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Effect of Anicut Dam on fish population in Kangsabati River of Paschim Medinipur district, West Bengal

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Abstract
Dams as barrier that restrict the flow of water. Dams not only suppress floods but also provide water for human activities such as aquaculture, consumption, irrigation, industrial use and navigability. One of the finest environmental challenges of this century is to preserve the natural organic structural and functional attributes of aquatic ecosystems and rivers mainly. The construction of dams effects the fish population. Dams change the migratory fish habit. Changes in discharge regime or water satisfaction can also have indirect results on fish species. Anthropogenic effects on migratory fishes are observed. Total number of fish species were found 44, belonging to 8 orders, 17 families and 27 genera.

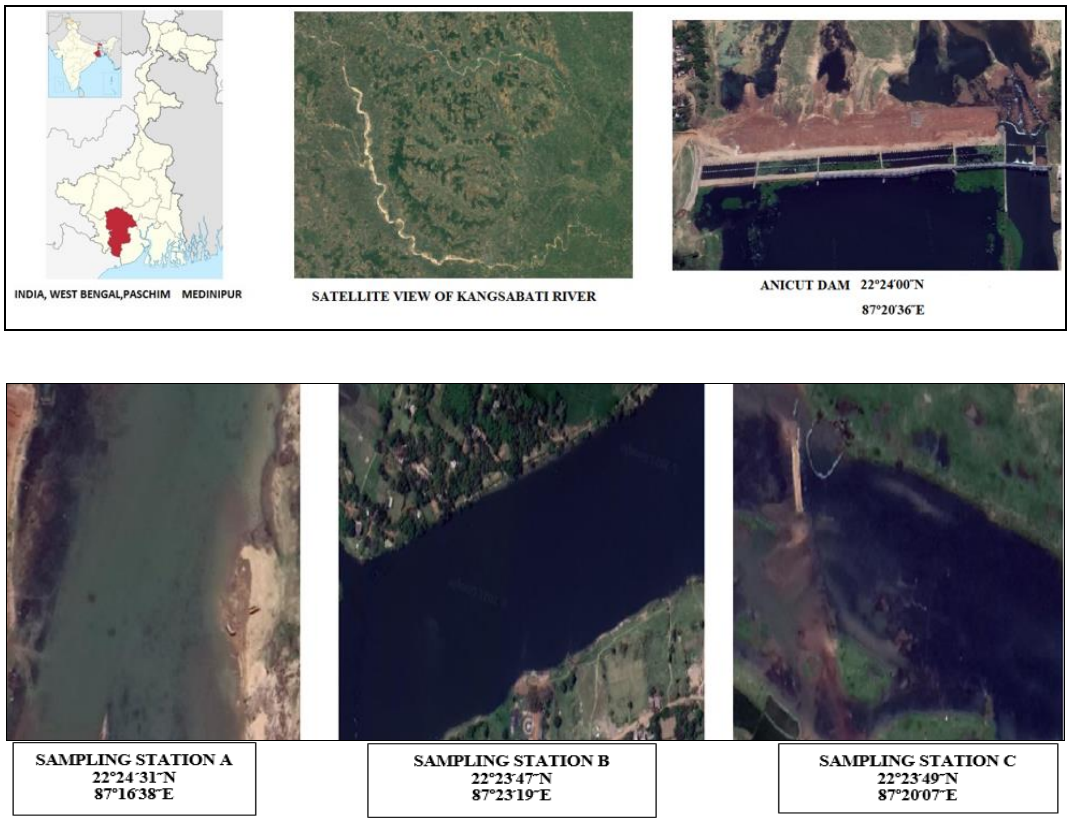
Keywords: Dam effect, water parameter, fish diversity, relative abundance

1. Introduction
River infrastructure is the main reason for habitat fragmentation in aquatic ecosystem. Structures that hinder the movement of fish between habitats crucial for rearing and spawning can negatively affect the population lives (Roni *et al.*, 2008) [16]. The effects of obstacles can be highly variable, starting from quick delays to complete blockage and are dependent on barrier kind, river hydrology and species. The version and versatility in migration are obvious among and within people, population and species, thereby offer a useful model system that maintains to tell how ecological and evolutionary approaches mildew biodiversity and the way biological system reply to environmental heterogeneity and trade (Tamario *et al.*, 2019) [1]. The dams construction and different infrastructure often compromise the connectivity of rivers, leading to reduce fish population and abundance. The assessment and mitigation of river boundaries is crucial to the success of restoration efforts geared toward restoring river integrity (King *et al.*, 2017) [4]. The dams currently planned for the water reservoir can have a prime impact on the aquatic environment of the Kangsabati River. The dams create barriers that affect upstream and downstream spawning migration of biologically and economically vital species. In river system, along with dams and weirs are a major purpose of habitat fragmentation in fluvial ecosystem. These structures can partially obstruct the movement of fish between crucial habitats and negatively impact the fish population (Martyn *et al.*, 2001) [2]. The terrible effect of numerous barrier sorts on diadromous and resident species of fish may be rather variable, starting from quick delays to finish obstruction and are depending on the nature of the barrier, river hydrology and species for example timing of migration and swimming capabilities (Northcote, 1998) [3].

2. Materials and Methods
2.1. Study Area
The Kangsabati River (additionally variously referred to as the Kasai and Cossye, and not to be burdened with the Kasai River in Africa), rises from the Chota Nagpur plateau inside the Jharkhand state, India and passes through the districts of Purulia, Bankura and Paschim Medinipur in West Bengal earlier than draining in the Bay of Bengal.in

Table 1: Details of the study site

Sl. No.	Name of the Sampling Station	Latitude and Longitude of the Sampling Station	Distance
1.	Sampling Station A	22º24'31"N 87º16'38"E	Dam to 6000 m
2.	Sampling Station B	22º23'47"N 87º23'19"E	Dam to 5800 m
3.	Sampling Station C	22º23'49"N 87º20'07"E	Dam to 343.7 m



Anicut Dam is situated (Latitude 22°24'00"N and Longitude 87°20'36"E) on Kangsabati River in Midnapore town and is 23 meter above sea level. The work was carried out during March 2018 to December 2020.

2.2. Collection of fish samples and identification

Hand net, drag net, cast net and basket trap were used by the local fishermen for capturing fish samples. 10% formalin solution were used to preserve fish species. Some keys provided by Fischer (2013) [5], Jayaram (2002) [6] and Schultz (2004) [7] help to identify the fish specimens.

2.3. Water sample collection

The water samples were collected on every last day in a week of each month of the year from the Sampling Station A, B and C. Temperature, pH, Dissolved Oxygen and Biological Oxygen Demand were measured using water analyser kit (Model No - KONVIO NEER: 040120211).

3. Results

Table 2: Fish species in Kangsabati River dam side of Paschim Medinipur district

Sl. No.	Fish Species	Family	Site A	Site B	Site C
Order - Cypriniformes					
1	*Osteobrama cotio*	Cyprinidae	3	4	2
2	*Puntius ticto*	Cyprinidae	29	37	35
3	*Puntius conchonius*	Cyprinidae	11	13	8
4	*Puntius phutunio*	Cyprinidae	2	1	0
5	*Puntius sophore*	Cyprinidae	17	8	14
6	*Amblypharyngodon mola*	Cyprinidae	31	34	29
7	*Danio rerio*	Cyprinidae	15	11	9
8	*Danio devario*	Cyprinidae	16	18	9
9	*Labeo bata*	Cyprinidae	9	3	1
10	*Labeo rohita*	Cyprinidae	10	5	3
11	*Labeo calbasu*	Cyprinidae	3	0	2
12	*Salmostoma acalia*	Cyprinidae	13	17	11
13	*Catla catla*	Cyprinidae	5	3	2
14	*Cirrhinus mrigala*	Cyprinidae	4	3	6
15	*Lepidocephalichthys guntea*	Cobitidae	1	2	0
16	*Salmophasia phulo*	Cyprinidae	7	6	5
17	*Salmophasia bacaila*	Cyprinidae	5	4	7
18	*Esomus danricus*	Cyprinidae	1	0	2
Order - Siluriformes					
19	*Mystus vittatus*	Bagridae	27	23	18
20	*Mystus tengara*	Bagridae	18	7	11
21	*Mystus seenghala*	Bagridae	0	0	1
22	*Mystus aor*	Bagridae	2	1	0
23	*Mystus cavassius*	Bagridae	8	7	3
24	*Rita rita*	Bagridae	0	1	0

25	*Pangasius pangasius*	Pangasiidae	0	2	0
26	*Clarias batrachus*	Clariidae	1	2	1
27	*Macrognathus pancalus*	Mastacembelidae	3	4	2
28	*Heteropneustes fossilis*	Siluridae	2	1	1
Order - Perciformes					
29	*Channa striatus*	Channidae	2	3	2
30	*Channa punctate*	Channidae	19	21	14
31	*Channa marulias*	Channidae	5	2	1
32	*Channa gachua*	Channidae	2	1	3
33	*Colisa fasciata*	Osphronemidae	15	21	13
34	*Colisa lala*	Osphronemidae	13	11	9
35	*Chanda nama*	Ambassidae	6	2	3
36	*Chanda ranga*	Ambassidae	5	3	1
37	*Nandus nandus*	Nandidae	0	2	1
38	*Glossogobius giuris*	Gobiidae	4	3	2
Order - Osteoglossiformes					
39	*Notopterus notopterus*	Notopteridae	4	1	5
40	*Notopterus chitala*	Notopteridae	0	3	2
Order - Beloniformes					
41	*Xenentodon cancila*	Belonidae	1	0	0
Order - Clupeiformes					
42	*Gudusia chapra*	Clupeidae	2	4	5
Order - Cyprinodontiformes					
43	*Aplocheilus panchax*	Aplocheilidae	0	1	0
Order - Tetraodontiformes					
44	*Leiodon cutcutia*	Tetraodontidae	0	1	1
Total			321	296	244

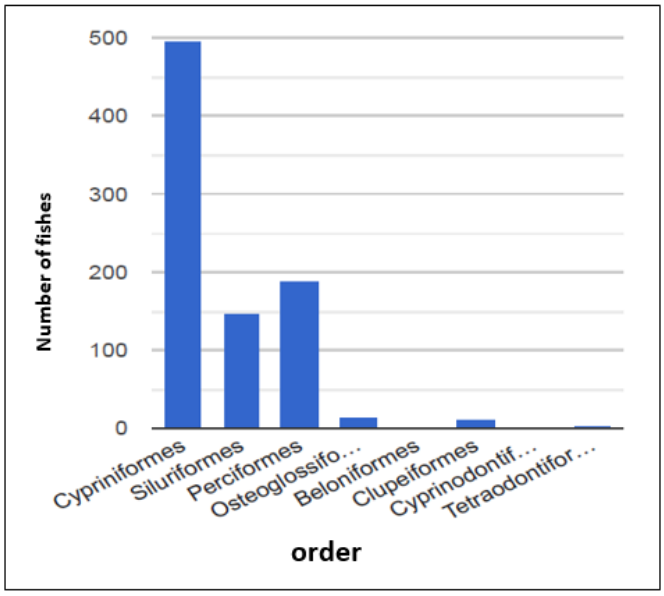


Fig 1: Number representation of fishes at order level of Kangsabati River

Table 3: Fish species abundance, richness and biodiversity indices of River Kangsabati

Sampling station	Abundance	Species richness	Evenness index (e)	Shannon-Wiener diversity index (H')	Simpson's index(D)
Site A	321	37	0.892	3.221	0.95
Site B	296	40	0.850	3.136	0.95
Site C	244	37	0.861	3.108	0.94

Table 4: Relative abundance of fish order of Kangsabati River

Order	Site A	Site B	Site C
Cypriniformes	56.69%	57.09%	59.42%
Siluriformes	19.00%	16.21%	15.16%
Perciformes	22.11%	23.31%	20.08%
Osteoglossiformes	1.24%	1.35%	2.86%
Beloniformes	0.31%	0%	0%
Clupeiformes	0.62%	1.35%	2.04%
Cyprinodontiformes	0%	0.33%	0%
Tetraodontiformes	0%	0.33%	0.40%

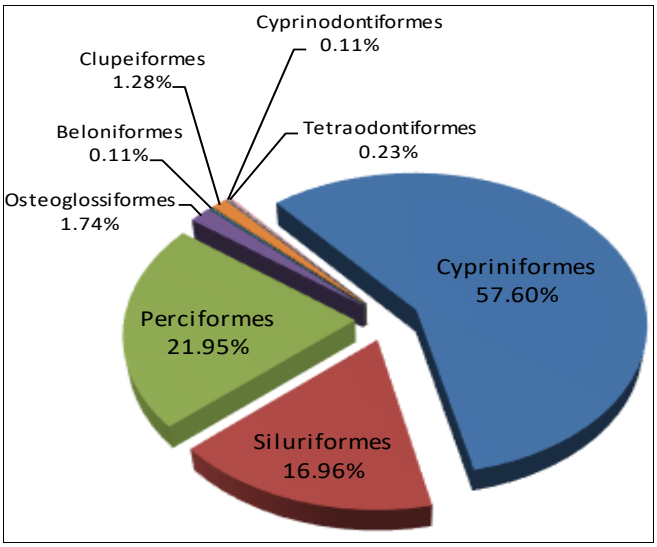


Fig 2: Percentage representation of fish species at order level in River Kangsabati

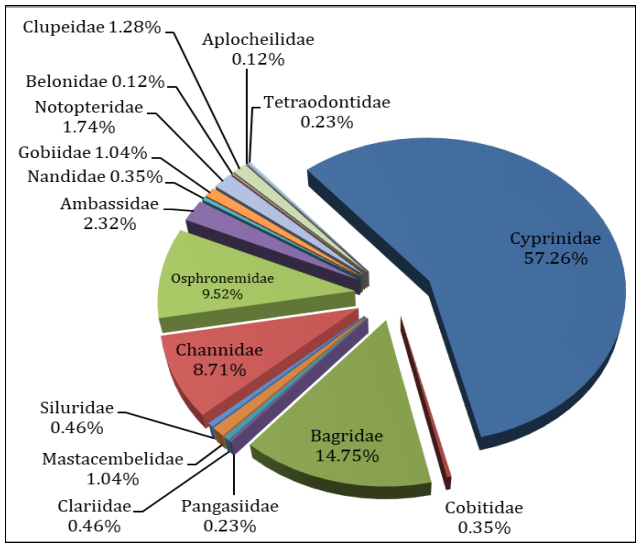


Fig 3: Percentage representation of fish species at family level in Kangsabati River

Table 5: The IUCN Red List

Order	Family	Species	IUCN status					
			DD	LC	VU	NE	EN	NT
Cypriniformes	Cyprinidae	*Osteobrama cotio*		★				
	Cyprinidae	*Puntius ticto*		★				
	Cyprinidae	*Puntius conchonius*		★				
	Cyprinidae	*Puntius phutunio*		★				
	Cyprinidae	*Puntius sophore*		★				
	Cyprinidae	*Amblypharyngodon mola*		★				
	Cyprinidae	*Danio rerio*		★				
	Cyprinidae	*Danio devario*		★				
	Cyprinidae	*Labeo bata*		★				
	Cyprinidae	*Labeo rohita*		★				
	Cyprinidae	*Labeo calbasu*		★				
	Cyprinidae	*Salmostoma acalia*		★				
	Cyprinidae	*Catla catla*		★				
	Cyprinidae	*Cirrhinus mrigala*		★				
	Cyprinidae	*Lepidocephalichthys guntea*		★				
	Cyprinidae	*Salmophasia phulo*		★				
	Cyprinidae	*Salmophasia bacaila*		★				
	Cyprinidae	*Esomus danricus*		★				
Siluriformes	Bagridae	*Mystus vittatus*		★				
	Bagridae	*Mystus tengara*		★				
	Bagridae	*Mystus seenghala*		★				
	Bagridae	*Mystus aor*		★				
	Bagridae	*Mystus cavasius*		★				
	Bagridae	*Rita rita*		★				
	Pangasiidae	*Pangasius pangasius*		★				
	Clariidae	*Clarias batrachus*		★				
	Mastacembelidae	*Macrognathus pancalus*		★				
	Siluridae	*Heteropneustes fossilis*		★				
Perciformes	Channidae	*Channa striatus*		★				
	Channidae	*Channa punctata*		★				
	Channidae	*Channa marulias*		★				
	Channidae	*Channa gachua*		★				
	Osphronemidae	*Colisa fasciata*		★				
	Osphronemidae	*Colisa lala*		★				
	Ambassidae	*Chanda nama*		★				
	Ambassidae	*Chanda ranga*		★				
	Nandidae	*Nandus Nandus*		★				
	Gobiidae	*Glossogobius giuris*		★				
Osteoglossiformes	Notopteridae	*Notopterus notopterus*		★				
	Notopteridae	*Notopterus chitala*						★
Beloniformes	Belonidae	*Xenentodon cancila*		★				
Clupeiformes	Clupeidae	*Gudusia chapra*		★				
Cyprinodontiformes	Aplocheilidae	*Aplocheilus panchax*		★				
Tetraodontiformes	Tetraodontidae	*Leiodon cutcutia*		★				

(DD - Data Deficient, LC - Least Concern, VU - Vulnerable, NE - Not Evaluated, EN - Endangered, NT - Near Threatened, IUCN 2021. The IUCN Red List of Threatened Species. https://www.iucnredlist.org) [8]

Table 6: Water parameter during Wet Season of Kangsabati River (2018)

Parameter	Site A	Site B	Site C
Temperature (°C)	26.5 ± 0.25	26.5 ± 0.17	26.6 ± 0.20
pH	7.1 ± 0.08	7.2 ± 0.08	7.2 ± 0.12
DO (mg/L)	4.1 ± 0.08	4.2 ± 0.08	4.2 ± 0.08
BOD (mg/L)	2.4 ± 0.12	2.4 ± 0.08	2.3 ± 0.20

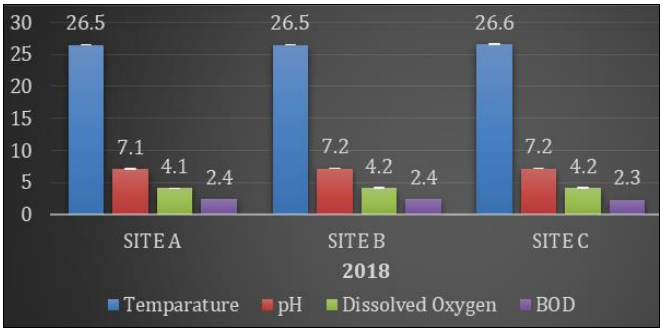


Fig 4: Water Parameter during Wet Season of Kangsabati River (2018)

Table 7: Water parameter during Dry Season of Kangsabati River (2018)

Parameter	Site A	Site B	Site C
Temperature (°C)	34.3 ± 0.18	34.3 ± 0.18	34.4 ± 0.33
pH	7.5 ± 0.16	7.3 ± 0.12	7.6 ± 0.12
DO (mg/L)	3.4 ± 0.18	3.2 ± 0.20	3.2 ± 0.20
BOD (mg/ L)	1.5 ± 0.16	2.1 ± 0.16	1.7 ± 0.12

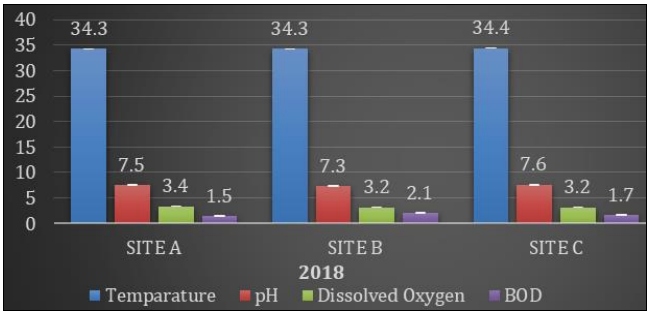


Fig 5: Water parameter during Dry Season of Kangsabati River (2018)

Table 8: Water parameter during Wet Season of River Kangsabati (2019)

Parameter	Site A	Site B	Site C
Temperature (°C)	26.4 ± 0.25	26.4 ± 0.18	26.5 ± 0.20
pH	7.2 ± 0.08	7.2 ± 0.08	7.1 ± 0.12
DO (mg/L)	4.2 ± 0.08	4.2 ± 0.08	4.1 ± 0.08
BOD (mg/L)	2.4 ± 0.12	2.4 ± 0.08	2.3 ± 0.20

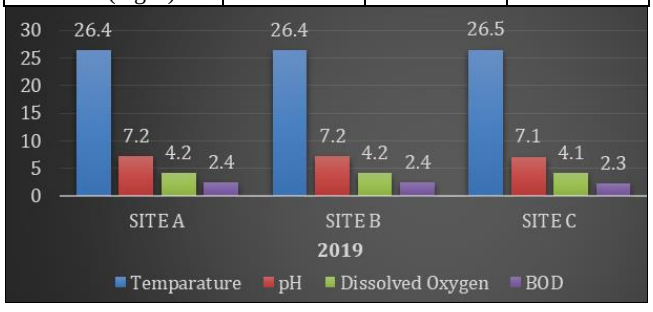


Fig 6: Water Parameter during Wet Season of River Kangsabati (2019)

Table 9: Water parameter during Dry Season of Kangsabati River (2019)

Parameter	Site A	Site B	Site C
Temperature (°C)	34.5 ± 0.18	34.5 ± 0.18	34.6 ± 0.33
pH	7.4 ± 0.16	7.4 ± 0.12	7.5 ± 0.12
DO (mg/L)	3.5 ± 0.20	3.4 ± 0.20	3.4 ± 0.20
BOD (mg/L)	1.6 ± 0.16	2.1 ± 0.16	1.8 ± 0.12

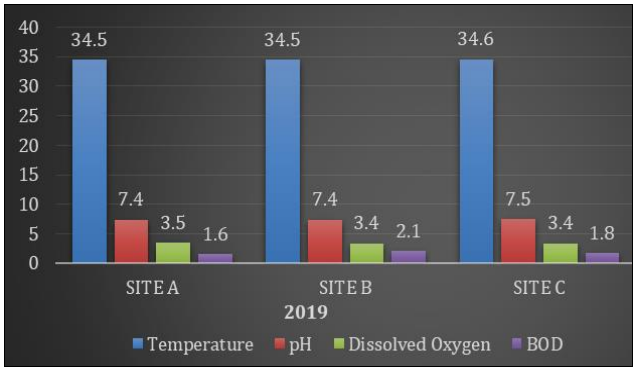


Fig 7: Water parameter during Dry Season of Kangsabati River (2019)

Table 10: Water parameter during Wet Season of River Kangsabati (2020)

Parameter	Site A	Site B	Site C
Temperature (°C)	27.4 ± 0.28	27.4 ± 0.20	26.5 ± 0.20
pH	7.3 ± 0.08	7.3 ± 0.08	7.2 ± 0.12
DO (mg/L)	4.2 ± 0.08	4.2 ± 0.08	4.1 ± 0.08
BOD (mg/L)	2.4 ± 0.12	2.4 ± 0.08	2.3 ± 0.20

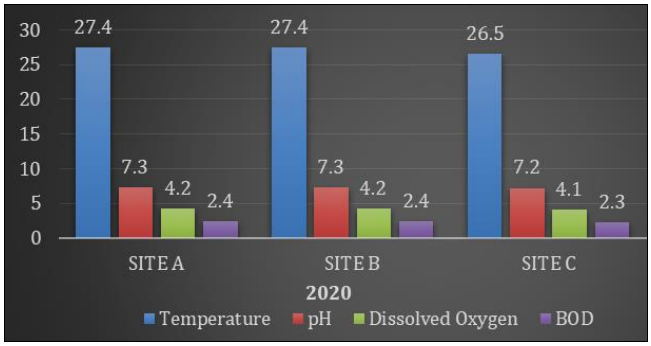


Fig 8: Water Parameter during Wet Season of River Kangsabati (2020)

Table 11: Water parameter during Dry Season of Kangsabati River (2020)

Parameter	Site A	Site B	Site C
Temperature (°C)	35.5 ± 0.20	35.5 ± 0.18	34.6 ± 0.33
pH	7.3 ± 0.16	7.3 ± 0.12	7.4 ± 0.12
DO (mg/L)	3.6 ± 0.20	3.6 ± 0.20	3.5 ± 0.20
BOD (mg/L)	1.6 ± 0.16	2.1 ± 0.16	1.8 ± 0.12

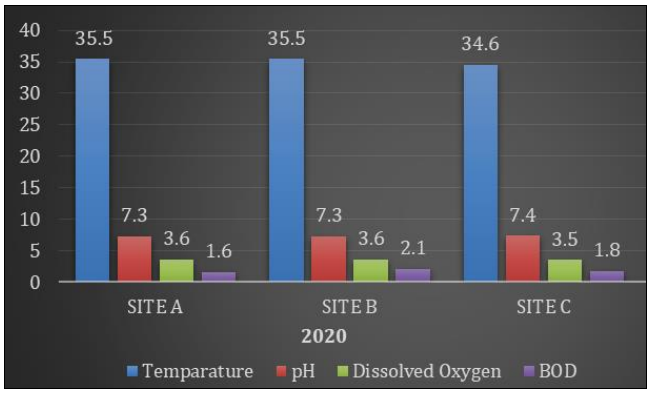


Fig 9: Water parameter during Dry Season of Kangsabati River (2020)

In river structures both artificial and natural consisting of waterfalls, dams may have foremost influences on species that have multiple existence level established and aquatic habitat necessities (Henriette *et al.*, 2001) [9]. The loss and fragmentation of habitat truncate movement, lessen connectivity and regularly precede the decline and extirpation of a species (Ceballos and Paul, 2002) [10]. The Evenness index (e) shows high in Site A - 0.892 and low in Site B - 0.850. The Shannon - wiener diversity index (H') shows highest in Site A - 3.221 and lowest in Site C - 3.108. The Simpson's index (D) shows high in Site A - 0.95 and low in Site C - 0.94. A total of 44 fish species belonging to 17 families, 8 orders and 27 genera were found from the selected study sites. Among the all fish species, the *Notopterus chitala* is under Near Threatened category.

4. Discussion

Species richness changed negatively and undoubtedly related to BOD, temperature, pH and Dissolved Oxygen respectively. Relative abundance various inversely with discharge and ambient ammonia, at once with intensity, substratum, ambient oxygen and alkalinity (Sampan *et al.*, 2008) [14]. Stream fishes live in habitats characterized by means of species favourable in biotic and abiotic conditions and in some cases, a small number of environmental elements exercise a robust influence on assemblage or community structure whilst in others the variety is notably large (Clifford *et al.*, 1989) [15]. Sampling Station A is 6000m (Table - 1) distance from the dam. *Amblypharyngodon mola* was observed highest 31 in Site A. *Mystus seenghala, Rita rita, Pangasius pangasius, Nandus nandus, Notopterus chitala, Aplocheilus panchax* and *Leiodon cutcutia* were not found in Site A (Table - 2). Sampling Station B distance from the dam is 5800m (Table -1). *Puntitus ticto* was observed highest 37 among the all species in Site B. *Labeo calbasu, Esomus danricus, Mystus seenghala* and *Xenentodon cancila* were not found in Site B (Table -2). Sampling Station C is only 343.7 m (Table -1) distance from the dam. *Puntitus ticto* was observed highest 35 in Site C. *Puntius phutunio, Lepidocephalichthys guntea, Mystus aor, Rita rita, Pangasius pangasius, Xenentodon cancila* and *Aplocheilus panchax* were not found in Site C (Table -2).

Dam side area is surrounded by many anthropological activities like polluted water, garbage, heavy weight vechicle vibration, industrial discharges and water pump. The temperature between two sides of dam is different. The Stagnant water in the west side of the dam is always low temperature and east side of dam is always high temperature. The main cause is that reserve water depth and storage capacity level are always high in the west side of the dam and in the east side are always low.

5. Conclusion

The assessment and mitigation of river boundaries are important to the fulfilment of recovery efforts aimed toward restoring river integrity. For long height and deep depth of dam, numerous species of poorly known variable swimming abilities, migratory behavior and populace length, it is best to start with concentrated mitigation efforts at the lower part of the fish pass. As a results migratory fish cannot pass from Site A to Site B and Site C. Fish bypass layout entails a multidisciplinary method. Engineers and biologists ought to work intently together.

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