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Research Article

Impact of Jute Retting on Indigenous Fish Diversity and Aquatic Health of Roadside Transitory Water Bodies: An Assessment in Eastern India

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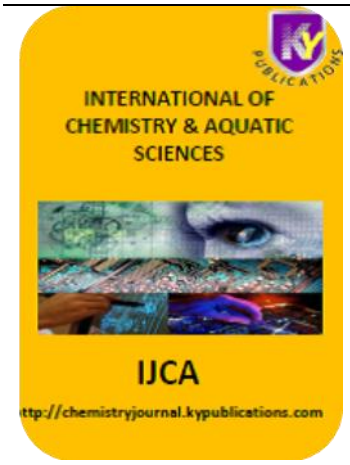

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ABSTRACT
Roadside transitory water bodies being manmade depressions have great ecological and socio-economical importance from years. The effects of agricultural runoffs, jute retting, macro-phytes infestations and inadequate rainfall in changed climate often degrade transitory water bodies' environment while the biodiversity have impacted severely because of population pressure, over exploitation and indiscriminate use of fine meshed fishing gears as a whole.
Physico-chemical and biological analysis was done for sediment pH, water Transparency, pH, Temperature, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Hardness, Alkalinity, and fish species composition, indigenous fish diversity indices like Species richness, evenness and Shannon-Wiener Index during pre, post and during jute retting season were calculated to assess impact of jute retting on the roadside transitory water body's environment and indigenous fish diversity. Fish diversity was also correlated with the physicochemical variables.
Jute retting impacted low Shannon-Wiener Index values (1.94 to 2.68) clearly indicated poor to moderate pollution status of the transitory water body in the area during monsoon in particular and throughout the year in general. So it is opined that there should be control over the intense jute retting in the road side transitory water bodies for sustainable management of these manmade resources.

Key words: Transitory water bodies, physico-chemical analysis, Fish diversity index, Species richness, evenness and Shannon-Wiener Index, Jute retting

INTRODUCTION

Roadside transitory water bodies (TWB) which are manmade artificial depressions have great ecological and socio-economical importance from years. The effects of agricultural runoffs, jute retting, macro-phytes infestations and inadequate rainfall in changed climate often degrade TWBs' environment while the biodiversity in TWBs have impacted severely because of

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population pressure, over exploitation and indiscriminate use of fine meshed fishing gears as a whole. The ecological, social, economic, and cultural values and functions of TWBs include: playing a key role in supporting the diversity and abundance of plants and animals, and providing important habitat and refuges for many migratory, rare or threatened species; being an essential part of natural hydrological cycles, providing water passage and storage, and may be contributing to flood mitigation and the recharge of aquifers; purifying water by stripping nutrients and intercepting sediments; making a significant contribution to the economic productivity of the State by providing essential water sources for agricultural, rural and industrial uses, vital breeding, nursery and harvest sites for edible fish, molluscs and crustaceans, brood stock for aquaculture, and areas of pasture for stock; featuring significantly in the day-to-day living of rural peoples; contributing to the well-being of people through landscape diversity and aesthetic appeal; and featuring strongly in the local tourism and recreation appeal (Alain Lambert. 2003).

The role of TWBs in a healthy environment has traditionally been poorly understood. Many TWBs have been and are being continuously modified and destroyed because of human activities. Some of the key threatening processes that affect TWBs include: draining TWBs to provide land for agriculture or forestry; reclamation of transitory water body areas for rural development or dredge spoil placement; construction of bunds and constructed barrages in areas that affect the flow of water into the TWBs; storm water runoff that affects transitory water body water quality as a result of siltation and from pollutants such as heavy metals, insecticides, fertilizers and sewage; construction of flood control and water conservation works (both on- and off-stream) that affect a transitory water body's natural hydrology which is crucial for temporary TWBs and the breeding cycles of some animals; introduction of livestock grazing around transitory water body edges that cause damage to TWBs plants and cause sedimentation; introduction of exotic pastures, weeds and exotic fish species to transitory water body areas; clearing of transitory water body vegetation for firebreaks and other purposes; and climate change (Chakraborty T R. 2009).

However the studies on impact of jute retting on fish diversity in roadside transitory water bodies in Nadia district in particular is lacking; hence the present study is aimed at examining the impact of jute retting on the water quality and indigenous fish diversity of roadside TBW near Sahebnagar aside the West Bengal state high way between Plassey and Betai in Nadia district. The findings from the study will benefit the planning and management of sustainable fisheries and conservation of these manmade resources at state level.

MATERIALS AND METHODS

Study area

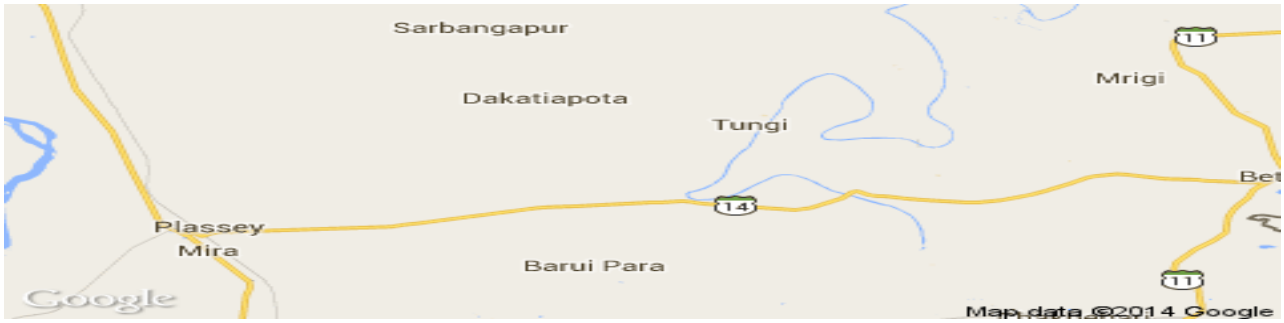

Figure 1: Sahebnagar study area marked as 14

Sahebnagar a village in Tehatta-II development Block in Nadia District of West Bengal State, India, located on 23°47′59″N 88°24′10.3″E, 161 KM from State capital Kolkata, 13km and 5 km away from NH-34 road and the river Jalangi respectively is surrounded by Tehatta-II Block towards East, Beldanga-II Block towards west, Tehatta-I Block towards East, Kaliganj Block towards west, near Plassey. This Place is in the border of the districts Nadia and Murshidabad (Figure-1).

The selected site was sampled from November, 2007 to Octobers, 2011 at 6.00 AM during pre-Jute retting season, Jute retting season (when jute retting period lies normally during August- September) and Post Jute retting season (nearly fortnight after the jute retting process gets over normally during late October). Water and soil quality parameters were estimated using standard methods (APHA, 1998). Average values were taken.

BOD was calculated by using modified in-situ method where initial DO reading was taken at 6.00AM and the water sample was diluted (5, 100 and 10 times during pre-Jute retting season, Jute retting season and Post Jute retting season period respectively) and taken in 250 ml plastic bottle wrapped with black polyethylene to prevent photosynthesis and kept the bottle in the transitory water body environment for 24 hrs from 6 AM to next day 6.00 AM when final DO reading was taken. BOD was then calculated by multiplying the difference value in DO level by dilution factors. This is simplified and easy field level technique of estimation of BOD which does not include photosynthesis releases of oxygen of that day and much close to reality in tropical water (Selvaraj, G S D, 2005).

Fish sampling was done by using variety of fishing gears (Table-3). After collection fishes were identified with the help of keys prescribed by Dutta Munshi and Shrivastava (1988), Talwar and Jhingran (1991), and Jayaram (1999). Fishes were sorted out by their numbers and weighed. Fish species compositions during pre-Jute retting season, Jute retting season and Post Jute retting season period were calculated. Fish species diversity subjected to diversity analysis using different indices like Species richness, evenness and Shannon-Wiener Index during pre jute retting season, Jute retting season and post jute retting season was used to assess the roadside transitory water body's environment and fish diversity. Fish species diversity was also correlated with the physicochemical variables.

RESULTS AND DISCUSSIONS:

Physico- chemical parameters analysis (Table-1) showed almost all parameters in transitory water body located at Sahebnagar during pre-Jute retting season, Jute retting season and Post Jute retting season periods remaining more or less same or marginally got changed except BOD and water transparency.

Table-1: Physico- chemical Parameters at Sahebnagar

Parameter	Pre JRS	JRS	Post JRS	Year Average	SD
Soil pH	6.80	7.70	7.20	7.33	0.35
Water pH	7.80	8.70	8.60	8.24	0.35
Transparency (cm)	40.56	13.64	35.87	29.01	11.91
Temperature(0c)	35.50	29.00	16.50	24.43	8.06
DO in ppm	3.80	1.90	3.50	3.11	0.89

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BOD_1 in ppm	14.80	144.78	20.62	59.17	55.16
Hardness in ppm	101.46	97.88	98.26	94.37	4.81
Alkalinity in ppm	138.84	141.56	140.12	140.65	1.35

Table-1 and Figure-5 show variation of soil and water quality parameters in their mean values. All values do not show much variation in all seasons except of water transparency and BOD which are in much demoted and elevated conditions respectively.

Variations in biochemical oxygen demand (BOD) of roadside transitory water body show an elevated steep during Jute retting season period as compared to pre or post Jute retting season periods (Figure 4).

Mean value of BOD got almost 10 times increased during the Jute retting season over pre-Jute retting season period at TWB near Sahebnagar implying heavy jute retting intensity in that area during the the season. Mean BOD value also got 7.25 times decreased in post-Jute retting season period within 15-20 days time after the jute retting processes got over in the TWB.

The water transparency (refers to the extent of solar light penetration into the water depth) mean values showed sharp fall by 22-27 cm during Jute retting season from pre and post-Jute retting season in TWB, indicating high total solids concentration due to heavy organic matter load restricting light penetration into transitory water body indicating decrease in oxygen production due to photosynthesis. This is obviously due to heavy and huge jute retting processes in the pit during Jute retting season.

Killi fish (*Apolocheilus panchax*) in numbers and Carp *(Cirhinus mrigala)* in biomass dominated the table during pre Jute retting season. Chanda (*Scatophagus argus*) and Murrel (*Channa striatus*) dominated in numbers and in biomass respectively during Jute retting season while the snakehead (*Channa punctatus*) led both in numbers and biomass during post Jute retting season.

Table-2: Indigenous Fish Species composition and Diversity index at Sahebnagar
JRS=Jute Retting Season

		Pre JRS		JRS		Post JRS	
Indigenous Fish Species	Vernacular Name	nos %	wt %	nos %	wt %	nos %	wt %
Carp *(Labeo rohita)*	Rohu	6.56	19.12	-	-	8.70	9.96
Carp *(Catla catla)*	Catla	4.92	12.24	-	-	4.35	4.55
Carp *(Cirhinus mrigala)*	Mrigal	9.84	26.69	-	-	8.70	14.74
Dwarf gourami (*Colisa Lalia*)	Khalse	6.56	3.76	8	3.70	-	-
Barb (*Puntius spp*)	Punti	9.84	3.61	4	1.30	-	-
Magur (Clarias batrachus)	Magur	3.28	3.47	8	19.64	8.70	6.50
Singhi(*Heteropneutes fossilis*)	Singhi	4.92	3.37	8	16.70	17.39	6.82
Snakehead (*Channa punctatus*)	Lyata	1.64	2.70	8	5.68	21.74	35.66

Koi (*Anabas testudineus*)	Koi	4.92	2.58	4	3.79	4.35	3.79
Murrel (*Channa striatus*)	Shol	1.64	6.24	12	25.61	4.35	8.91
Tangra (*Mystus vittatus*)	Tyangra	6.56	2.07	4	12.87	-	-
Chanda(*Scatophagus argus*)	Chanda	6.56	1.44	40	1.43	-	-
Killifish(*Apolocheilus panchax*)	Techokha	19.67	0.96	-	-	-	-
Sarpunti (*Puntius Sarana sarana)*	Sarpunti	3.28	3.67	-	-	-	-
Freshwater eel (*Jute retting seasonopterus cuchia)*	Kunche	1.64	4.50	4	9.29	-	-
Green eel(*Mastocembelus puncalus)*	Pankal	1.64	2.25	-	-	13.04	8.08
Zebra Danio(*Brachydanio rario)*	Zebrafish	1.64	0.48	-	-	-	-
Goby (*Glossogobius giuris*)	Goby	3.28	0.48	-	-	-	-
Puffer fish(*Tetradon cutcutia*)	Tyapa	1.64	0.39	-	-	8.70	0.99
Total		100.00	100.00	100	100.00	100.00	100.00
Fish species diversity index	Species Richness	19	19	10	10	10	10
	Shannon Wiener Index	2.68	2.37	1.94	1.98	2.16	1.97
	Species Evenness	0.91	0.80	0.84	0.86	0.94	0.86

Table-3: Gears and Crafts commonly used in Fishing in TWB under study

Sl	Type	Description	Local Name	Attribute
01	Chinese Dip net	Lift net	Dhenki Jaal	Mesh size: 6-12mm
02	Gill net	Made of Monofilament set across breadth of canal receiving water inflow during Jute retting season	Fansh Jaal	Mesh size:more than 22mm
03	Drag net	Seine net	Chat jal	Mesh size:6-12mm
04	Bamboo Trap	Conical type, Box type	Bitti	Fixed type
05	Spear	Handy Gear	koch	Piercing fish
06	Angle	Fitted with or without wheel	Chhip / Borshi	Luring fish
07	Country boat	Wooden Craft	Nauka	Length :5 m
08	Dingi	Craft made of Tin	Dingi	Easy movement

Table-2 and Figure-6 & 7 depicted comparisons of different fish species compositions in their relative percentage of numbers and biomass in the roadside water body near Sahebnagar area. Table-2 also furnished fish diversity indices like Species Richness, Evenness and Shannon-Wiener Index during those three seasons of the transitory water body roadside.

Comparisons of Fish species diversity index of Numbers & biomass during all the three seasons are shown in Figure-8. Species Richness of 19 slashed down to 10 during the retting period. High Shannon Wiener diversity index (2.68, 2.37) of indigenous fish (for both numbers and biomass) was seen during just before jute retting season began compared to other two seasons (Figure-8) and jute retting period observed the lowest (1.94). It shows deeps in

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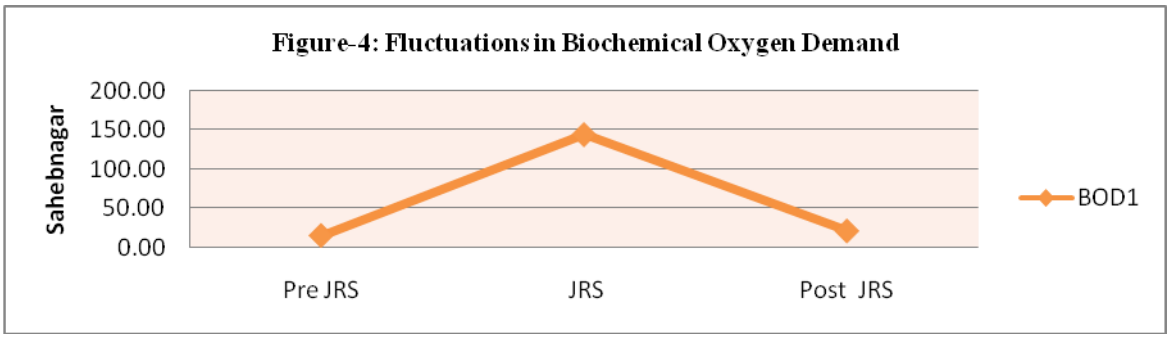
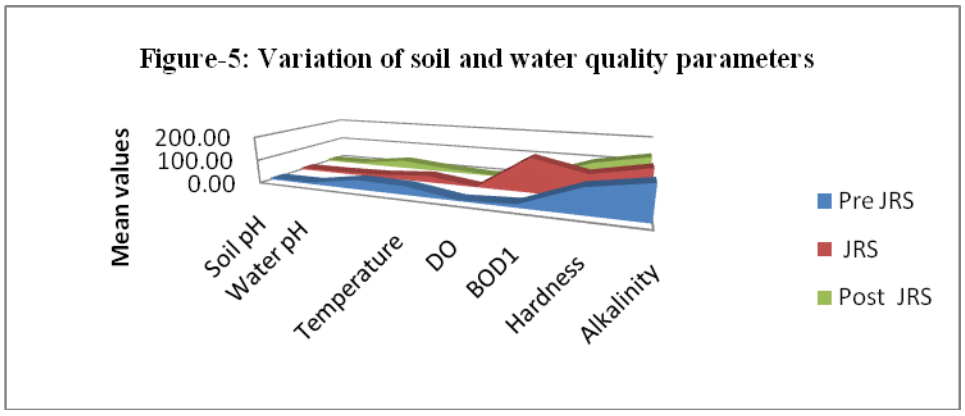
Shannon-Wiener Index of both numbers and weight during Jute retting season. Evenness (numbers) values also showed the lowest (0.84) during this season. There was a gradual increase in fish species evenness of biomass from pre to post Jute retting season period while a sharp decrease in evenness of numbers was observed during Jute retting season in the transitory water body.

Figure-2: A view of TWB near Sahebnagar choked with intense jute retting during Jute retting season

Figure-3: A view of TWB near Sahebnagar during Post Jute retting season period





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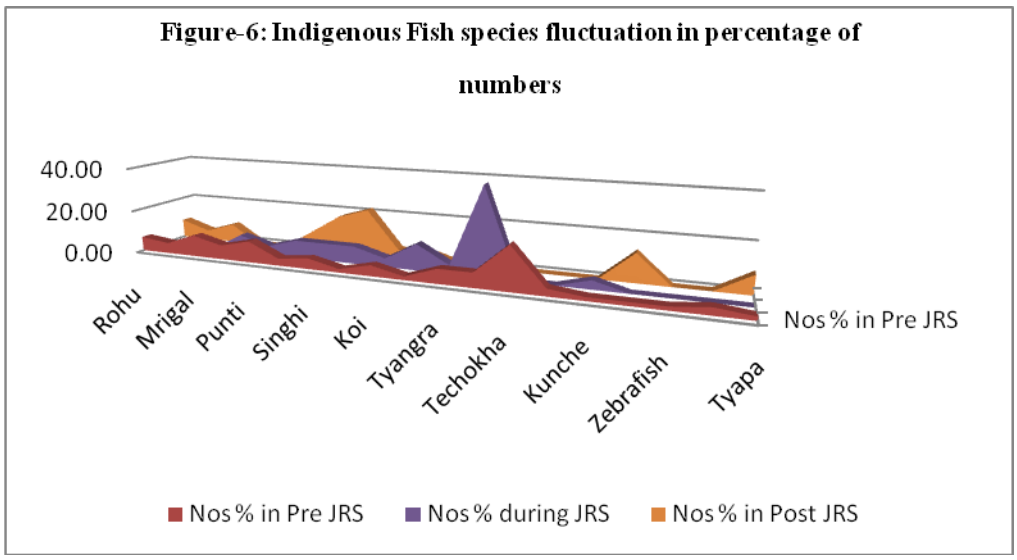

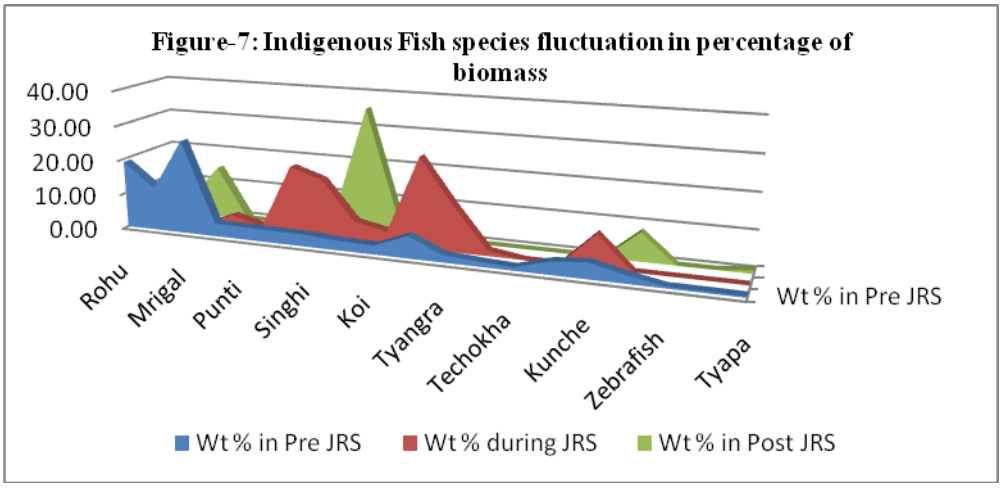

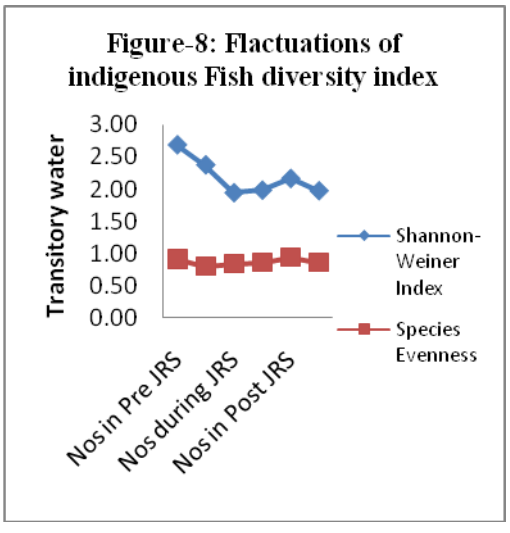

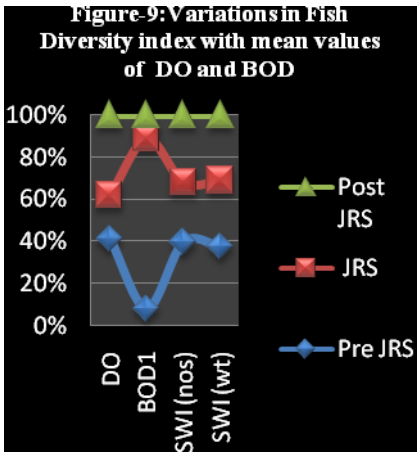

Figure-9 attempted a correlation of Fish Diversity indices with mean values of physico - chemical variables of dissolved oxygen and biochemical oxygen demand in the roadside transitory water body during pre jute retting season, Jute retting season and post jute retting season.

According to Water Framework Directive, the relationship between the indices and ecological level is as following (Natalia *et al* 2009): High status: bigger than 4 bits / individual Good status: 4 -3 bits / individual, Moderate status: 3-2 bits/ individual, poor status: 2-1 bits/individual, Bad status: 1-0 bits/individual. Jute retting impacted low Shannon-Wiener Index values indicated poor to moderate pollution status of the transitory water body in the area during monsoon in particular and throughout the year in general. So it is opined that there should be control over the intense jute retting in the road side transitory water bodies for sustainable management of these manmade resources.

The study about indigenous fish diversity in roadside TWB in Nadia district in particular is lacking; hence this study will be reference archive for examining the impact of jute retting on water quality and indigenous fish diversity of roadside TBW in the region of Nadia district. The findings from the study will definitely benefit the planning and management of sustainable fisheries and conservation of these manmade resources at state level.

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