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Research Article

ASSESSMENT OF THE VARIATIONS IN PHYSICO-CHEMICAL CHARACTERISTICS OF WATER QUALITY OF THE WETLANDS IN DISTRICT MAINPURI (U.P.) INDIA

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ABSTRACT
Wetlands are one of our most important natural resources because of the many environmental and economic benefits that they provide. The present study was carried out to evaluate the physico-chemical parameters of study of the five wetlands *viz*- Site-I (Markandeshwar), Site-II (Bhamwat Canal), Site-III (Saman), Site IV Sauj) and Site-V (Kirithua) in Mainpuri district (U P). The physicochemical parameters play a vital role in the wetland ecosystems. A significant variation in these parameters was observed throughout the study period; between April 2011 to February 2012. In this paper we discuss Colour, Carbonates, Bi carbonates, Chloride, Fluoride, Phosphate, Turbidity and Salinity of water from these wetlands. Degradation in the wetland ecosystem can change water bird species composition, particularly breeding fauna, by influencing habitat use for nesting and breeding activities. Saman and Sauj (Site-III and IV) are IBAs (Important bird areas) under Important Bird Areas Programmes of BNHS and Bird Life International.

***Key Words**: Physicochemical, Wetland, Ecosystem, Environmental*

INTRODUCTION
Wetlands are defined as "areas of marsh, fen, peat land" or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters Ramsar convention Burea (2006).
The wetland's ecological diversity depends on the crucial balance of complexly interactive forces of physical, chemical and biological processes (Bhattacharya, 1994). Being highly productive and having genetically diversified ecosystems, the wetland provides important benefits of both goods and services. The wetland provides important values of i) biological diversities in terms of both floral and faunal assemblages, ii) cultural and historic values to be designated as a heritage site, iii) aesthetic values in form of its excellence in natural beauty, variable landscapes and habitat types and iv) a large number of attractive wildlife (Chakrabarti,1991). Moreover, the wetland serves several functions like i) nutrient retention through persistent vegetation, restricted circulation through winding channels and creeks, seasonal flooding and high sediment organic content, ii) nutrient recycling with a high rate of primary productivity, with significant areas of submerged vegetation that dies seasonally. iii) Groundwater recharging through the permeable substrates IV) controlling biogeochemical cycles, v) the major source and sink of carbon, and, vi) breeding ground of waterfowls and other aquatic organisms (Selvam, 2003).
The wetland plays a unique role to stabilization of climate which interalia, controls the life cycles of species and maintenance of ecosystems. In addition to its large wealth of alluvial soils, water resources, biodiversity, commercially exploitable species of shell and fin fishes (Bhattacharya and Sarkar, 2003). Wetlands are among the most threatened habitats globally, and it is estimated that since 1900 more than half of the world's wetlands have been destroyed and lost to other land uses (Barbier, 1993). Indeed, despite various forms of international and national legislation ratifying their protection (Bergstrom and Stoll 1993), wetlands continue to be affected by human activities, including channelization, drainage, crop production, effluent disposal, and water abstraction, including in South Africa (Walmsley 1991 and Bowers 1983).

Wetlands are also effective in processing nitrates (Cooke *et al.,* 2005). They have the capacity to remove various pathogens from water passing through. Although this is true of many wetlands when pathogens (e.g., coliform bacteria) are present in high loads, it should be noted that wetlands themselves include active populations of many bacteria. Wetlands with large populations of birds or other wildlife may well contribute more fecal bacteria to through-flowing water than they remove (Kadlec and Knight, 1996). Wetlands are world's most productive environment with stunning biological diversity. Around 4-6% of earth's surface is covered by wetlands. In addition, they provide refuge for endangered species of plants and animals and economic benefits in aquatic fauna. Wetlands reduce the impact of floods by acting as storage areas (Jindal and Gusain, 2007).

MATERIAL AND METHODS

Geographical Location of Study Site

Mainpuri is a District of Agra Division, U.P., India, is bounded on the north by Etah District, on the East by District Farrukhabad and Kannauj on the South by District Etawah and on West by District Firozabad. It lies between north latitude 26º 53' to 27º 31' and East Longitude 78º 27' to 79º 26'. The area of the Distt. is 2745 Sq. km and population 13, 11, 492 in 2001.Out of 1,228 bird species found in India(I.U.C.N.); Uttar Pradesh has 25-30% of birds species out of total species found in India, and of all Sarus counted in U. P. were 73.04 percent encountered in the districts of Mainpuri, Etawah, Etah, and Aligarh (Plate-I).

Study Area

Markandeshwar(Site-I), Bhamwat Canal(Site-II), Saman(Site-III), Sauj(Site-IV) and Kirithua(Site-V) are the major wetlands in Mainpuri, which were selected for the present study. BNHS and Bird life International has designated Saman bird sanctuary (Site-III) and Sauj (Site-IV) as IBAs (Important bird areas), under IBAs programme.

Collection and Analysis of Water Samples

The physiochemical characteristics which were studied are Colour, Carbonates, Bi carbonates, Chloride, Fluoride, Phosphate, Turbidity and Salinity of water.

For the analysis of water, water samples were collected at random basis from each site, in plastic bottles previously rinsed with distilled water. The water samples were collected at seasonal intervals from five wetlands to conduct physico chemical study. The methods of analysis were in accordance to Standard Methods for the Examination of water and waste water (APHA, AWWA and WEF, 1998). The colour of the samples was observed by filling a matched Nessler tube to mark 50ml with the water to be examined and comparing it with the standards. Turbidity was measured by turbidity meter. Salinity was analysed with the help of 'water analysis kit' in lab. Determination of PO_4 was made by kit method in lab, though conventional methods were also used for the comparison of the data. According to the requirement samples were preserved in the refrigerator after treatment.

Stastical Analysis

Data were analyzed by one-way analysis of variance (ANOVA). Significant difference among groups was determined by Duncan's Multiple Range Tests. Data are presented as mean ± Sem. The values of $p<0.05$ were considered significantly different.

RESULTS AND DISCUSSION

Colour

The optical characteristics and colour of water depends upon the contents of suspended matter and percentage of organic contaminants and other non biodegradable matter which persists for a long time. Dissolved and particulate material in water can cause discoloration. Slight discoloration is measured in Hazen units (HU). It was recorded as 5 for different sites. Impurities can be deeply colored as well, for instance dissolved organic compounds called tannins can result in dark brown colors, or algae floating in the water (particles) can impart a green color. Colour is pH dependent (ISO, 1973). During present

investigations raw water showed greenish tinge in winter months, while in summer it was slightly yellowish, due to lesser dilution. The colour ranged from slight yellow to xanthous green at station III,IV and V. However, water samples were muddy. During rainy season muddiness of water increased. Site I and II water samples were clearer. The colour of water changes leading to modification of light quality and quantity that affect the photosynthesis of water plants.Values of Colour differed insignificantly at $p \geq 0.05$.

Table 1: **Showing mean values of parameters of water from five sampling sites of Mainpuri, during April 2011 to Feb 2012.Data are presented as mean ± Sem**

MONTHS	IMarkadeswar	IIBhamwat	III Saman	IV Sauz	V Krithua
Carbonates					
APRIL	1.0 ± 0.173	0.66 ± 0.034	1.0 ±0.199	_	0.9 ±0.152
JUNE	1.1±0.057	0.82 ± 0.02	1.1±0.05	1.0 ± 0.115	1.0 ±0.099
AUGUST	1.0± 0.099	0.52 ± 0.019	1.0 ±0.057	_	1.2 ±0.152
OCT	0.8 ± 0.152	0.85 ± 0.023	1.2 ±0.152	1.0 ± 0.098	1.1 ±0.057
DEC	0.9 ± 0.173	0.76 ± 0.294	1.0±0.173	_	0.8 ±0.115
FEB 12	1.0 ± 0.057	0.54 ± 0.011	_	_	1.0 ±0.057
Bi carbonates					
APRIL	115 ± 0.248	105 ± 1.36	220 ± 0.152	250 ± 1.68	35.5 ± 0.818
JUNE	150 ± 0.577	110 ± 2.88	250 ± 2.07	273 ± 0.866	24.0 ± 0.150
AUGUST	115 ± 1.73	116 ± 0.866	244 ± 1.98	260 ± 0.306	28.6 ± 0.433
OCT	155 ± 1.52	110 ± 0.715	230 ± 0.848	240 ± 3.66	34.0 ± 0.575
DEC	160 ± 1.00	100 ± 0.057	141 ± 1.15	145 ± 0.230	33.5 ± 0.230
FEB 12	130 ± 0.496	120 ± 1.15	235 ± 1.52	260 ± 1.67	31.0 ± 0.514
Chlorides					
APRIL	140 ± 1.44	130 ± 1.50	180 ± 2.51	135 ± 0.461	150 ± 1.99
JUNE	140 ± 1.0	110 ± 0.288	190 ± 1.0	146 ± 0.687	170 ± 0.152
AUGUST	150 ± 1.15	110 ± 0.912	200 ± 0.508	150 ± 1.0	190 ± 2.51
OCT	140 ± 0.288	125 ± 1.0	180 ± 0.866	140 ± 2.07	180 ± 1.52
DEC	130 ± 2.07	130 ± 0.294	160 ± 0.173	130 ± 0.680	155 ± 0.866
FEB 12	110 ± 1.73	130 ± 0.544	160 ± 0.369	130 ± 1.52	141 ± 1.15
Fluoride					
APRIL	_	_	_	_	_
JUNE	_	_	_	0.02 ± 0.001	0.02 ± 0.005
AUGUST	_	_	_	_	_
OCT	_	_	_	0.03 ± 0.005	_
DEC	_	_	_	0.01 ± 0	_
FEB 12	_	_	_	0.02 ± .005	_
Phosphate					
APRIL	0.02 ± 0.005	_	_	0.029 ± 0.002	_
JUNE	0.022 ± 0.002	0.05 ± 0.005	0.028 ± 0.001	0.042 ± 0.006	0.034 ± 0.004
AUGUST	0.05 ± 0.014	0.035 ± 0.004	0.05 ± 0.005	_	0.011 ± 0.002
OCT	0.026 ± 0.004	_	_	0.015 ± 0.002	0.046 ± 0.008
DEC	_	_	0.012 ± 0.001	_	0.008 ± 0.0
FEB 12	_	0.013 ± 0.002	_		0.026 ± 0.005
Turbidity					
APRIL	7 ± 0.577	6.2 ± 0.099	8 ± 0.577	8± 0.152	7 ± 0.150
JUNE	7 ± 0.577	6.8 ± 0.057	8 ± 0.173	9.2 ± 0.173	7.2 ± 0.199
AUGUST	8.5 ± 0.05	8.5 ± 0.17	7.6 ± 0.2	8 ± 0.577	9.6 ± 0.208
OCT	7 ± 0.207	7 ± 0.057	7.5 ± 0.550	6.8± 0.196	6.4 ± 0.08
DEC	6 ± 0.421	7± 0.098	6.1± 0.115	6 ± 0.248	6.2 ± 0.091
FEB 12	6.8 ± 0.305	7 ± 0.305	7.2 ± 0.30	6.1 ± 0.472	5.4 ± 0.207
Salinity					
APRIL	167 ± 1.15	135 ± 0.50	200 ± 2.88	185 ± 0.866	141 ± 0.848
JUNE	184 ±1.52	170 ± 1.15	230 ± 0.5	220 ± 1.732	139 ± 0.958
AUGUST	170 ± 2.88	129 ± 0.493	250 ± 2.30	195 ± 1.732	195 ± 0.928
OCT	192 ± 0.763	100 ± 1.732	250 ± 0.577	207 ± 1.18	190 ± 1.0
DEC	185 ± 0.50	92 ± 0.378	210 ± 2.30	193 ± 0.577	175 ± 1.52
FEB 12	198 ± 1.03	91 ± 0.577	190 ± 2.07	208 ± 1.73	128 ± 1.73

The variation in physico-chemical characteristics of the five study sites of Mainpuri region have been summarized in the table 1. The interpretation of data has been made with the help of statistical tools

Carbonates Value for carbonates was 0.82 ± 0.02mg/L. at site II in June, 11 to 1.2 ±0.152mg/ltr. at site III and V (Table-1 and fig. 1). The alkalinity is entirely due to the carbonates and bicarbonates (Jameel, 1998) and is concerned with the pollution state of the water. The alkalinity values indicate presence of carbonates, bicarbonates and hydroxide in water bodies (Garg, 2003).

Bicarbonates were 24.0 ± 0.150 mg/L, at Site-V during June 11 to 273 ± 0.866 mg/l at site IV,during June11 (Table-1 and fig. 2). Values of bicarbonates at different sites differed significantly. (P≤0.001).

Chloride contents tend to vary inversely to the rate of flow of water and Cl content shows positive correlation with alkalinity and total hardness of water (Rai, 1974). Cl was recorded 130 ± 0.544mg/ltr. at site II during feb12 -200 ± 0.508mg/ltr. at site III in Aug.11 (Table-1 and fig. 3). The excess sodium and chloride can cause hypertension and heart failure (Brooker and Johnson, 1984 and Hussain and Iqbal, 2003). The chlorides, in high concentration, indicate presence of organic matter (Dhanpakiam *et al.*, 1999). Levels of Chloride at different sites differed significantly (p≤0.001).

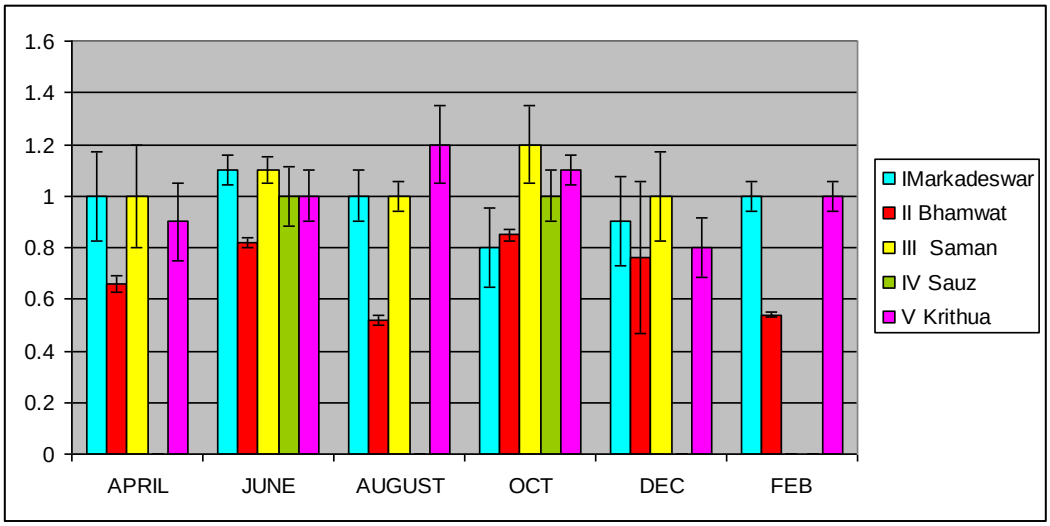

Figure 1: Showing variations in Carbonates levels at different sites of Mainpuri region between April 2011 and feb 2012. Data are presented as Mean±Sem, Error bar indicates standard error.

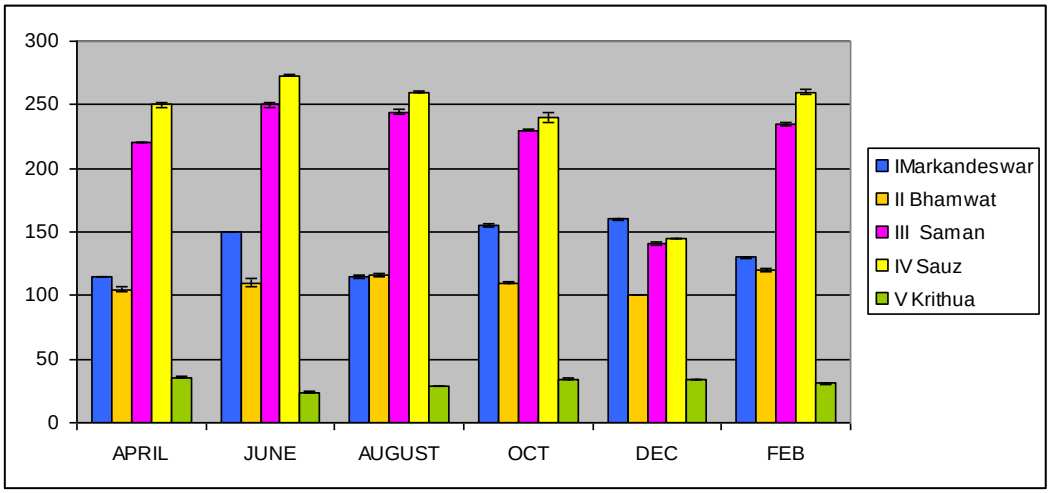

Figure 2: Showing variations in Bi carbonate levels in different sites at Mainpuri region between April 2011 and Feb 2012.Data are presented as Mean±Sem, Error bar indicates standard error.

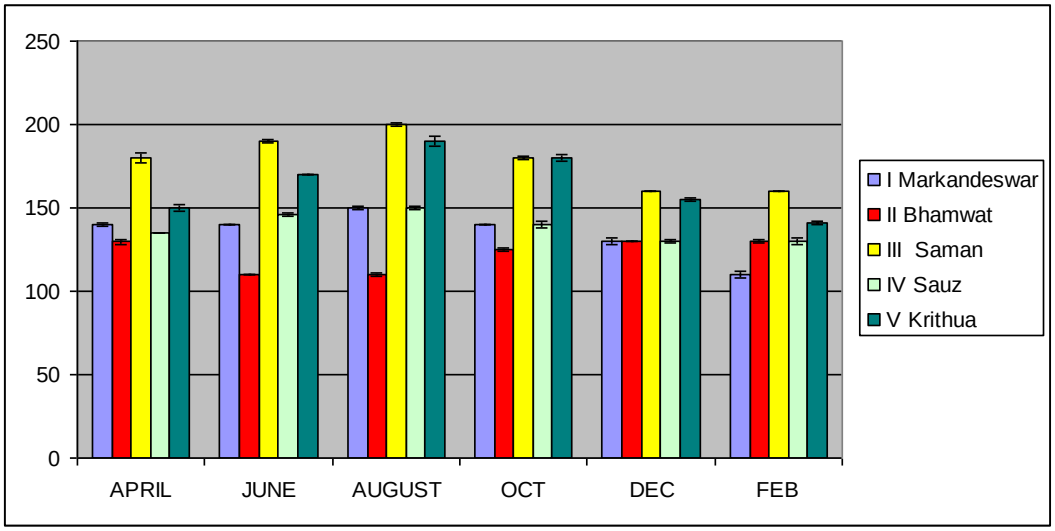

Figure 3: Showing variations in Chlorides levels at different sites of Mainpuri region between April 2011 and feb 2012.Data are presented as Mean±Sem, Error bars indicate standard error.

Flouride contents were 0.01 ± 0 mg/l to 0.03 ± 0.005 mg/l at Site IV. Flouride has been noticed in traces at Site IV and Site V. At other sites it was not present (Table-1 and fig. 4). All water samples in present study were within permissible limits of BIS and WHO.The safety of fluoridated water for birds has not been proven or disproved, many scientists feel that fluoride is detrimental to the health of humans, so, fluorinated water is not suitable for birds; although side effects should be minimal, except in the debilitated bird. Natural water contains traces of dissolved minerals, including calcium, magnesium and potassium. More than 3mg/L of Flouride can cause skeletal and non skeletal flourosis (Park, 1997).
Phosphates were 0.011 ± 0.002mg/L to 0.05-.005 mg/L during Dec. 2011 and oct. 2011. Phosphates levels were fluctuating (Table-1 and fig. 5). Phosphate is least abundant, yet it commonly limits biological productivity; it is affected by anthropological activities (Rao *et al.,* 1993). Low levels of phosphates, which is more than 0.50mg/L, is indicator of pollution (Jain *et al.,* 1996).

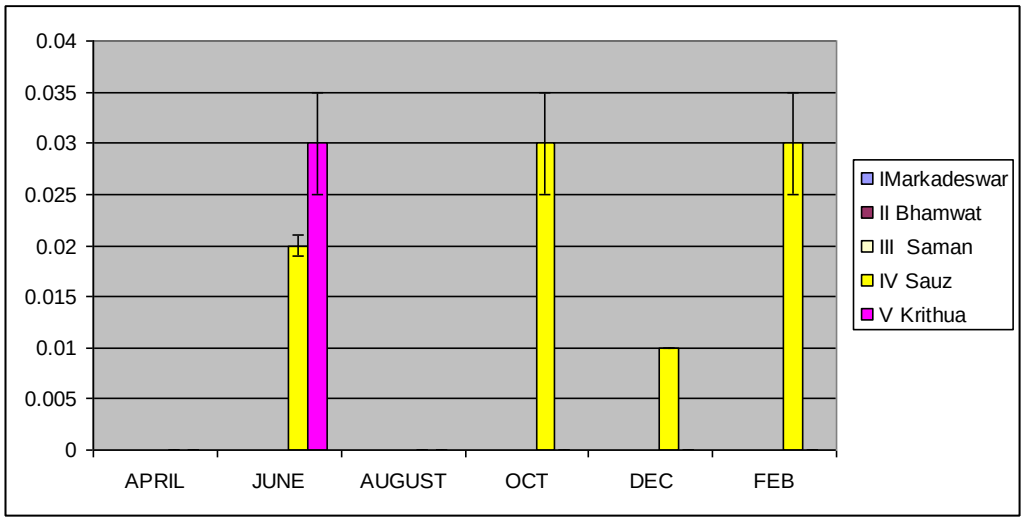

Figure 4: Showing variations in Fluoride levels at different sites of Mainpuri region between April 2011 and feb 2012. Data are presented as Mean±Sem, Error bars indicate standard error.

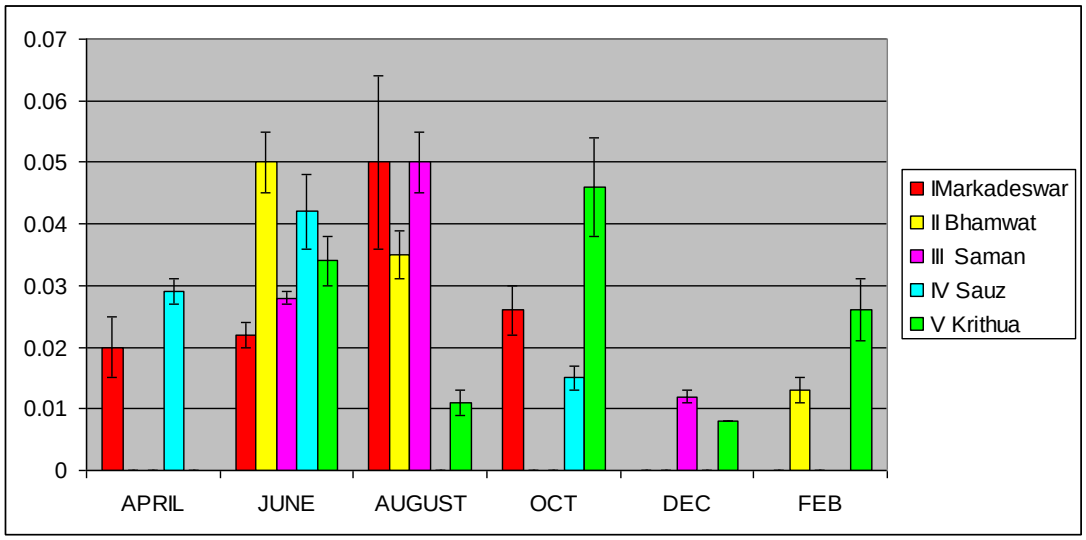

Figure 5: Showing variations in Phosphate levels in different sites at Mainpuri region between April 2011 and feb 2012.Data are presented as Mean±Sem, Error bars indicate standard error.

Turbidity: When the water is not transparent it contains many ions and planktons etc. Turbidity is due to small and light colloidal particles which do not settle at the bottom of the water (clay, humus etc.).Presence of planktons etc. especially green algae, also makes water turbid. Turbidity reduces light penetration and photosynthesis rate, thus reducing dissolved oxygen (D.O), which leads the water unfit for use. Amongst the various study sites turbidity was maximum at site V, 9.6 ± 0.208 NTU and minimum at site V, 5.4 ± 0.207 NTU and indicating fluctuating levels of solids in water samples. Mostly, the turbidity remained high in summer and rains (Table-1 and fig. 6). During present investigations, peak value of turbidity was reported during monsoon at all the five sites,although highest value of turbidity could be observed at site IV during June. Similar results were obtained by Saxena *et al.*, (1996). Sharma *et al.*, (1981) have observed value of turbidity upto 1102.0 mg/l in Yamuna River at Agra. Turbidity levels at different sites differed insignificantly ($p \geq 0.05$).

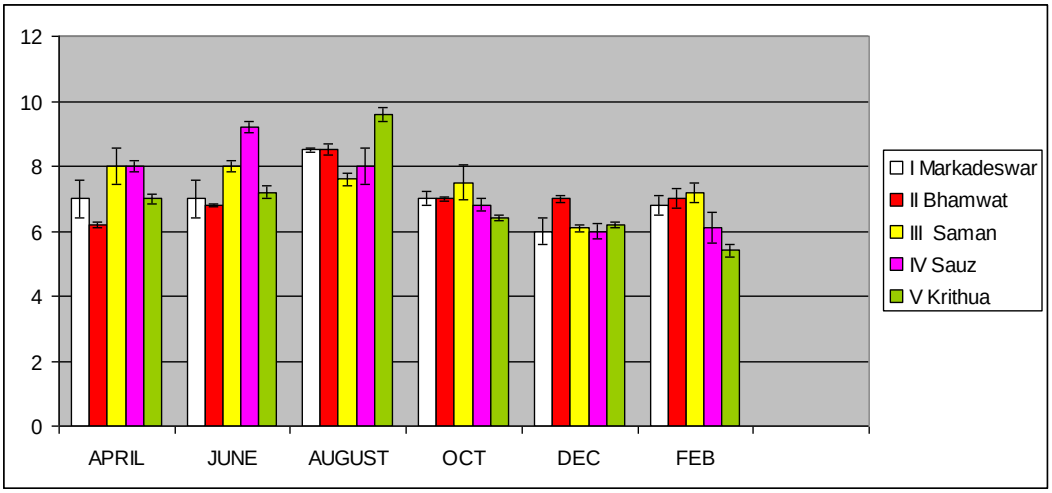

Figure 6: Showing variations in Turbidity levels in different sites at Mainpuri region between April 2011 and feb 2012. Data are presented as Mean±Sem, Error bars indicate standard error.

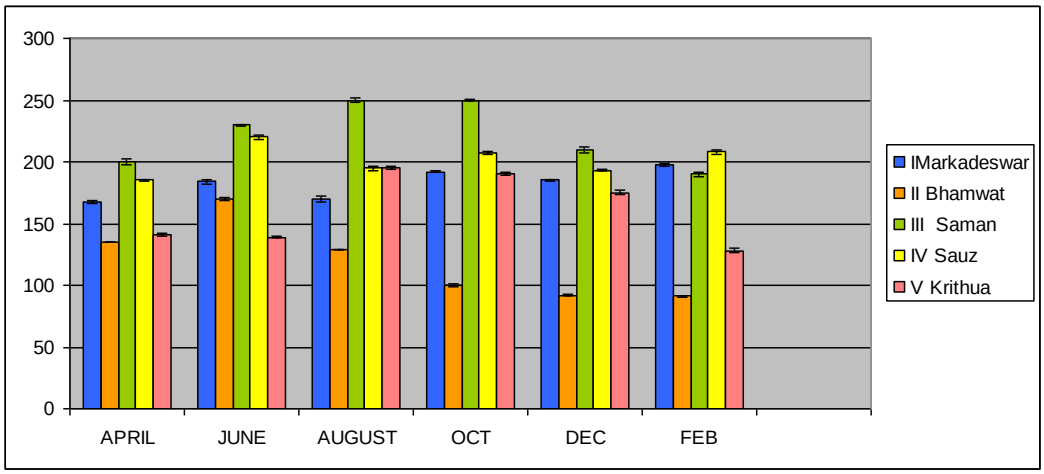

Figure 7: Showing variations in Salinity levels at different sites of Mainpuri region between April 2011 and feb 2012. Data are presented as Mean±Sem, Error bars indicate standard error.

Salinity: Salinity ranged from 91 ± 0.577 - 250 ± 2.30mg/l (Table-1 and fig. 7). Nearly all water has a certain quantity of dissolved solid material in it. Much of this comes from the soils that water flows through, but even rainwater derives it from the sea and is not entirely pure. The key solids in water are the salts. Most common of these are sodium chloride (50-80%); other compounds derived from gypsum (calcium and sulphur), or lime (calcium or magnesium carbonate). Birds, like other vertebrates, filter solutes, such as salts, out of their blood stream by means of kidneys. Although the formation of uric acid is less water consumptive than the formation of urea, avian kidneys are less effective at concentrating solutes than are mammalian kidneys (Skadhauge, 1981). When drinking salty water, birds cannot maintain water balance through renal excretion alone (Willoughby and Peaker 1979). They have Salt gland, which functions in correlation with saline habitats and salty diets. Salt glands are large and fully functional in birds using marine habitats especially those eating invertebrates are isotonic with surroundings while the gland is small and dormant in most terrestrial and freshwater birds (Holmes *et al.*, 1961). In manys species, activity and development of the gland can be stimulated by continuous exposure to saline water. Levels of Salinity at different sites differed significantly ($p \leq 0.001$).

Conclusion

Results indicate fluctuation in levels of different parameters, throughout the study period. The water at these sites is alkaline in nature. Although level of Flouride is fluctuating and less, but it requires concern. Much eutrification has been observed at Kirithua (site V). BNHS and Bird life International has designated Saman bird sanctuary (Site-III) and Sauj (Site-IV) as IBAs(Important bird areas),under IBAs programme .Therefore eutrification and pollution of these wetlands should be checked.

Wetlands are vital water bodies; their role is complex and varied. Apart from being highly productive as the habitat of birds, fishes and a variety of other aquatic life forms, including microorganisms, wetlands provide other ecosystem services, from maintaining the natural balance to sustaining human livelihoods (Sisodiya and Moundidotiya, 2006).

Unfortunately, there has been much neglect of wetlands in recent times through lack of appreciation of their role and the pressures of growing human needs (agriculture, urbanization) and sheer mismanagement of land resources. There is also a misconception that wetlands are only wastelands. As a result, many precious wetlands have been sacrificed and converted to other uses throughout India and elsewhere in the world. This trend has to be checked and reversed for the greater good. Wetlands are very diverse, but they all share one fundamental feature: the complex interaction of their basic components-soil, water, animals

and plants that fulfil many functions and provide many products that have sustained humans over the centuries (Wetlands International 2002).

Available literature has revealed that less limnological and Avifaunal work on wetlands and wetland birds has been done, however many scholars have worked on wetlands, wetland- birds and terrestrial birds in other parts of the country. Wetlands of Mainpuri are rich in biodiversity with aquatic flora and fauna act as water purifiers and water filters .Therefore their maintenance is essential to keep up the ecological balance.

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