Ecology and Cost-limited Restoration of Daha River for Fish Productivity

Archna Kumari
Ex-Research Scholar, JaiPrakash University, Chapra (Bihar)
Email ID: Sanjayncc77@gmail.com

The Sona river, a threatened seasonal river of eutrophicated nature in the Siwan district of Bihar was studied for its degradation and possible restoration Practices. The study revealed high rate of sedimentation and agricultural activities, changes in water quality and biotic community were observed. The agricultural activities have led to high input of N and P fertilizers along with pesticides being used by the farmers. The positives response of restoration practices was observed with partial improvement in fish-productivity due to hindrance factors acting upon severe fish species.

Keywords: water quality, sediment analysis, restoration practices.

INTRODUCTION

Small rivers in Gangetic region serve as water resource for local area. In last few decades' rapid population growth resulted in pollution of water bodies by domestic, industrial sewage and agricultural effluents containing fertilizers and pesticides. The fact that wetland values are overlooked has resulted in threat to the 'Kidneys of the landscape' (Mitsch and Gosselinls 1986). Hydrologic conditions altered through anthropogenic activities can modify physical and chemical quality of water resources. These changes have direct impact on the biotic component of the water body. The study of ecological parameters in such resources may provide clue for appreciating the key relations which are relevant for restoration strategies. The anthropogenic activities in last two decades polluted this river so exclusively that several places hold water only in flood time during winter.

Restoration requires reconstruction of antecedent physical conditions, chemical adjustment of soil and water; and biological manipulation (Zedler, 1996). A survey of is essential for restoration of any open system like rivers. This means that a functional ecosystem can be constituted from an arbitrary set of species from the species pool that could occupy a given site. Restoration practice typically begins with a different goal, which is to accomplish specific objectives. The restoration project needs re-establish a species in a place, reduce rates of within its natural range, re-establish a natural environment, eliminate an invading species, or create vegetation that will provide nesting habitat for a species of interest. Besides other restoration tools bused on ecological theory, public co-operation is important for fast recovery of degraded ecosystems.

The main objective of this research was to determine the ecological status of Sona river prior and after restoration in terms of fish productivity.

MATERIALS AND METHODS

For analysis of physic-chemical characteristics of water, samples were collected repeatedly during 2010 to 2012. To cover the variation at sites of the river, water samples were taken from three sites in aid washed bottles of two liter capacity. The temperature, pH, electrical conductivity and DO were analyzed immediately after sampling. Various physic-chemical parameters Viz. DO, Total hardness, alkalinity, COD, TDS, nitrate and phosphate were determined as per the standard methods described in APHA (1998).

This research was conducted to restore functional ecology through water storage with excavation, debris jam removal and rockslide removal. Restoration of spawning site of fishes accomplished with gravel placement and creation of side-channel. The vegetative methods for bank stabilization were applied. The fish assemblage was also determined on the basis of ecological (Schiemer and Weidbacher, 1992) and balance of fish assemblage according to Balon (1975).

RESULTS AND OBSERVATIONS

In general, data on water quality is indicative of pollution prior to restoration with extreme temperature variation is due to differential amount of light incidence over the water surface, in different seasons and mean value of total alkalinity were comparatively high in cold months may be possible due to dissolution of calcium carbonates at lower temperature (Table 1). All other parameters also showed pollution in water prior to restoration (Table 1). There is considerable change in all physical parameters after restoration might be adaptive for growth and survival of fishes (Table 2).

The assessment of migration barriers was best performed after restoration setup in studied river. Barriers to fish migration have evaluated at various flow conditions, and observed that barrier only prevent fish movement during low flow regime of water. The majority of migration barrier was associated with vertical drops in life-stage of target species. A pool depth of at least 1.25 times the length of the barrier provides ideal leaping of largest fishes. Introduced vegetation was cost effective and self-sustainable appliance for improvement of bank stability. However, selected species at studied sites with specific requirements showed hindrance.

The colonization of the adult fish in restored water occurred with restoration in 2012. Species occurrence varied only as predatory fishes were dominated during summer and followed months. The herbivore species was also occurred during rainy season. The relative abundance increased mainly due to high occurrence of 1^+ and 2^+ fish in assemblage after restoration at different studied sites rathe than polluted state of Sona river (Figure 1).

In January 2013, the abundance and biomass were 3-4 times higher than river prior to restoration suggested possible adaptive changes of environmental condition after restoration in Daha river and there is great difference in species abundance (Figure 2). The contribution of herbivore fishes were linked only in flood time. The fish abundance showed seasonal variation in fishes in both cases of pollution and restoration (Figure 3). However, predatory fish remains dominated in river. Applied vegetative method improved the aesthetic qualities of the riparian zone. The plantation of graminaceous grass and road creeper reduced surface erosion and structural integrity of river bank has enhanced with root spreading in soil and access for spawning site of fishes.

DISCUSSIONS

This study is in agreement with Nazneen (1980) reported the influence of hydrological factors on the seasonal abundance of dissolved oxygen play an immense role in temporal changes of fish assemblage with seasonal variation. The variation in pH was due to presence of free carbon dioxide and carbonate related, and, decreased pH after restoration. Also gradual decrease of alkalinity from March to July and after restoration is attributed to low rate of nutrient cycling in Sona river. High concentration of total hardness during summer in polluted state of river and gradual decrease in hardness after restoration is probably related with organic deposition in water. The variation in salinity and TDS as pH was observed and consistent with study of Kumar et al (2002). The present study support findings of Elser et al (1990) as high level of chloride and nitrogen resulted with growth of planktons and agricultural effluents. The phosphate amount showed similar trend as nitrogen through fertilizer effluents in river.

This research hold relation between water quality and fish productivity was consistent with study of Downing et al (1990). The fish yield was variable for existing species and showed Gaussian curve for productivity. There is effect of unconventional diets on growth and survival of fishes as reported in the case of *Clarias batrachus* as reported by Tiwary et al.(2013). The accumulation of bed load is beneficial in terms of their role in the creation of spawning, rearing and over-wintering habitat. Removal of soil from lower surface of river during restoration increases both the water volume and flow rate. The entrapment of spawning gravel was necessary during restoration after clearance of riparian vegetation. The study showed that the restoration supported fish assemblage increment as reported in similar case by Penaz and Jurajda (1993). The fish habitat has been achieved with improvement in water quality. A lower ratio of predatory fishes after project was partly caused by increased occurrence of herbivore than previous years. During the study, initial land limiting fish migration was observed. This study confirms that restoration provide new chances and enriched habitat scale of the river system for local populations as reported by Schiemer and Weidbacher (1992) in the similar case.

CONCLUSION

There is direct relationship between fish yield and water quality. However, restoration of Sona river with limited approach and economy resulted in partial backwater and there are several hindrance factors encountered due to specific need of all fish species. Thus, further researches may be needful during restoration for particular fish species for local population.

REFERENCES

1. APHA (1998). Standard methods for the examination of water and waste watershed. Washington, USA.
2. Balon EK (1975) Reproductive guilds of Fishes: A proposal and definition. J. fish Res. Board (Canada), 32:821-864.
3. Downing JA, Plante C and Lalonde S (1990). Fish production correlated with primary productivity, not the morpho-edaphic index. Can J. Fish aquat. Sci, 47:1929-1936.

4. Elser JJ, ER Marzolf and CR Goldman (1990). Phosphorus and Nitrogen limitation in the freshwaters of North America; A review and critic of experimental enrichments. Can. J. Fish aquat Sci., 47:1468-1477.
5. Kumar A, Bohra C and A.K Singh (2002). Ecotechnology for limnological project of kawar lake with special reference to biogeochemical cycle, In: Ecology and Ethology of Aquatic biota, Daya Publishing House, Delhi (India) 1:149-199.
6. Nazneen S (1980). Influence of hydrological factors on the seasonal abundance of phytoplankton in keinjer lake. Ine. Rev. hydrobiol., 65 (20): 269-282.
7. Penaz M and Jurajda P (1993). Fish assemblage of the Morava river: Longitudinal Zonation and Protection. Folia Zool, 42:317-328.
8. Scheimer F and waidbacher H (1992). Strategies for conservation of Danubian fish fauna, In:Boon PJ, Calow P and Petts GJ (Eds.): River Conservation and Management. John Wiley Sons Ltd. Chichester. 363-382.
9. Tiwary CB, KK Thakur and SK Tiwari (2013). Effect of Unconventional diets on Growth and Survival of Clarias batrachus (Lin.). Journal of Inland Fisheries Society India, 45(1): 53-56.

Table 1. Physicochemical Characteristics of Sona river prior to restoration at selected Sites.

Sl. No.	Parameters	Site- I		Site- II		Site – III	
		Min	Max	Min	Max	Min	Max
1.	Water Temp. (^{0}C)	12.6	28.3	11.7	27.6	13.6	29.6
2.	pH	7.4	8.2	7.6	8.4	8.2	8.9
3.	TDS (mg/L)	1230.60	1410.0	1310.0	1520.0	1460.0	1580.0
4.	Total hardness (mg/L)	620.30	770.10	660.20	810.10	710.30	840.10
5.	Chloride (mg/L)	470.40	560.10	520.30	610.0	620.10	680.60
6.	Alkalinity (mg/L)	380.10	732.60	410.30	840.20	530.0	910.60
7.	DO (mg/L)	3.10	4.20	3.70	4.80	4.30	6.10
8.	COD (mg/L)	110	170	140	210	170	240
9.	Nitrate (mg/L)	1.30	1.70	1.60	2.30	1.80	2.50
10.	Phosphate (mg/L)	0.60	0.90	0.70	0.90	1.10	1.40

Table 2. Physicochemical characteristics of Sona river after restoration.

Sl. No.	Parameters	Site- I		Site- II		Site – III	
		Min	Max	Min	Max	Min	Max
1.	Water Temp (^{0}C)	13.1	29.4	12.9	28.8	13.3	29.6
2.	pH	6.1	6.3	6.4	6.7	6.5	6.8
3.	TDS (mg/L)	478.10	530.20	524.20	560.10	540.10	570.60
4.	Total hardness	180.20	210.10	200.0	230.0	220.0	240.0

	(mg/L)						
5.	Chloride (mg/L)	470.40	560.10	520.30	610.0	620.10	680.60
6.	Alkalinity (mg/L)	90.60	130.0	110.0	160.10	120.10	168.20
7.	DO (mg/L)	6.10	6.70	5.80	6.40	5.60	6.20
8.	COD (mg/L)	25.20	32.10	26.10	32.60	28.0	34.10
9.	Nitrate (mg/L)	0.60	0.90	0.70	1.0	0.80	1.10
10.	Phosphate (mg/L)	0.20	0.35	0.25	0.40	0.32	0.48

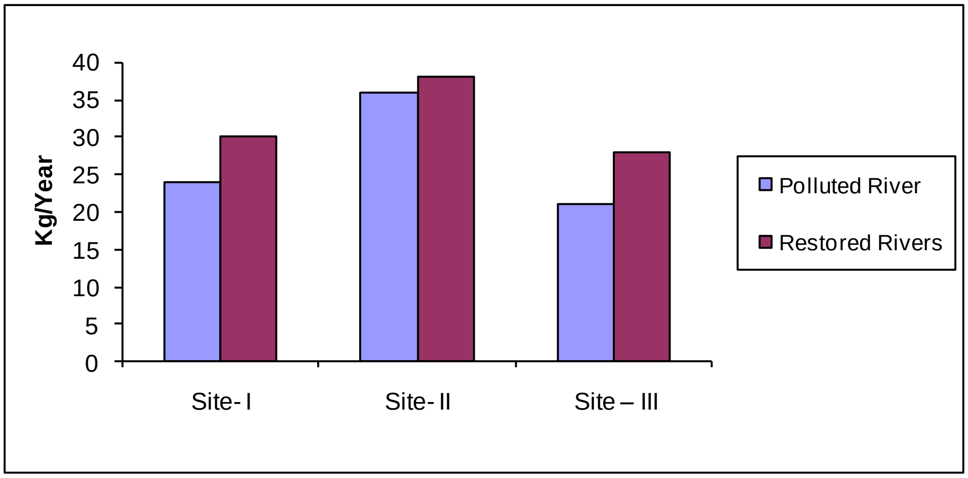

Figure 1. Fish assemblage at different sites under pollution and restoration period.

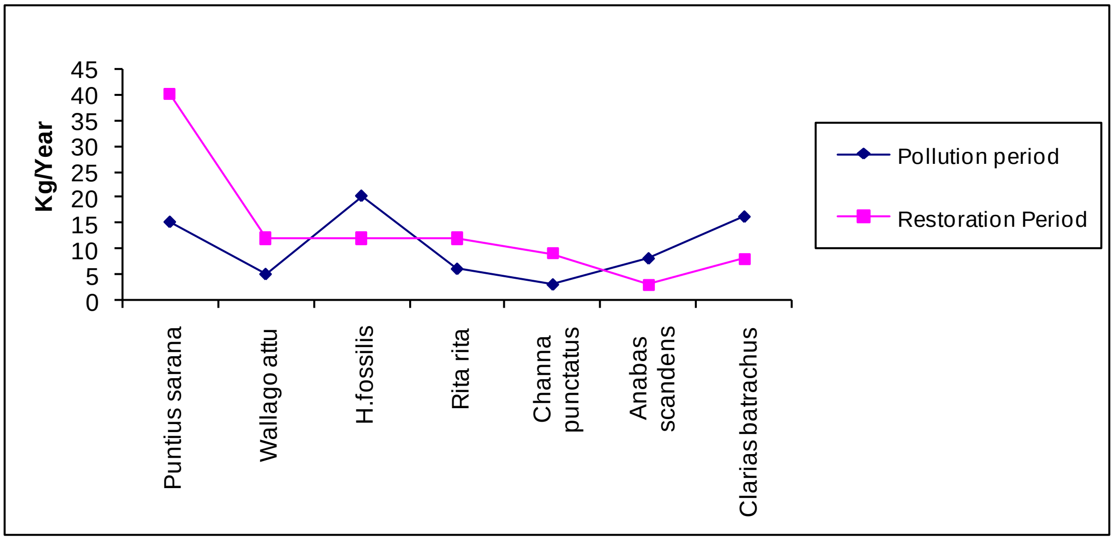

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Figure 2. Species abundance under pollution and restoration period.

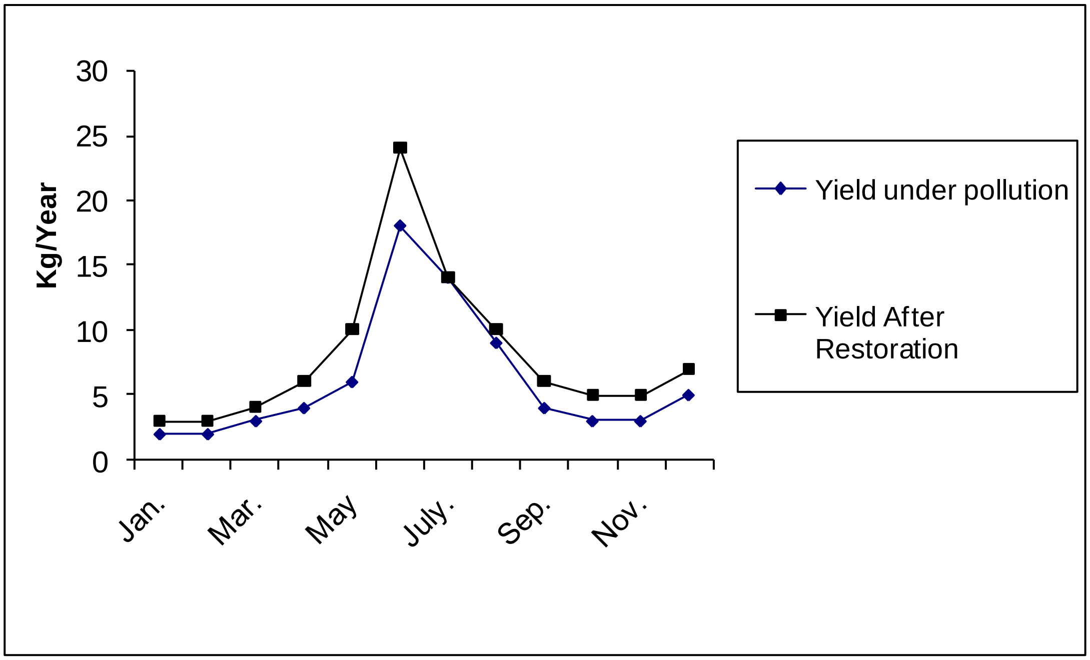

Fig3. Seasonal Fish Catchment under pollution and after restoration period.