Pollution of our rivers with special reference to domestic waste and sewage

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Abstract-Rivers get polluted by receiving wastes and effluents from sewage which are discharged in river water. It has been studied over a period of 2 years from Jan 2008 to Dec 2009 in Siwan town in different seasons. The phycological study and physicochemical parameters like pH, TDS, DO, BOD, Phosphate, Chloride, Nitrate etc has been used to assess the level of pollution. Using various indices, we have been able to quantify the extent of pollution it has been subjected to. Water Quality Index has been applied in indexing pollution level.

Keywords: *Waste and effluents in river, Water pollution study, Daha river pollution, Water Quality Index*

Introduction-Despite stringent laws, we are dumping untreated wastes and effluents in our river system making them heavily polluted. Uncontrolled population increase led to the urbanization. The humungous population in cities have been dumping untreated domestic wastes and effluents directly into the nearby rivers which has drastically affected self-purifying capacity*(VentakataTeswarlu and V Sampath Kumar PT, 1982)*. The evaluation of degree of pollution in water bodies is assessed by:

- Phycological study
- Physicochemical analysis of water sample

Physicochemical parameter study of water samples with their valuesindicates the degree of pollution of a water body (Kataria HC 1994).Algal presence in a water bodyis a key indicator of pollution level *(Jafri N, Int. J Algae 2009)*. These above mentioned complementary methods helps in assessing the pollution level of the water body.

Material and Methods-We selected the Daha river meanders through the Siwan town and it's serpentine path makes it a tempting target to irresponsible dumping. The river originates from Chaur of a small village

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called Sasamusa in Gopalganj district of Saran division and finally discharges into the river Ghaghra. Three sugar industries that sprang along its course were the worst offenders. Huge amount of untreated effluents of these factories situated in Sasamusa, Gopalganj and Hathua finally pass into this river raising its level of pollution. During the operational period, only Hathua sugar mill discharges on an average 60000 gallons of effluents an hour.

We divided the river in following four different zones for our study:

Zone 1: River while entering the town
Zone 2: Immediately before the dumping site
Zone 3: Just after the sewage dumping site
Zone 4: River leaving the town

Zone 1 It looks somewhat fresh with less quantity of pollutants. Farmers use water from this part in various agricultural processes.

Zone 2 Seems to be comparatively a bit more polluted and more turbid

Zone 3 Appears to be comparatively dark brown making it hard for light penetration (most turbid). It does not support the growth of clean water algae.

Zone 4It is least polluted because polluting factors get saturated during the course ofriver stretch.

The investigation was made for two years from January 2008 – December 2009 during which water samples and algae were collected on a monthly basis from the pre-selected four zones.

Physicochemical Parameters and Water Quality Index-Collected water samples from the four zones were investigated through pH, TDS, temperature, nitrates, turbidity, DO, BOD, phosphate, FC, chloride and conductivity. The investigations reflect the levels of pollution which exists in different zones of water *(Riund FE 1965)*. We combined these above mentioned parameters through statistical approach to quantify the extent of pollution in terms of Water Quality Index. We also prepared modified Palmer's Algal Index of the four zones *(Palmer CM 1969)*. Lastly, we combined phycological and physicochemical study of indexing to prepare a new index which we call NPI (New pollution Index).

Results and Discussions-In tables 1-6, we present different parameters, their contribution to WQI in different months (average) in all the four zones accordingly results have also been presented.

Table 1

Water Quality Index Legend *

Sl. No.	Range	Quality
1	90-100	Excellent
2	70-90	Good
3	50-70	Medium
4	25-50	Bad
5	0-25	Very Bad

*The above 100 point index has been prepared by Wilkes University, Center for Environmental Quality Environmental Engineering and Earth Sciences.

Table 2

Contribution of different physicochemical parameters to overall water quality index of collected samples for the month of January (Average of year 2008 - 2009)

Name of Factor/parameter (P)	Weight of the factor (F)	Region 1			Region 2			Region 3			Region 4		
		Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)
D.O.	0.17	8.4	6	1.02	8.3	6	1.02	8.1	6	1.02	8.4	6	1.02
F.C.	0.16	400	31	4.96	415	30	4.8	450	30	4.8	425	30	4.8
pH	0.11	6.7	80	8.8	6.6	76	8.36	6.5	72	7.92	6.8	85	9.35
BOD	0.11	6.5	48	5.28	6.9	46	5.06	8	42	4.62	7	46	5.06
TEMP. CHANGE	0.1		90	9		90	9		90	9		90	9
TOTAL PHOSPHATE	0.1	0.023	95	9.5	0.027	95	9.5	0.035	95	9.5	0.022	95	9.5
NITRATES	0.1	9	55	5.5	9.1	55	5.5	9.4	52	5.2	8.9	55	5.5
TURBIDITY	0.08	111	5	0.4	112	5	0.4	120	5	0.4	110	5	0.4
T.D.S.	0.07	121	82	5.74	125	80	5.6	140	78	5.46	120	82	5.74
OVERALL WATER QUALITY INDEX OF SAMPLE				50.2			49.24			47.92			50.37

*THE QUALITY INDEX OF INDIVIDUAL PARAMETER / FACTOR HAS BEEN OBTAINED FROM THE WEIGHING CURVE CHARTS OF WILKESUNIVERSITY.

Table 3

Contribution of different physicochemical parameters to overall water quality index of collected samples for the month of July (Average of year 2008 - 2009)

Name of Factor/parameter (P)	Weight of the factor (F)	Region 1			Region 2			Region 3			Region 4		
		Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)
D.O.	0.17	8.6	6	1.02	8.2	6	1.02	8.3	6	1.02	9	7	1.19
F.C.	0.16	310	33	5.28	320	33	5.28	350	32	5.12	300	34	5.44
pH	0.11	6.9	86	9.46	6.8	85	9.35	6.7	80	8.8	6.9	86	9.46
BOD	0.11	6.2	50	5.5	6.3	49	5.39	7	46	5.06	6	50	5.5
TEMP. CHANGE	0.1		90	9		90	9		90	9		90	9
TOTAL PHOSPHATE	0.1	0.021	95	9.5	0.023	95	9.5	0.026	95	9.5	0.02	95	9.5
NITRATES	0.1	8.3	57	5.7	8.8	55	5.5	9	55	5.5	8	60	6
TURBIDITY	0.08	139	5	0.4	148	5	0.4	156	5	0.4	136	5	0.4
T.D.S.	0.08	225	68	5.44	260	65	5.2	275	62	4.96	250	66	5.28
OVERALL WATER QUALITY INDEX OF SAMPLE				51.3			50.64			49.36			51.77

*THE QUALITY INDEX OF INDIVIDUAL PARAMETER / FACTOR HAS BEEN OBTAINED FROM THE WEIGHING CURVE CHARTS OF WILKESUNIVERSITY.

Table 4

Contribution of different physicochemical parameters to overall water quality index of collected samples for the month of Sept (Average of year 2008 - 2009)

Name of Factor/parameter (P)	Weight of the factor (F)	Region 1			Region 2			Region 3			Region 4		
		Numerical Value of P	Qual. Index of the parameter Q	WQI (QXW)	Numerical Value of P	Qual. Index of the parameter Q	WQI (QXW)	Numerical Value of P	Qual. Index of the parameter Q	WQI (QXW)	Numerical Value of P	Qual. Index of the parameter Q	WQI (QXW)
D.O.	0.17	8.4	6	1.02	8.3	6	1.02	8.2	6	1.02	8.4	6	1.02
F.C.	0.16	300	34	5.44	320	33	5.28	400	31	4.96	325	33	5.28
pH	0.11	6.8	85	9.35	6.7	80	8.8	6.6	76	8.36	6.9	86	9.16
BOD	0.11	6	50	5.5	6.2	50	5.5	7.5	44	4.84	6.5	48	5.28
TEMP. CHANGE	0.1		90	9		90	9		90	9		90	9
TOTAL PHOSPHATE	0.1	0.025	95	9.5	0.026	95	9.5	0.03	95	9.5	0.025	95	9.5
NITRATES	0.1	8.3	57	5.7	8.4	56	5.6	8.2	55	5.5	8.2	57	5.7
TURBIDITY	0.08	121	5	0.4	122	5	0.4	130	5	0.4	120	5	0.4
T.D.S.	0.08	222	70	5.6	225	68	5.44	245	67	5.36	220	70	5.6
OVERALL WATER QUALITY INDEX OF SAMPLE				51.51			50.54			48.94			50.94

*THE QUALITY INDEX OF INDIVIDUAL PARAMETER / FACTOR HAS BEEN OBTAINED FROM THE WEIGHING CURVE CHARTS OF WILKESUNIVERSITY.

Table 5

Contribution of different physicochemical parameters to overall water quality index of collected samples for the month of November (Average of year 2008 - 2009)

Name of Factor/parameter (P)	Weight of the factor (F)	Region 1			Region 2			Region 3			Region 4		
		Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)	Numerical Value of P	Quality Index of the parameter Q	WQI (QXW)
D.O.	0.17	8.2	6	1.02	8.1	6	1.02	8	6	1.02	8.3	6	1.02
F.C.	0.16	325	33	5.28	350	32	5.12	500	29	4.64	300	34	5.44
pH	0.11	6.6	76	8.36	6.5	72	7.92	6.4	69	7.59	6.8	85	9.35
BOD	0.11	7	46	5.06	7.1	46	5.06	9	38	4.18	7.2	45	4.95
TEMP. CHANGE	0.1		90	9		90	9		90	9		90	9
TOTAL PHOSPHATE	0.1	0.025	95	9.5	0.029	95	9.5	0.038	95	9.5	0.028	95	9.5
NITRATES	0.1	8.9	55	5.5	9.3	52	5.2	9.6	50	5	8.7	56	5.6
TURBIDITY	0.08	112	5	0.4	120	5	0.4	126	5	0.4	100	17	1.36
T.D.S.	0.08	130	80	6.4	138	78	6.24	150	78	6.24	130	80	6.4
OVERALL WATER QUALITY INDEX OF SAMPLE				50.52			49.46			47.57			52.62

Table 6

Modified Palmer Algal Index Indication

Pollution level in region 1 & 2

	Region 1								Region 2									
	Jan	Feb	Mar	Apr	May	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Sep	Oct	Nov	Dec
CYANOPYCEAE																		
Anabaena																4	4	4
Langbya																		
Oscillitoriachlorina										2	2	2	2				2	2
O. limosa																		
O. moniliformae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
O. princeps	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
O. tenuis																		
O. irigua																		
O. annae																		
O. subbrevis														5				
Arthrospia.gomontiana																		
CHLOROPHYCEAE																		
Cladophora			1	1	1					1	1	1	1					
Hydrodictyon			2	2	2					2	2	2	2	2				
BACILARIOPHYCEAE																		
Nevicula	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
Total	2	2	5	5	5	2	2	2	2	5	5	5	5	4.3	2	6	6.3	6.3

The WQI calculated for the four zones shows that Zone 1 and Zone 4 is the least polluted. Zone 3 is the most polluted while Zone 2 contains comparatively lesser pollutants.

Zone 3 Data during summers	
COD	80 PPM
TDS	275 PPM
Chlorine	20
DO	8.3
FC	350
pH	6.7 (ideal is 6.0 to 6.9)
BOD	7
Phosphate	0.026 PPM
Nitrate	9 PPM
Turbidity	156 NTU(ideal is 5 to 10 NTU)

Total Dissolved Solids (TDS):-Almost all water samples, exhibited maxima in summer and minima in monsoon. The TDS values range from 120ppm to 275ppm; in the months of summer, they are maximum. Water with high TDS is unpalatable and makes water aesthetically objectionable.

Temperature Change:-During summer the pollution concentration is maximum because solar radiation causes evaporation. Temperature is naturally recorded highest in the month of May (31Úc to 32Úc) in region 3. A remarkable feature is that the average value of temperatures of regions 1, 2 and 4,having less pollution load remains nearly same.

Nitrates (NO3):-The collected samples of Nitrate ranges from 8.0 to 10.5. The Nitrate content was maximum in March and May being 10.5 and 10.2 respectively in Region 3 showing maximum pollution level.

Dissolved Oxygen (DO):-DO was usually found to be minimum during summer and maximum in winter and monsoon. The dissolved oxygen content ranged from 7.2 ppm to 9ppm.The summer minima may be attributed to the low oxygen carrying capacity of water. The monsoon maxima were due to dilution factor.

BOD(Biochemical Oxygen Demand):-Region 3 recorded 12ppm in March and 10ppmin May. In comparison to other regions, BOD is maximum. More BOD in Region 3 indicates that pollution is maximum in summer months.

Phosphate:-It ranges from 0.020ppm to 0.045ppm. In the month of March, it is 0.035 in regions 3 and in May it is 0.045. In monsoon season as well as in winter, it is less than that in the summer and ranges from 0.020 to 0.035 indicating less pollution level in regions 1, 2 & 4.

Faecal Coliform:-All the samples of water collected were examined and the number of FC was found to be maximum in March and May which were 650 and 600 respectively.

Chloride:-The seasonal variations in the chloride have been depicted in the table. It varied from 10ppm to 32ppm.

Significant variation from the optimum pH value of water shows higher pollution concentration. Raised amount of phosphate found in the water bodies is indicative of increasing pollution level because there is no use of phosphate in aquatic condition other than sugar factory (Murthy K et.al 1997). Difference in temperature between the water body and surrounding makes it significant contribution in overall pollution (Ojha DD et.al 1993). It is alarming not only for livings but also for ecological balance and sustainable development. It is suggestive that waste discharge from town and sugar factory discharged wastes should be minimized.

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