework to check the effectiveness of regulations for non-conflicting fisheries resources and the sustainable conservation of the TH Ramsar. Primary empirical data were collected by employing Participatory Rural Appraisal (PRA) tools, i.e., 204 semi-structured questionnaire-based individual interviews with fishers, three focus group discussions, and 14 key informants' interviews in three fishing villages in the TH. In contrast, secondary data was set by reviewing published literature and related official documents. Results showed that, due to weak enforcement with inadequate surveillance and poor implementation of the legal framework, there was a high non-compliance with fishing laws, rules, and policies. Destructive and prohibited fishing gears, e.g., the use of small mesh fine nylon nets (current jal), purse seine net (ber jal), and the harvesting during ban period-illicit catch were widespread in the study areas. In addition, catching undersized fish, fishing at the restricted areas (sanctuary area), and fishing during spawning seasons occur often. There is a crying need for a comprehensive legal and policy framework to contextualize the local context, ensure the proper implementation of the fishing laws and regulations, increase the managerial inefficiency of enforcing agencies, ensure livelihood support during the fishing ban, and afford good alternative income options are still significant issues for good governance in the Tanguar Haor ECA. Findings might help to identify the gaps and misunderstanding of the existing legal practice while submitting urgent attention to the need for drawing a comprehensive legal and policy framework (contextually modified according to the local context), taking initiatives and acting synchronously for proper implementation, and calling transdisciplinary collaboration and cooperation among the agencies that may ensure the non-conflicting use of the natural resources of the TH that can be also helpful for the better conservation of this Ramsar wetland.

Keywords: Tangoar Haor; Ramsar wetland; ECA; ecosystems service; fisheries; legal framework; non-compliance; conservation; sustainability

Citation: Tima, T.A.; Schneider, P.; Chanda, S.K.; Mozumder, M.M.H.; Hossain, M.M.; Begum, A.; Shamsuzzaman, M.M. Analyses Implementation Realities of Legal Frameworks for Sustainable Management of Tanguar Haor Fisheries Resources in Bangladesh. *Sustainability* **2021**, *13*, 8784. https://doi.org/10.3390/su13168784

Academic Editor: Gualtiero Basilone

Received: 8 June 2021
Accepted: 31 July 2021
Published: 6 August 2021

1. Introduction

Wetlands occupy 1.5% of the earth's surface yet are considered prized and productive ecosystems that provide nearly 40% of the global ecosystem services (ES) in economic, social, and ecological benefits to the broader society [1]. As with the global context, wetlands are an immersible part of society and provide multiple ES in economic, ecological, and cultural contexts since the historical era in most Southeast Asian countries, including Bangladesh [2–7]. Bangladesh is one of the top fish-producing countries, having the world's largest wetland and the third largest aquatic biodiversity in Asia [8]. In Bangladesh, the natural wetlands are locally called haor viz. the bowl-shaped or saucer-like natural depression usually resulted in levees of rivers or large floodplain areas joining a sequence of low-lying basins. The entire hoar basin of Bangladesh occupies approximately 70,000–80,000 km^2 of wetlands, including freshwater and saltwater wetlands [9,10], in which the Sylhet–Mymensing Haor basin covers about 27,126.18 km^2 [11]. Wetlands usually support significant habitat and breeding grounds for many aquatic species [12,13]. For instance, it shelters about 293 freshwater native finfish, 24 exotic fish, 24 prawns, and numerous aquatic–terrestrial faunas [14,15].

Tanguar Haor (TH), having the global identity as the Ramsar wetland and national significance as one of the six Ecologically Critical Areas (ECAs) of Bangladesh, covers an area of nearly 160 km^2 in north-eastern Bangladesh [16–18]. The TH formed unique and productive ecosystems and was considered one of the six mother fisheries (storage of fish) of the country, producing 0.67% of the country's fishery production [14,19]. The TH wetland is immensely interconnecting with the livelihoods and employment of the community in the broader society by providing a variety of benefits, e.g., provisional, regulating, and cultural ecosystems services [20]. The TH is very important in fish species diversity, production, and breeding habitat [14]. Of the 423 small and large haor ecosystems in Bangladesh, this unique and biodiversity-rich productive wetland supports the habitat and spawning ground for diverse life forms, e.g., fish, shellfishes, birds, reptiles, amphibians [21,22]. The TH wetland is home to 141 fish species from 35 families, around half of Bangladesh's total freshwater fish species [14]. Moreover, there were 11 amphibians, 34 reptiles (6 turtles, 7 lizards, and 21 snakes), 206 birds, and 31 mammals found in this haor [14]. It is also considered a refuge for threatened fish species [23]. The haor provides a home to three Channa barca (Pipla, or Tila Shol), Labeo boggut, Labeo nandina (Nandina), 16 critically endangered, and 26 endangered fish species [24].

However, inland fisheries are being governed by several common fisheries laws in Bangladesh. The Protection and Conservation of Fish Act 1950 and the Protection and Conservation of Fish Rules 1985 are the primary legal instruments governing inland and wetland [25]. Indeed, the government adopted the Jalmahal Management Policy (2009) to safeguard the rights of actual fishers. Further, Community-Based Fisheries Management (CBFM), or co-management, emerged in Bangladesh as an alternative strategy for the management of TH to solve the adverse effects of the government leasing policy on fisheries resources [26]. Likewise, the government developed a comprehensive management plan, The Tanguar Hoar Management Plan (TMHP) and, in agreement with NGOs, took several initiatives to protect biodiversity [27] (Ara and Islam, 2019). However, the biodiversity of the TH wetland is gradually dwindling, including many indigenous fish species which are being threatened due to several anthropogenic and natural causes [18,22,28]. Reducing fish stocks might result in a loss of food, income, employment, and other eventual benefits in the immediate and long-term future [29].

Although the principle of ECAs, Ramsar policy, and ecosystem-based fishery co-management regime is implied for two decades (since 1999), and existed legal framework promises for sustainable conservation, the non-conflicting use of natural resources and biodiversity conservation are still significant challenges in this wetland. For instance, over the past few decades, this wetland ecosystem's environmental quality and ecological settings have degraded a lot. Moreover, illegal fishing during the breeding season and in restricted areas, the use of banned and destructive gears, habitat degradation, water quality deterio-

ration, soil erosion, increased sedimentation, and a flash flood are significant challenges for the sustainable management of TH wetland [18,24,28]. In these circumstances, the proper implementation of laws is deemed essential, as the effective enforcement measures in the binding sites and the breeding period might contribute to the production of biodiversity safeguarding to a greater extent [30]. Furthermore, from a management perspective, it is essential to examine the level and causes of non-compliance to provide essential insights to policymakers for the creating of more compliant situations to prevent degradation and unsustainability in fishery sectors [25,31].

Nevertheless, no study on legal framework implication has been conducted regarding this globally recognized wetland. Therefore, it is crucial to evaluate the wetland's legal framework and provide the foundation for improved compliance to restore and conserve TH wetland fisheries resources. Hence, this study aimed at analyzing the legal framework to assess the effectiveness of its regulations for the sustainable conservation of fisheries resources in the TH wetland.

2. Materials and Methods

2.1. Area Setting and Study Sites Profile

The study was conducted in the Tanguar Haor wetland that is located in the north-eastern part of Bangladesh, between 25°06′ and 25°11′ N latitude and 91°01′ and 91°06′ E longitude under the administrative jurisdiction of the Dharmapasha and Tahirpur Upazilas of Sunamganj district in Sylhet division (Figure 1). The TH comprises approximately 10,000 ha of land (160 km^2), approximately 100 km^2 covered by the haor area during monsoon, and 28.02360 km^2 exclusively regarded as perennial as wetlands. The TH wetland directly provides a range of social, economic, and environmental benefits and services to 70,000 people inhabiting the 88 villages surrounded by the hoar basin [14,27,32]. Among the inhabitants, the fishing community mainly depends on the fisheries resources of the TH. Therefore, three fishing communities inhabiting the Indrapur, Joypur, and Lamargaon villages in Tahirpur Upazila were selected for the study (Figure 1). One of the villages was selected from a short distance from camp and/or town (Joypur) and the other two from both sides of it (one from north and the other from south) with longer distances.

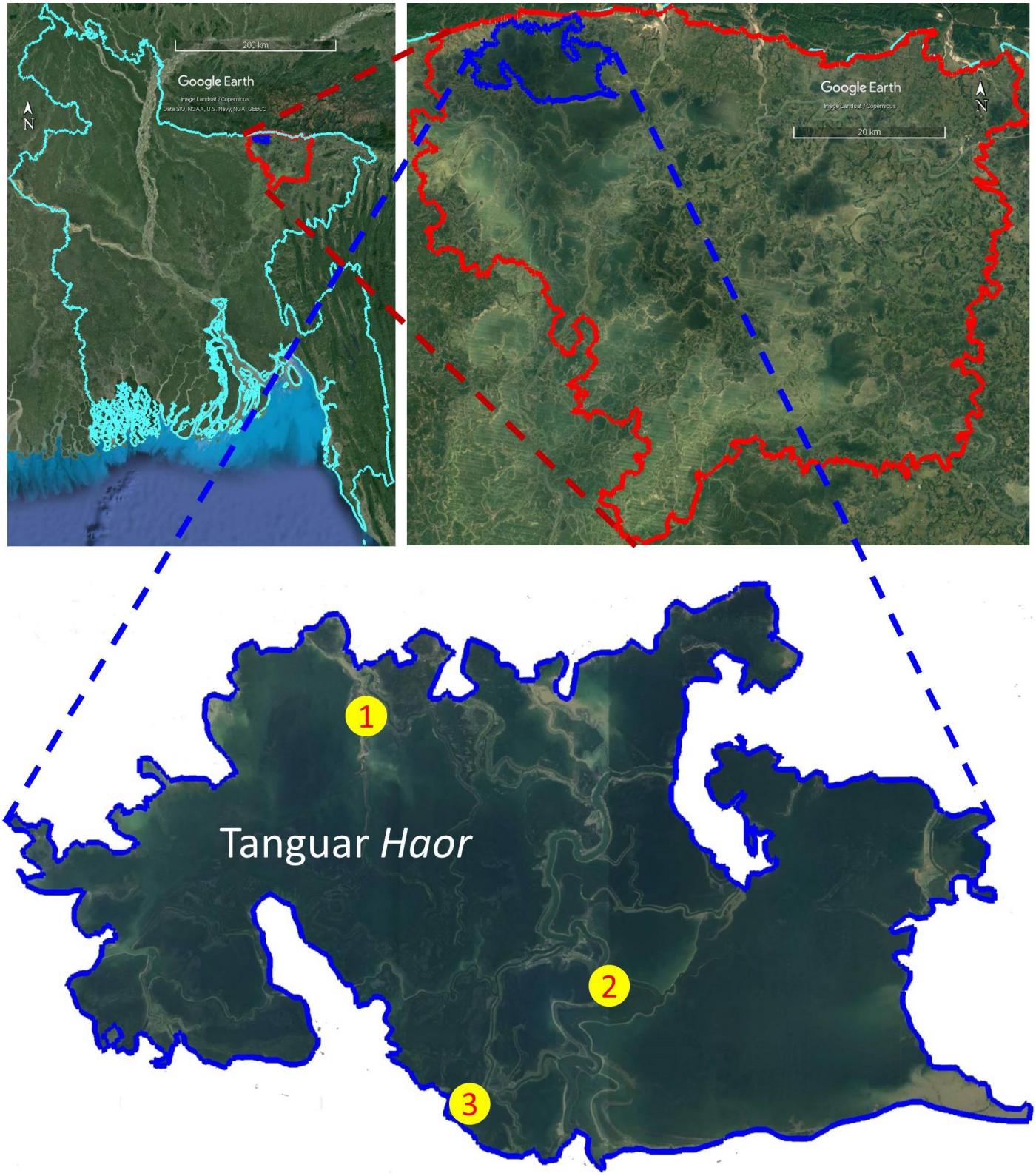

Figure 1. Location of the studied fishing villages ❶ Indrapur ❷ Joypur and ❸ Lamargaon in the Tanguar Haor Ramsar wetlands (Source: Google Earth Pro.).

2.2. Primary and Secondary Data Collection

A semi-structured questionnaire that contained basic qualitative questions related to fish conservation regulations that collected primary data from the fishermen to check for compliance and non-compliance regulations was made early, pre-tested, and finalized. In addition, a field survey was conducted for four months, starting from October 2019 to January 2020.

Empirical primary data were collected by employing a set of Participatory Rural Appraisal (PRA) tools, i.e., individual interviews (II), focus group discussion (FGD), and key informants interviews (KII) in the study sites. A total of 204 semi-structured questionnaires were based on individual interviews with fishers, 3 FGDs with a checklist (group size: 5–10 people sit for 45–90 min), and 14 cross-checking KII in selected fishing villages the TH wetland (Table 1). We have taken more extensive size sampling from larger and more densely populated villages (70 from Indrapur and 80 from Lamargaon). A likely small sample was taken from small and less densely populated ones (for example, 54 from Joypur). Individual interviews with fishers, fish traders, and entrepreneurs involved with fisheries-related activities were conducted according to convenient setup, e.g., in their house, workplace, fish market, fishing, boat, and time frame, i.e., 45–60 min. In addition, FGDs with resource users and cross-checking KII with key informants, e.g., Upazila Fisheries officers (UFO), officials of the Department of Environment and Forest department, NGO staff, Union Parisad members, members of the co-management committee, and knowledgeable persons were done based on face to face personal commination in accordance with pre-schedule timing. Apart from primary data, secondary documents from scholarly published literature collected from ScienceDirect, Scopus, Google scholar, official government regulations and NGOs' reports related to TH management were also interpreted. Almost half of the respondent fishermen were illiterate at each study site (Table 1). Moreover, fishing is the primary source of income generation for 74%, 75%, and 67% of fishers at Indrapur, Joypur, and Lamargaon, respectively.

Table 1. Area coverage, location of study sites, methodological tools, and sample size implied in this research and background of community.

Area Coverage in the Tanguar Haor			Global Positioning System (GPS) Location	Tools and Sample Size			Educational Profile	Occupation
District (Upazila)	Union	Villages		II (Individual Interview)	FGD (Focus Group Discussion)	KII (Key Informant Interview)		
Sunamgonj (Tahirpur)	Uttar Sripur	Indrapur	25.186220 N, 91.071261 S	70	1	5	Illiterate: 51% Primary: 31% Secondary: 18%	Fishing as primary: 74% Secondary options: 74%
	Uttar Sripur	Joypur	25.128141 N, 91.104771 S	54	1	4	Illiterate: 52% Primary: 41% Secondary: 7%	Fishing as primary: 75% Secondary options: 96%
	Dakshin Sripur	Lamargaon	25.116832 N, 91.067792 S	80	1	5	Illiterate: 50% Primary: 36% Secondary: 40%	Fishing as primary: 67% Secondary options: 77%
Total				204	3	14		

2.3. Data Analysis

Qualitative analyses require adequate descriptions for each level of consequence and likelihood; the more precise, the less ambiguity in assigning ratings, Fletcher, 2005. The questionnaire covered four different segments, including (i) the socio-economic status of respondents; (ii) participants' knowledge of fishing regulations and their role in haor fisheries production; (iii) perception of fish act enforcement; (iv) perceptions of the effectiveness of fish act implementation. In addition, Likert scale responses were used to assess community perceptions on law enforcement realities and implementation effectiveness through an

informal interview. The quantitative data were compiled in MS excels and analyzed by SPSS (Statistical Package for Social Science, Version 22) software.

3. Results

3.1. Existing Management Tools of Tangoar Haor Fisheries

The Protection and Conservation of Fish Act, 1950 is known as the mother act for fisheries management in Bangladesh. It was previously known as the East Bengal Act No. XVII of 1950. This Act aimed to regulate the use of current jal, fixed engines, explosives, and other harmful fishing practices of all species of all-natural or artificial, open or closed, flowing or stagnant, bodies of water. There were several amendments under the Protection and Conservation of Fish Act, 1950. The Act, over time, prescribed measures and restricted harmful fishing practices to sustain fisheries resources in Bangladesh. These measures comprised mesh size regulations, banned fishing areas (e.g., sanctuary), restrictions on fishing gear (monofilament gill net and other destructive gears), and the restricting of the fishing season (breeding season). The Act also imposed penalties against breaching restrictions (see Tables 2 and 3). Other legislative measures included the Jalmohal Policy 2009, which provided access rights to fishers, and the Ramsar convention signatory was given to manage and conserve the wetland resources sustainably (described in Table 2).

Table 2. Legal Framework of Fisheries Management implied in the Tanguar Haor Ramsar wetland.

Framework in Place	Major Aspects Covered			
	Prohibitions	**Prescription**	**Penalties**	**Responsibilities**
The protection and conservation of fish act 1950	■ Destroy fishes by drying or dewatering [Section 3.g] ■ Fishing during ban seasons [Section 3.3.f] ■ Manufacture or marketing of illegal fishing nets [Section 3.3.a.IV] ■ Fishing by poisoning [Section 3.3.c] ■ Use of fixed engine [Section 3.a.I] ■ The small mesh size [Section 3.3.a.III]	■ Size under which the caught fish is prohibited [Section 3.3.g] ■ Seasons for fishing ban period [Section 3.3.d]	■ One year imprisonment with a fine may extend to BDT five thousand, or with both [Section 5.1]. ■ Three years or five years imprisonment with a fine may extend to BDT ten thousand [Section 5.2.a].	■ Magistrate of the first-class rank (Section-7) ■ Police officer not below the rank of Sub Inspector (Section-7) ■ All fisheries officers (Section-7)
The protection and conservation of fish rules 1985	■ Current Jal [Rule-12] ■ Destruction of fish fry of Shol, Gazar, and Taki, carp fishes or the parent fish from the first day of April to 31st day of August [Rule 7,8]	■ July–December, each year, Carp species below 23 cm [Section 9] ■ April–August, each year, Boal fish below 30 cm [Section 9]	N/A	■ Authorized government officers will be the responsible core body.
Ramsar Site	■ This convention aims to stop the continued destruction of water bodies, particularly those that are the habitat of migratory waterfowl, and recognizes the ecological, scientific, economic, and recreational values of water bodies. The convention places general obligations on contracting party states relating to the conservation of wetlands throughout their territories, with special obligations about those Wetlands of International Importance. Bangladesh signed the convention in 1972 (Bashar MA, 2012). Following Tangoar, Haor was declared as the second Ramsar site in Bangladesh.			
Jalmohal Policy 2009	■ Emphasized actual fishermen's active involvement in the management process			

Table 3. Regulation related to the amendment of the Protection and Conservation of Fish Act, 1950.

Amendment (Year)	Aspects Covered
1963	• "Use or method of operation of any kind of net and the size of the mesh of any net" was added. [Subsection 3(a)]
1970	• "Pisciculture, collection of data, scientific investigation for biological study on fish" had been a substitute. [Subsection 3]
1982	• "Catching, carrying, transporting, offering, exposing or possession" was substituted for the words "Offering, exposing, possession." [Section 6]
1995	• The definition of 'Fishery' was added. [Section 2 (Ia)] • Substituted "fishing net" for the word "net" [Subsection 3(iii)a]; there was added a semicolon at the end of subsection (iii). • Prohibition of the manufacture, import, marketing, carrying, transporting, or possessing of such fishing nets, traps, gears, and other contrivances as may be specified in the rules [sub-clause (iv) was added at subsection 3]. Prohibition of the destruction of fishes by dewatering was inserted into clause (g). Amendment of Section 5, in subsection (1) the time of imprisonment was described as not less than one month and may be extended to six months; the fine was extended to one thousand takas, in sub-section (2) The time of imprisonment was described as not be less than two months and may extend to one year, and also with fine which may extend to two thousand takas".
2002	• "Fishing net or current jal" was added in (section-3, Subsection-4a). • Prohibit the manufacture, fabrication, marketing, carrying, transporting, or use of current jal in (Section-4A).
2008	• Added rule 16 in the protection and conservation of fish rules 1985, which prohibited importation and sale.
2010	• Prohibited the catching of all kinds of fishes in a certain period in particular areas. [Substitute rule 13]
2011	• ***Prohibitions*** 1. Prohibited the manufacturing, fabrication, importation, marketing, storing, carrying, transporting, owning, possession, or use of current jal [Section 3.3.a.IV]. 2. Prohibited for a specified period the catching, carrying, transporting, offering, exposing, or possession for sale or barter of fishes below the prescribed size of any prescribed species throughout Bangladesh or any part thereof [Section 4]. • ***Penalties*** 1. Carrying, transporting, owning, possession or using of current jal by any person shall be punishable with rigorous imprisonment for a term which shall not be less than one year. It may extend to three years, or with fine which may extend to BDT five thousand, or with both [Section 5.2.b].
2013	• Prohibiting of Ber Jal, Jogot Ber Jal, Vhim Jal from Falguni to Shaban months every year. It also prohibited different fixed net-like chingri puna jal and Bindi Jal all year-round.

3.2. Socio-Economic Profile of Respondents

3.2.1. Income Generations, Catch Status, and Fishing Activities

The respondents' average monthly incomes (BDT) were 19,457.14 ± 12,469.31 at Indrapur, 14,166.67 ± 9797.96 at Joypur, and 20,550 ± 13,661.74 at Lamargaon village. The average family members of the study were 6.60 (±3.61) at Indrapur, 6.78 (±2.54) at Joypur, 6.68 (±2.26) at Lamargaon. The respondents had at least one boat, and they had an average catch of 5.11 (±5.068), 5.04 (±3.647), and 5.16 (±2.802) kg per day at Indrapur, Joypur, and Lamargaon, respectively (Table 4). The comparative differences of income generation (monthly income), fishing activities (years of fishing and number of boats of the respondents), and amount of harvest (caught per day) were realized from significant variation in the result of the Kruskal–Wallis test (Table 4).

Table 4. Income generation, amount of fish harvest, and number of boats operated by the respondents.

Attributes	*Indrapur*	*Joypur*	*Lamargaon*	Kruskal–Wallis Test Statistics	
	Mean (±SD)	Mean (±SD)	Mean (±SD)	Chi-Square Value (df)	Asymp. Significance
Monthly Income (BDT)	19,457.14 ± 12,469.31	14,166.67 ± 9797.96	20,550 ± 13,661.74	49.684 (26)	0.003
Amount of fish caught (kg/day)	5.11 ± 5.068	5.04 ± 3.647	5.16 ± 2.802	63.169 (26)	0.000
Ownership of boat	1 ± 0.24	1.19 ± 0.39	0.99 ± 0.11	84.414 (26)	0.000
Years of fishing	14.5 ± 9.41	25 ± 5	23.5 ± 1.5	130.872 (26)	0.000
Family size	6.60± 3.61	6.78 ± 2.54	6.68 ± 2.26	-	-

3.2.2. Access to Bank Credit

Some respondents are indebted to different financial sources such as the Bangladesh Rural Advancement Committee (BRAC), as they took loans to buy a net, boat, and house materials. The percentage of indebted fishers is highest in the Indrapur study area (54%), which is comparatively lower in the other study areas such as Joypur (26%) and Lamargaon (33%)(Figure 2).

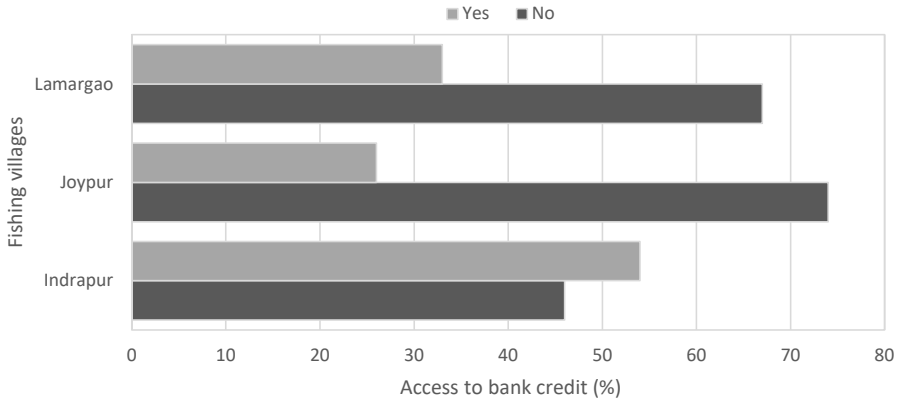

Figure 2. Status of access to bank credit among the respondents.

3.3. Incentive Receives Status

Seventy percent of Indrapur village respondents needed incentives but did not get any incentives, 27% of respondents got incentives, and 3% of fishers did not need any incentives. Sixty-seven percent of respondents in Joypur village needed incentives. However, they did not get any incentives, and 33% of respondents got incentives from Joypur village, which is the highest among the three study areas. Eighty-eight percent of fishers in Lamargaon village needed incentives, but they did not get incentives; only 9% of respondents got incentives, but 3% of fishers did not need any incentives (Figure 3).

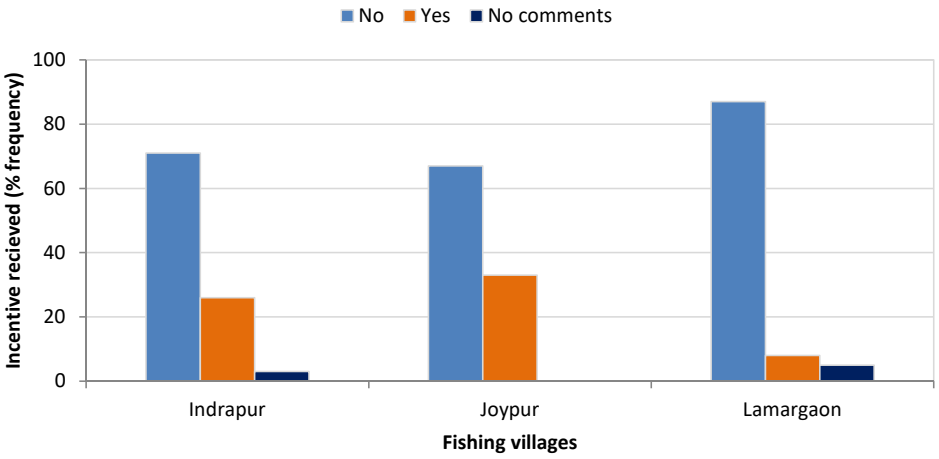

Figure 3. Status of incentives received by the fishers of the studied community.

3.4. Fisher's Knowledge about the Role of Regulations

About 60% of respondents at Indrapur, 80% of respondents at Joypur, and 56% of fishers at Lamargaon were more or less knowledgeable about fishing laws. However, the rest had little or no knowledge about fishing laws (Figure 4). The result shows that the level of compliance with fishing laws varies among the respondents of different sites. A high level of non-compliance with fishing laws was noticed at Lamargaon (about 57%) and Indrapur (around 49%). On the other hand, non-compliance to regulations was found to be relatively lower than the sites mentioned above at Joypur (about 33%) (Figure 5).

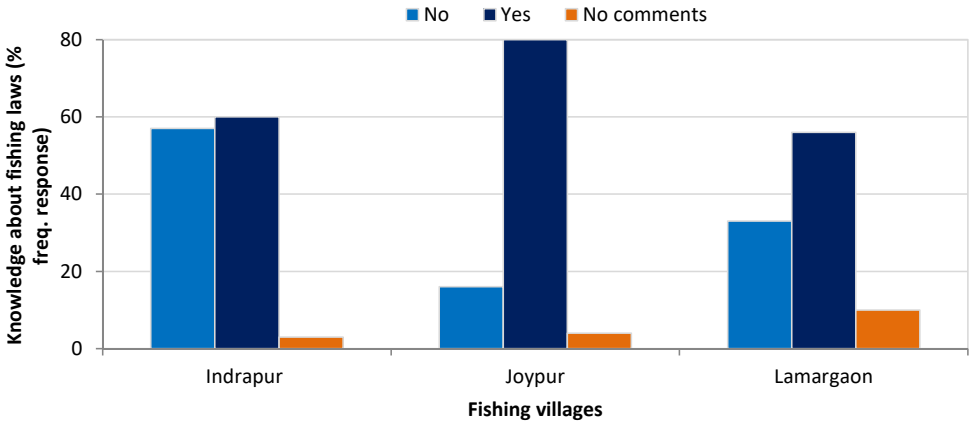

Figure 4. Knowledge about fishing laws among the responding fishers.

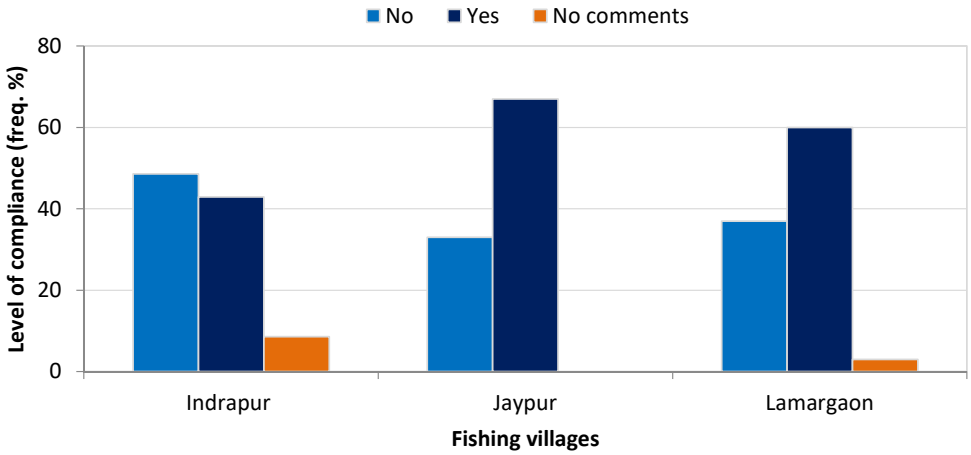

Figure 5. Level of compliance to fishing regulations by responding fishers.

3.5. Perceptions of Respondents on Enforcement Realities

Respondents expressed a negative opinion about satisfactory enforcement at Joypur (37%), Lamargaon (78%), and Indrapur (83%). Respondents complained that visits by law enforcement agencies is low and irregular, according to 26% respondent from Joypur, 50% from Lamargaon, and 57% from Indrapur. Indeed, they reported that fishing by current jal was not controlled at Joypur, Lamargaon, and Indrapur by 11%, 33%, and 57% fishers, respectively. Fishing by poisoning is available, according to 22% of fishers at Joypur, 13% at Lamargaon, and 43% at Indrapur. The catching of undersized fish is very common in three villages, as reported by fishermen at Joypur (78%), Lamargaon (75%), and Indrapur (83%). Prohibited and destructive fishing methods are punished much more at Joypur (about 66%) than in Lamargaon and Indrapur. The fishermen are highly agreed in all three villages that, when caught during illegal fishing, the equipment is seized and burned at landing sites by the law-enforcing agencies. In response to whether they are involved in the management process of Tangiuar Haor, the response rate at three sites varied. About 48% of respondents denied having involvement in the management process at Joypur, 73% at Lamargaon, and 60% at Indrapur village, respectively (Table 5).

Table 5. Community perceptions on enforcement of regulations in Tanguar Haor Ramsar wetlands, Bangladesh.

		Joypur		Lamargao		Indrapur	
Criteria	**Attributes**	**Sample Size (N)**	**Freq. (%)**	**Sample Size (N)**	**Freq. (%)**	**Sample Size (N)**	**Freq. (%)**
Are existing laws effective for TH management?	Strongly disagree	-	-	6	7.5	28	40.0
	Disagree	8	14.8	8	10.0	16	22.9
	Neither agree nor disagree	2	3.7	-	-	4	5.7
	Agree	30	55.6	40	50	16	22.9
	Strongly agree	14	25.9	26	32.5	6	8.6
Are you satisfied with the present governance system?	Strongly disagree	2	3.7	24	30.0	8	11.4
	Disagree	14	25.9	14	17.5	26	37.1
	Neither agree nor disagree	-	-	2	2.5	4	5.7
	Agree	28	51.9	36	45.0	22	31.4
	Strongly agree	10	18.5	4	5.0	10	14.3
Do you satisfy with the enforcement of laws?	Strongly disagree	12	22.2	32	40.0	22	31.4
	Disagree	8	14.8	30	37.5	36	51.4
	Neither agree nor disagree	2	3.7	2	2.5	-	-
	Agree	30	55.6	16	20.0	10	14.3
	Strongly agree	2	3.7	-	-	2	2.9
Do law enforcing agencies visit you regularly	Strongly disagree	4	7.4	18	22.5	10	14.3
	Disagree	10	18.5	22	27.5	30	42.9
	Neither agree nor disagree	-	-	-	-	-	-
	Agree	32	59.3	34	42.5	30	42.9
	Strongly agree	8	14.8	6	7.5	-	-
I have active involvement in the TH management process	Strongly disagree	24	44.4	52	65.0	42	60.0
	Disagree	2	3.7	6	7.5	10	14.3
	Neither agree nor disagree	2	3.7	-	-	-	-
	Agree	16	29.6	10	12.5	12	17.1
	Strongly agree	10	18.5	12	15.0	6	8.6
Fishing by current jal is controlled in the hoar	Strongly disagree	6	11.1	26	32.5	40	57.1
	Disagree	8	14.8	16	20.0	8	11.4
	Neither agree nor disagree	-	-	-	-	-	-
	Agree	28	51.9	16	20.0	14	20.0
	Strongly agree	12	22.2	22	27.5	8	11.4
Fishing by using fixed engine/explosive/poison is available here	Strongly disagree	8	14.8	30	37.5	22	31.4
	Disagree	24	44.4	16	20.0	16	22.9
	Neither agree nor disagree	10	18.5	24	30.0	2	2.9
	Agree	8	14.8	8	10.0	22	31.4
	Strongly agree	4	7.4	2	2.5	8	11.4
Catching of undersized fish are typical here	Strongly disagree	2	3.7	6	7.5	-	-
	Disagree	10	18.5	14	17.5	12	17.1
	Neither agree nor disagree	-	-	-	-	-	-
	Agree	36	66.7	56	70.0	14	20.0
	Strongly agree	6	11.1	4	5.0	44	62.9
Illegal fishing equipment is usually seized on landing sites	Strongly disagree	-	-	4	5.0	4	5.7
	Disagree	10	18.5	8	10.0	6	8.6
	Neither agree nor disagree	-	-	-	-	-	-
	Agree	30	55.6	60	75.0	48	68.6
	Strongly agree	14	25.9	8	10.0	12	17.1
Prohibited and destructive fishing methods are punished strongly	Strongly disagree	6	11.1	6	7.5	4	5.7
	Disagree	4	7.4	20	25.0	10	14.3
	Neither agree nor disagree	-	-	-	-	10	14.3
	Agree	28	51.9	38	47.5	44	62.9
	Strongly agree	16	29.6	12	15.0	2	2.9

3.6. Perceptions of Respondents on Implementation Realities

The implementation realities of the Protection and Conservation of Fish Act, 1950 were checked based on eight different questions (Table 6). The Act's effectiveness is measured in this study by its biological output, such as the increase of fish production, protection of brood fish and fry, conservation of endangered fish species, and the protection of juveniles from being caught. Though half of the respondents stated that the provision of ban season and sanctuary establishment according to fishing law could protect brood fish and fry, their perception of the Act's effect on increasing fisheries production was highly negatively. Only 11% of respondents thought that fisheries production had increased due to the Act's implementation, whereas 87.3% of fishers complained that legal implementation has had a minor role in the increase of fisheries production. Indeed, fry caught had not been reduced due to the high level of non-compliance of legal framework during implementation, according to around 64% respondent fishers, whereas the rest denied this statement. The majority of fishers (92.2%) stated they were against the protection of endangered fish species due to legal implementation. The response to a statement that fisheries resources are conserved very well was opposed by 82% of fishers. Fisheries resources are overfished, according to 53.9% of respondents. Fishers had little knowledge about Ramsar convention and Ramsar principles of management, therefore 32.4% of respondents had no comment about TH wetland management according to Ramsar convention principles. To some extent, 40.2% had positive opinions, but 27.4% possessed negative attitudes.

Table 6. Fisher's perceptions on the implementation status of fishing laws in the Tanguar Haor Ramsar wetlands, Bangladesh.

	Strongly Disagree (%)	Disagree (%)	Neither Agree Nor Disagree (%)	Agree (%)	Strongly Agree (%)	Chi-Square	Sig.
Are fishing laws essential for protecting the mother and juvenile fish?	6.9	5.9	-	37.3	50.0	315.86	0.000
Fisheries production has been increased after fish act implementation	36.3	51.0	2.0	8.8	2.0	57.856	0.000
Fish fry caught by fishermen decreased during the breeding season	37.3	26.5	1.0	27.5	7.8	100.155	0.000
This Act protects endangered fish species	50.0	42.2	3.9	2.0	2.0	50.815	0.000
Fisheries resources are conserved very well	23.0	58.8	2.9	11.8	2.9	83.593	0.000
Fishers overfish fisheries resources	2.9	3.9	44.1	49.0	4.9	137.204	0.000
Do you think fishing laws are adequate for your sustainable livelihood?	4.9	5.9	6.9	55.9	26.5	71.807	0.000
Ramsar convention promise to conserve TH	23.5	16.7	32.4	14.7	12.7	66.977	0.000

The study identified the causes driving the non-compliance of laws and regulations of TH during legal restriction implication. The only act safeguarding the TH fisheries resources is, however, questionable in its achieving of sustainability. The results found that people in that area do not comply with the regulations applied by the relevant agency. They did, however, complain about several reasons of social, economic, and political systems driving them. Primary reasons included inadequate incentive support, scarcity of alternative options for income, use of illegal fishing gears, laxity in sanctuary protection, corruption, political interference, concern about the authority's limitation, availability of current jal, and flash flood (see Table 7).

Table 7. Reasons of non-compliance to fisheries regulations in the Tanguar Haor.

Causes of Non-Compliance Recognized	Related Quote by Respondents
Inadequate incentive	*"I cannot go without fishing as I am indebted to BRAC NGO to buy housing materials; I have to pay the loan timely. I can starve, but I have to pay the loan. The government gives incentives, but I do not get incentives."*
Lack of alternative livelihood	*"We cannot stay at home, keep our family starving. If the government gives us work, we will not go fishing during the fishing ban seasons. The government has formulated rules for our welfare, but what kind of welfare are these that cannot satisfy our hunger?"*
Illegal fishing gears	i. *"A minimal number of fish is found in TH; we get little or no fish by using other fishing gears. Nevertheless, we can get a desirable number of fish by using the current jal. So, we are bound to use current jal."* ii. *"Ansar and CNRS members permit us to use current jal if they get bribe. We also get permission for fishing at sanctuary area by the same process."*
Laxity in sanctuary protection	i. *"Before, we could not go to sanctuary areas, as there were bamboo or spine fences around sanctuary areas. However, nowadays, we can enter the sanctuary areas because there are no bamboo or spine fences around the sanctuary areas. We are eager to enter sanctuary areas because we catch big-sized fishes there."* ii. *"Sanctuary areas are destroyed. We cannot recognize the sanctuary areas, as there is no border fence or protection of them. So, we are fishing at sanctuary areas subconsciously."*
Corruption	i. *"Ansar members should be banned in Tanguar Haor; they take a bribe to permit fishing during the ban period. Sometimes they seize current jal, and they give it back to fishers if they get bribe. However, if they do not get bribe Ansar members to sell the seized current jal to other fishermen."* ii. *"Magistrates are highly educated persons. They do not need a small amount of money like 100–200 tk. So they do not take bribes from fishers. They punish the illegal fishers by fine and imprisonment. However, magistrates hardly come to our locality."*
Little concern by MOFL	*"Magistrates are responsible persons; they try to implement rules. However, they cannot understand our problems."*
Compromise by some law enforcers	*"Government has many laws and regulations, but we do not get adequate funds to give fishermen incentives or alternative livelihoods. So, we can hardly punish them. How can I take a fine from a man who has a big family, but he has no money for food for one day."*
Limitation of enforcing agencies	*"The boatmen of Law enforcing officers take bribe from fishermen as they prior inform the fishermen about officers' arrival to the fishing sites to check illegal fishing. Thus, the illegal fishers escape from being caught by Law enforcing officers."*
Availability of current jal	*"Current jal is easy to catch fish, and at a lower price, we can buy it. If it is not available to buy, we cannot use it."*
Appealing of a higher catch	*"There is no way to get some extra income for our future, so use current jal, khona jal during fishing to get some extra income for our future crisis time. "*

4. Discussion

Tanguar Hoar plays a significant role in supporting food security [27]. It has received conservationists' attention since 1991, when it was declared as an ecologically critical area (ECA) having unique biodiversity features. However, the resource is continuously being degraded, which might impede sustainable management [18,22]. Though the fisheries resources are managed and conserved by common fishery laws, improper implementation and rule breaches are common in Bangladesh [33,34]. Consequently, degradation of TH wetland fisheries is a common phenomenon due to overfishing and destructive fishing practices [14,33–35].

Wetlands are the world's most significant and, unfortunately, utmost threatened environmental resources. Their wise use and conservation is required for the high-value goods and services which these ecosystems provide to society [36]. Further, the success of any system management lies in the human dimension of that system, as their behavior shapes the level of obedience to fishing laws. The socio-economic analysis of the respondents' community would help identify areas for intervention [7]. In this study, almost 70–75% of respondents fish as their primary source of occupation. During the rainy season, they involved themselves in fishing. The scope for other activities is limited in this area. People are, to some extent, also employed as tourists guides, boat drivers, daily laborers, and boat navigators. All these activities are low-income-earning compared to the fishinglead people who harvest fish here and there. However, at Joypur village, income-generating activities were varied, such as farming, animal husbandry, and duck rearing, as introduced by the CNRS project. The level of non-compliance among fishers who do not have an alternative livelihood is comparatively higher than the fishermen who have an alternative livelihood. As a result, compliance to fishing regulations somewhat occurred in Joypur, whereas, at Indrapur and Lamargaon, fishers did not comply with all rules and regulations. Moreover, the people of the Joypur village migrated to nearby towns or cities for earnings, as patrolling by lawmakers is frequent due to less distance from the Anser camp. Results also found that the illiteracy rate of respondents was high at all three sites (with an average of 51%). They possessed little knowledge of fishing laws and regulations (Figure 4). Most of the respondents are indebted to various financial institutions, moneylenders, and NGOs. They need to go to the debtors to buy a net, boat, and housing materials. Fishers always remain under pressure to earn more and more to support their family with food and other accessories. The demand of debtors intensifies their need to catch more fish without considering the restrictions on fishing methods and gear used. Consequently, they frequently break the fishing laws.

Though some laws, rules, and policies are in place, implementing these laws and policies often face conflicts and non-compliance by the stakeholders that result in poor governance [34]. For example, twenty-four Ansar (national Para force) members have been engaged in patrolling the TH wetland area to protect against the illegal harvesting of resources and tp maintain the law and order situation in the designated area [14]. However, the over-catching of fisheries and hunting of migratory birds are common scenarios in this haor [27]. Likewise, Central Anatolian wetlands are affected most by the water policies, plans, and implementations in Turkey. As a result, many lakes, ponds, and reedbeds in Central Anatolia have been, or are about to be, destroyed entirely [37]. As a result, the expected benefits have not been not realized, and, in many respects, the productivity of the hoar basin is declining [38].

Almost all fishermen living under the poverty level who need incentives to provide their families with food do not get any incentives during the three-month ban period. The poor eligible fishermen do not get enough incentives in most cases. A fisherman stated that the *"Incentive given is not adequate, even without considering the family members and assets owned."* They have no alternative way to earn a livelihood without prohibited fishing during the ban periods as they have a large family size of 7–8 members, on average. For these socio-economic realities, the level of fishing law compliance is comparatively low in these areas. The incentive scheme was also criticized by the respondents, claiming that the actual fishermen usually do not receive an incentive, and that nepotism and political interference cause the distributing of incentives to wealthy fishers, local government authorities, and relatives. Poverty, inadequate and improper distribution of incentives, and the limited alternative occupations regarding fishery regulations are the primary barrier to compliance with fishing laws [25]. Pre- and post-assessment analysis of compliance level due to the incentive giving program can help increase interest in complying with fishing laws.

The government-imposed provisions declare ban season in TH wetland fisheries from April 1 to August 31 to protect mother fishery and juvenile. The community, though, agreed that, while patrols are operating, destructing gears and seizing the boat, the de-

struction and overexploitation of undersized fish and juveniles continues even during the ban period. Despite the provision banning season being in operation, fish fry caught by fishermen was reduced in merely 35.3% cases. Moreover, a low increase (10.8%) of fish growth can be realized from the fishers' perceptions. Therefore, there is a significant gap in law implementation. Fishing laws have probations of declaration and protection sanctuary areas to protect the endangered species. However, endangered fish species such as Chitol, Pangas, Mohashol, Nanit, Bacha, Gaora, and Gulsha are found protected in only 4% of cases. Certain species that were used to be expected in the TH have now disappeared or become very rare, probably due to a combination of overutilization, anthropogenic disturbance, destructive fishing practice, aquatic pollution, changes in water quality, siltation, climate change impact, and the poor enforcement and non-compliance of regulations [18]. However, the reality is different, as fishermen depending on TH fisheries do not have a sustainable livelihood due to the reduction of fisheries biodiversity due to the improper implementation of fishing laws that further highlight the necessities of contextually modified comprehensive management tactics to increase the adaptive capacity within the fishery system while supporting self-organization among resource users. Similarities between wetland conservation and sustainability issues in developing countries were explored using case studies of Ramsar sites in Tanzania, Colombia, and Papua New Guinea. Key challenges identified included inadequate knowledge and data, population and development impacts, poor regulatory and planning processes, socio-economic inequities, and conflict [39]. Environmental justice scholars have argued that access to natural resources and ecosystem services should be established as a civic right [40]. This perspective acknowledged the difference between nominal consultation and multi-level community participation and empowerment [41] and the need for constant revision and adaptation through social learning and policy learning [42,43] to ensure social equity in solving intransigent environmental problems.

The Department of Fisheries is the responsible authority, according to the Protection and Conservation of Fish Act, 1950, to manage and conserve Tangoar Haor fisheries resources. On the other hand, after the declaration of the Ramsar site, Tangoar Haor resources allowed regulating rights to the Department of Environment and Forest. There is much conflict between sustainable resource utilization and food security in the TH wetland area between community and governance body and institutional authority. The hoar master plan's formulated policies to conserve resources and provide food security to the fishermen is stated, but, in reality, the implementation of food security provision is negligible. The conflict between efficient resource utilization and food security issues throughout the country has resulted in poor implementation output [44]. Combining community or local management and government policies for efficient resource management is necessary in such a case. The governance system of law-enforcing agencies is the prerequisite to better enforcement. Neither the management nor the institutions provide adequate representation or empowerment to the most vulnerable groups in the systems, such as the fisher communities in Kolkata and the urban poor in Colombo. There is no mention of the rights of the wetland communities in the official documents related to both cases. The notion of 'environmental justice' is absent [45]. However, shockingly, laws and regulations cannot solve problems that are newly created over time.

The status of fishing law enforcement is diverse in various places in the TH wetland. The three identical study areas show three different statuses of the enforcement of fishing laws. There are many factors of law enforcement that vary with the variation of place, time, and socio-economic condition. Law enforcement agencies regularly (74.1%) visit the TH wetland area near Joypur village to check for law compliance, therefore the enforcement's status is highest at the TH wetland area near Joypur village. The community claimed that the location of Joypur is nearer to Ansar camp than that of others. This may cause people not to go out fishing using prohibited methods, restricted gears, especially during the ban. Some social drivers are responsible for the better enforcement of fishing laws, such as participatory decision-making efforts [46]. However, in the Tangoar Haor, according to the

fishermen's involvement in the management process, and although Ansar and CNRS members are corrupted, during fishing law enforcement, higher government law enforcement officers are strict about enforcing fishing laws. Regular and continuous patrolling of law enforcement agencies can ensure better enforcement. Some law enforcement problems in Bangladesh, such as insufficient institutional capacity, lack of coordination, and inadequate and poorly managed protected areas, have been previously identified [47]. In this area, the enforcement was interrupted due to lack of coordination, workforce deficiencies, institutional capacity shortage, lack of community involvement, and the government officials' corruption. Following Bird Research Society (2006), that those who carried out the plan were not involved in its preparation has been one of the most significant deficiencies of the management plan process. Therefore, a shift toward participatory management means that new plans with significantly altered management prescriptions will be required to ensure community involvement [48].

Being concerned about the overexploitation of the TH wetland fisheries resources, the study was conducted to contribute to the sustainable conservation and management of TH wetland fisheries resources. The present laws, rules, and policies have offered provisions for the protection and sustainable management of TH wetland fisheries resources. The provisions also aim to protect endangered fish species. The provisions include different prohibitions of such activities that are harmful to biodiversity, including wildlife, fisheries, and endangered fish species. Non-compliance with such prohibitions due to different problems and limitations such corruption, weak enforcement, poverty, illiteracy, unawareness, lack of alternative livelihood, inadequate incentives are standard practices in the study sites. For a better compliance with fishing laws, regulations, policies, corruption of Ansar and CNRS members should be controlled. Upazila Fisheries Officer should be given the equal power of a magistrate to facilitate legal action against illegal fishing. A bamboo fence or spine should protect sanctuary areas from restricting the entrance of fishing boats. Government officers have to be more vigilant in the effective banning of illegal fishing gear. Participation of the local fishing community in decision-making should be ensured for the sustainable management of the TH wetland fisheries resources. The provisions of present regulations for fisheries conservation must be updated for appropriate legal framework or rules for many hazards, such as Thela jal fishing and duck husbandry. These are the causes of fish fry, egg, and larvae destruction. Alternative livelihoods and adequate incentives must be ensured for every impoverished fisher. More awareness should be made among members of the fishing community. Finally, necessary arrangements of more vigorous enforcement and the better implementation of fishing laws in the TH are the fundamental requirements for the sustainable utilization and management of Tanguar Haor fisheries resources for achieving the far-reaching Sustainable development goal 14 (SDG 14).

5. Conclusions

The Tanguar Haor (TH) RAMSAR wetland provides various ecosystem services to the society, yet, crucially threatens biodiversity conservation and the sustainability of this wetland. However, the legal framework promises sustainable conservation of fisheries resources. Nevertheless, proper implementation of the fisheries' regulation is still a significant issue in the TH. Scarcity of information on the implementation scenarios of fisheries laws, regulations, and policies face conflict, misunderstanding/misinterpretation, confusion, and often a failure to adequately explain non-compliances that hamper the non-conflicting use of fisheries resources and sustainable conservation of the TH Ramsar. Weak enforcement with inadequate surveillance and poor implementation of the legal framework has contributed to a high level of non-compliance with fishing laws, rules, and policies. Destructive and prohibited fishing gears, e.g., the use of small, fine nylon mesh nets (current jal), purse seine nets (ber jal),harvesting of illicit catches during ban period, harvesting of undersized fish, fishing in restricted areas (sanctuary area), and fishing during spawning seasons are widespread in the TH Ramsar wetland. In addition to this, the pressure and stressors from direct and indirect anthropogenic and natural origins lead to

changes in the environmental state, such as erosion, siltation, habitat degradation, pollution, overexploitation, scarcity of alternative livelihood options, managerial inefficiency by enforcing agencies that threaten economic, ecological, and environmental sustainability. This research submits urgent attention to the necessities/needs for drawing comprehensive legal and policy framework (contextually modified according to the local context), taking initiatives and acting synchronously for proper implementation with adequate incentive supports and alternative income-generating options, and calling for transdisciplinary collaboration and cooperation among the agencies that may ensure the non-conflicting use of the natural resources of the wetland that is also helpful for the better conservation of this ECA (the Tanguar Haor).

Moreover, to mitigate the existing threats and stressors, nature-based solutions, for instance, ecological engineering, ecosystem restoration, and conferring with the IUCN framework should also be taken into consideration to maintain ecological balance and restore the ecosystem's health. These findings might help to identify the gaps and misunderstandings of the present legal framework that should be under consideration during the formulation of a comprehensive legal framework for the sustainable management of TH fisheries resources of Bangladesh. We anticipated that the results of this research might be helpful for the multiple stakeholders (including resources users), the fishing community, local managers involved in operational activities, and indirectly to the policymakers and management authorities of the TH Ramsar wetland.

Author Contributions: T.A.T.: Writing, original draft preparation, P.S.: Data curation, funding acquisition, and editing, S.K.C.: Data curation, M.M.H.M.: Reviewing, editing, M.M.H.: Visualization, A.B.: Data analyzing, and M.M.S.: Conceptualization, methodology, writing and reviewing. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not Applicable.

Informed Consent Statement: Written informed consent has been obtained from the participants to publish this paper.

Data Availability Statement: Not Applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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