ASSESSMENT OF WATER QUALITY IN KOOTHAPAR WETLAND, TIRUCHIRAPPALLI DISTRICT

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Abstract - *Wetland is an important ecosystem which supports biodiversity and provide with ecosystem services. The present work was carried out to determine the water quality and its seasonal changes in Koothapar wetland. It receives water from Uyyakondan channel. Many water quality parameters were found to exceed the standard limits in many samples. It indicated pollution in all the seasons. Of all the sampling points, K1, the point at which the water enters the wetland, DO was less than 1 mg/L in all the seasons. Water in summer was found to be highly polluted.*

Key words: Ecosystem, Biodiversity, Seasonal changes, Physico-chemical parameters and Sewage

1. INTRODUCTION

Wetlands are patchy and dynamic ecosystems where a high number of species occur in different periods of the year [1] and were described as “Kidney of the landscape” as they function as the downstream receivers of water and waste from both natural and human sources [2]. India has totally 27,403 wetlands of which 23,444 are inland wetlands and remaining 3,959 are coastal wetlands. Most of them are directly or indirectly linked with major river systems, such as Ganges, Cauvery, Godavari and Tapti [3]. In the recent past, the quality of the water in Indian rivers has been deteriorating due to continuous discharge of industrial wastes and domestic sewage [4, 5, 6]. Pollution originates from these sources raise the level of turbidity, suspended solids, BOD, disease causing microbes and parasites in surface water sources [7]. It leads to over nutrition of water and ultimately eutrophication [8, 9]. These in turn affect the wetland dependent communities as well as the ecosystem [10]. It has an incalculable effect on wildlife numbers, water quality, hydrological cycles and other wetland functions and values [11]. Thus wetlands being integrated systems are affected by the changes in the key physical as well as chemical parameters at the catchment scale. This essential resource is becoming increasingly scarce in many parts of the world due to severe impairment of water quality. Chemical analysis of water provides a good indication of the chemical quality of the aquatic system [12]. Hence, the present investigation was undertaken to assess the water quality of the Koothapar wetland.

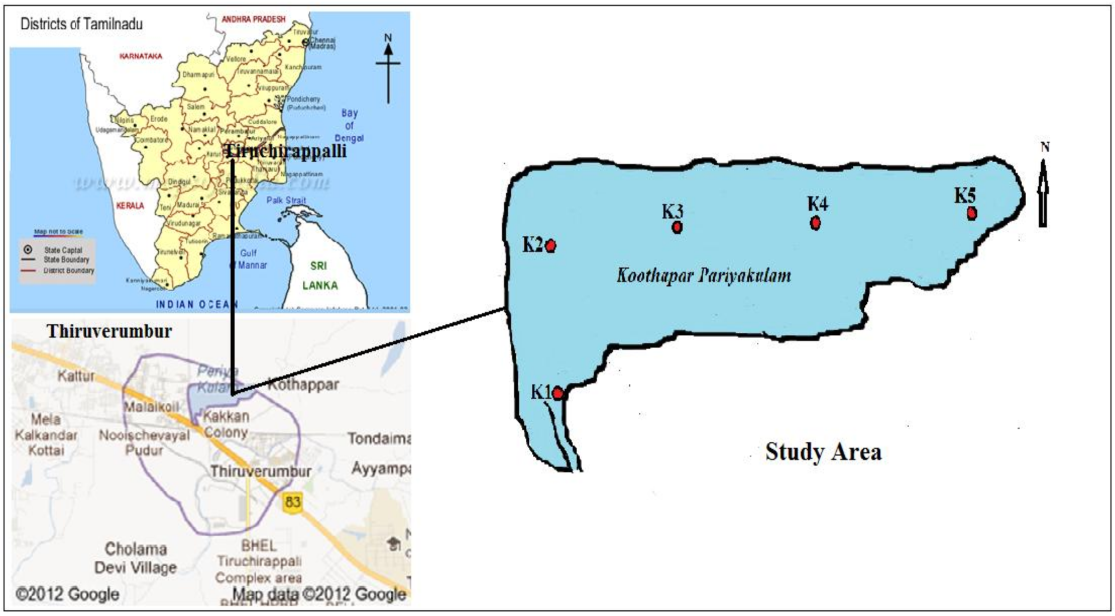
1.1 Study Area

KoothaparPeriyakulam (10º47’50”N:78º46’16”E) is one of the important seasonal wetlands in Tiruchirappalli. It supplies water for irrigation to the adjoining agricultural fields. It is situated close to the Tiruchirappalli – Thanjavur highway in ThiruverumberTaulk, Tiruchirappalli district, Tamilnadu, India. It receives water from Uyyakondan channel, a distributary of river Cauvery. During rains, it receives the rain water and stores it during precipitation. The wetland covers an area of 74 hectares. Fish farming is carried out by the local community. It supports large number of fishes, amphibians, mollusks and aquatic insects and their larvae which form a good food source of arriving migratory birds and waterfowls. *Eichorniacrassipes* was the dominant macro flora covering the wetland.

2. MATERIALS AND METHODS

2.1 Water Sampling and Analyses

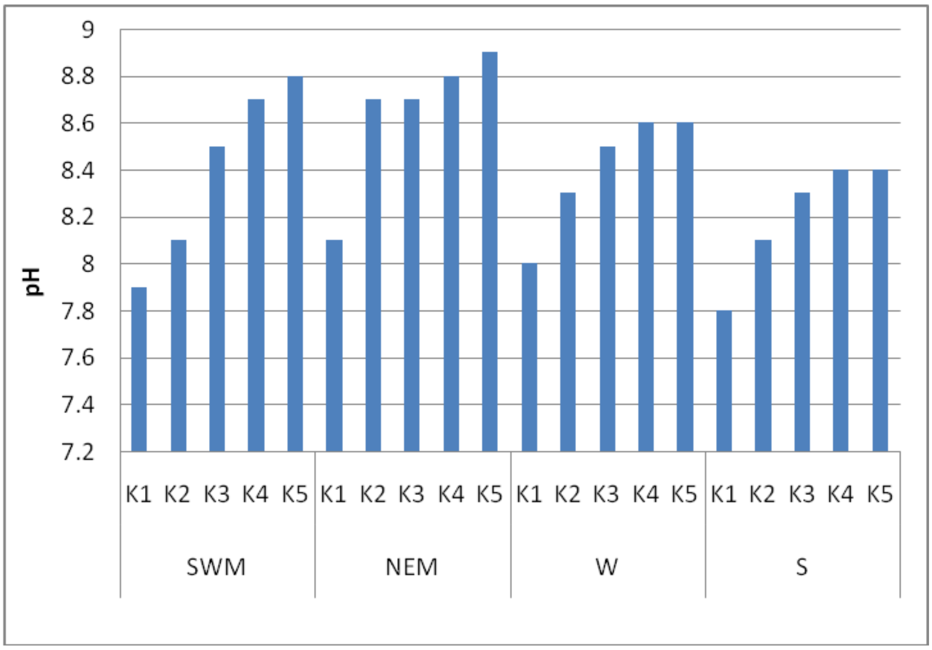
Water samples were collected at five sampling stations in four months – August, November, February and May to represent four seasons namely South west monsoon (SWM), North east monsoon (NEM), Winter (W) and Summer (S) respectively during the period of August 2013 – July 2014 (Map - 1). The samples were collected by grab sampling method. The physico-chemical and microbiological parameters pH, Electrical conductivity (EC), Total dissolved solids (TDS), Total hardness (TH), Dissolved oxygen (DO), Biological oxygen demand (BOD), Chloride, Fluoride, Nitrate, Sulphate, Calcium, Magnesium, Iron, and Total Coliform (TC) were determined as per standard methods [13]. The results were compared with surface water standards recommended by BIS[14] and CPCB[15].



Map - 1: Water sampling stations in Koothapar wetland

3. RESULTS AND DISCUSSION

The results of various Physico-chemical and microbial parameters of the water samples of the wetland are presented in chart 1 to 15.



Chart– 1:pH of water in Koothapar wetland

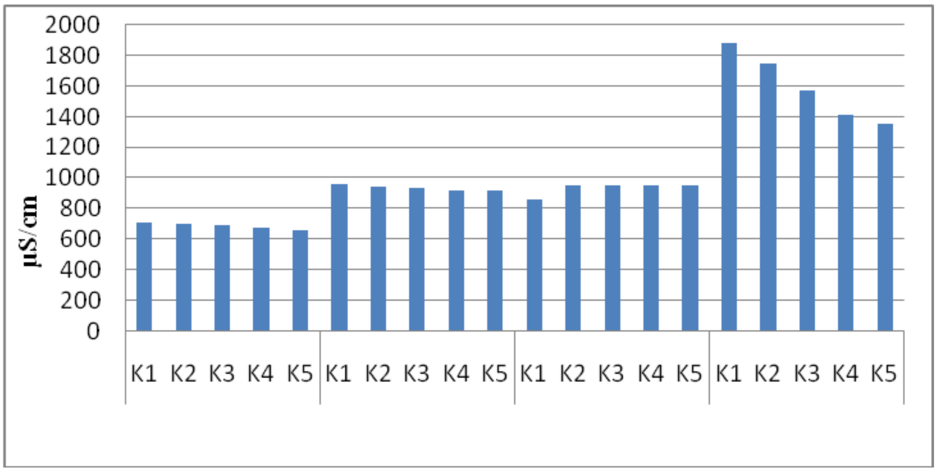


Chart – 2:EC in water of Koothapar wetland

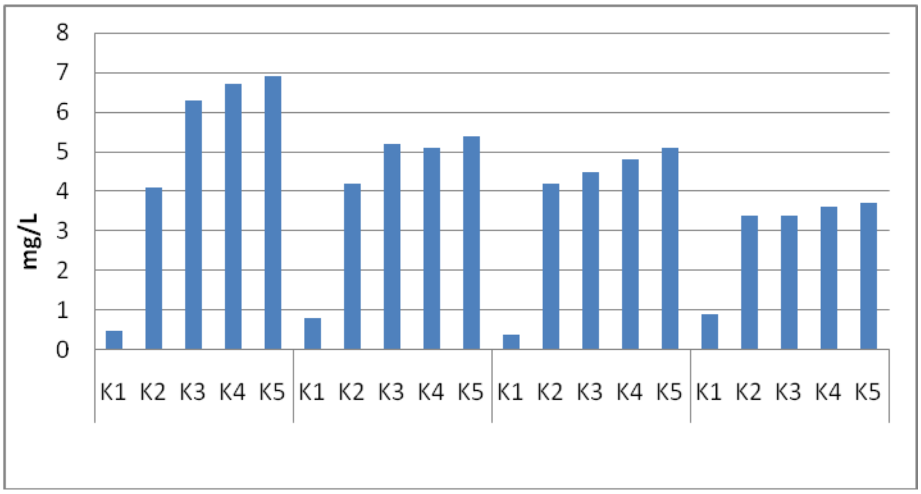


Chart – 3:DO in water of Koothapar wetland

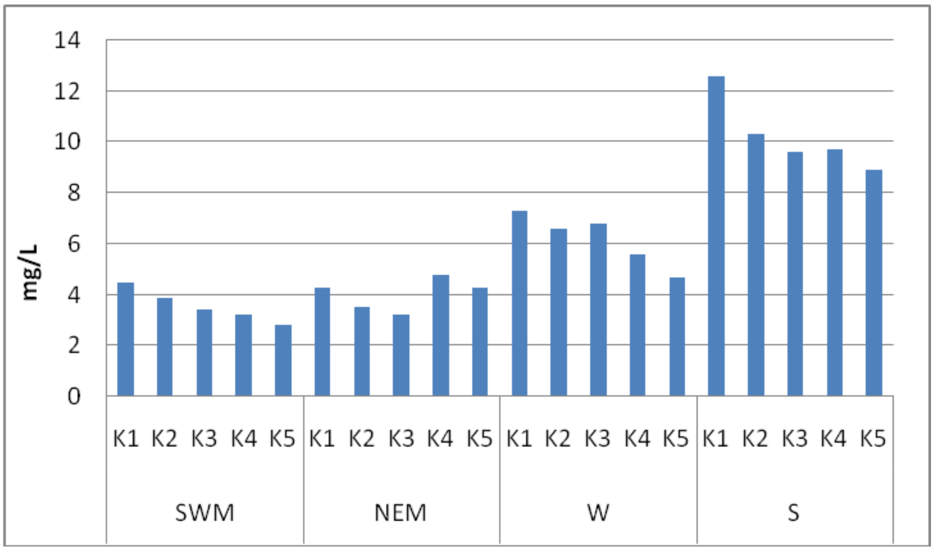


Chart – 4:BOD in water of Koothapar wetland

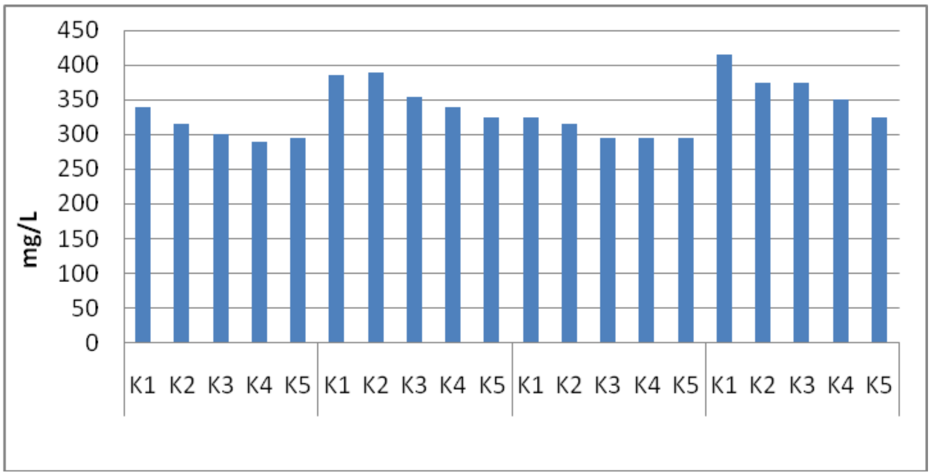


Chart – 5:Total hardness in water of Koothapar wetland

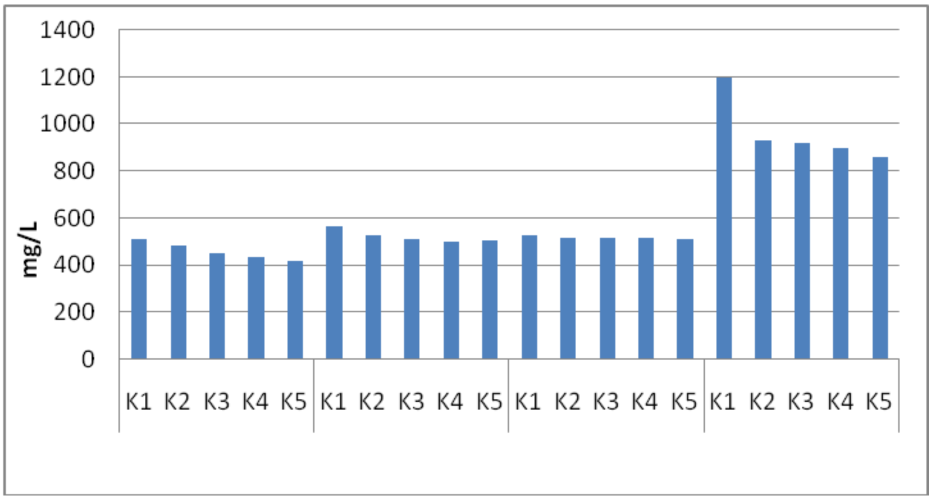


Chart – 6:TDS in water of Koothapar wetland

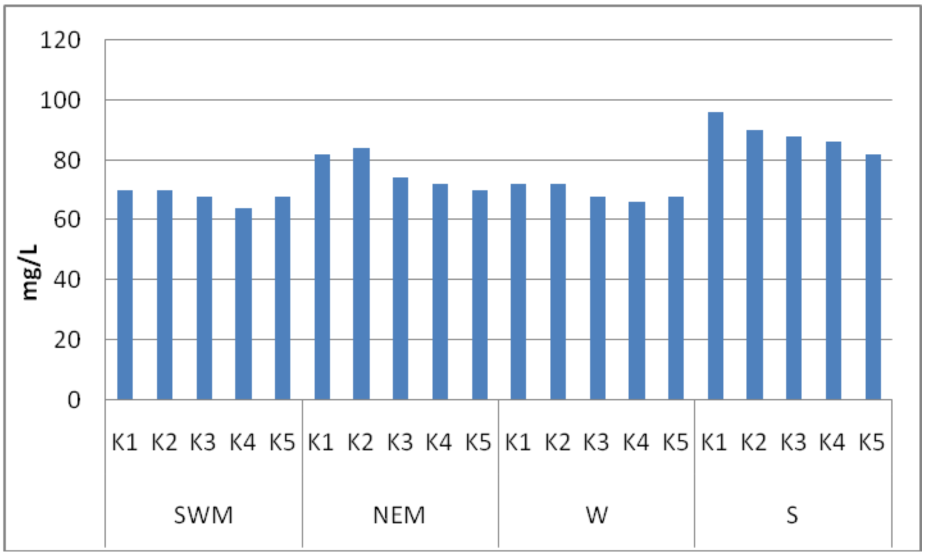


Chart – 7:Calcium in water of Koothapar wetland

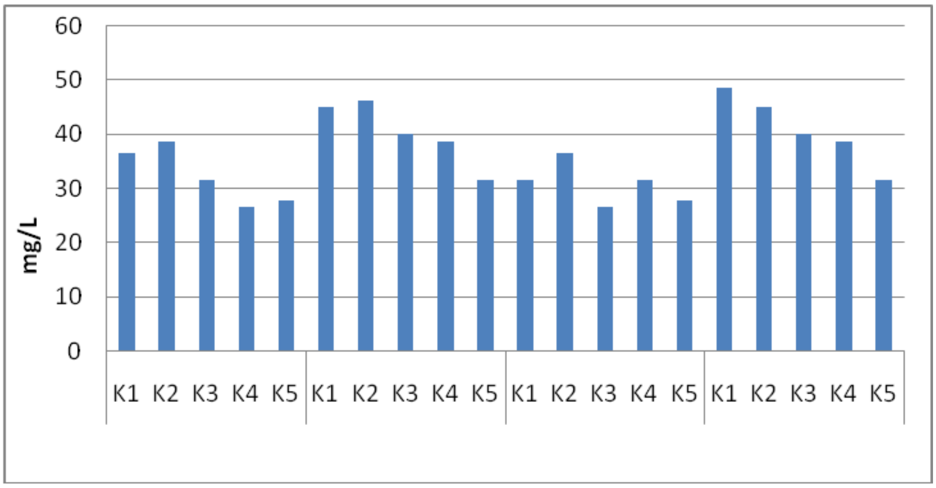


Chart – 8:Magnesium in water of Koothapar wetland

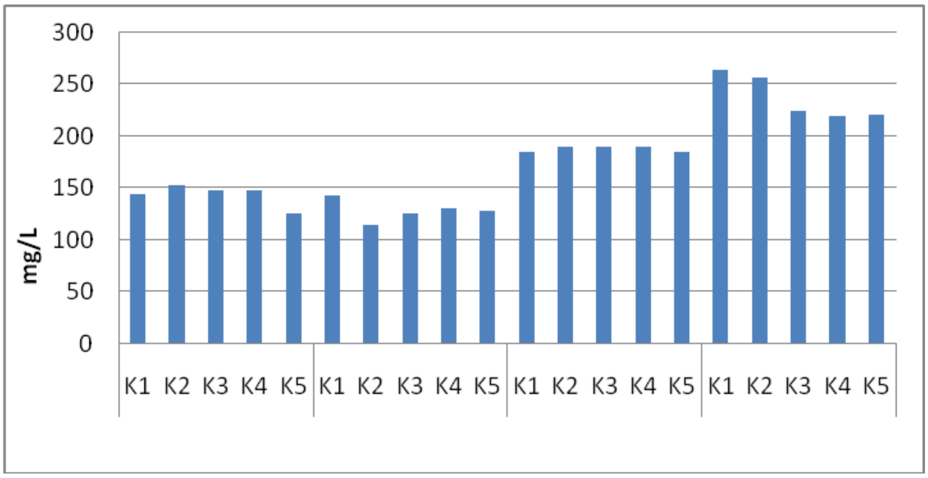


Chart – 9:Chloride in water of Koothapar wetland

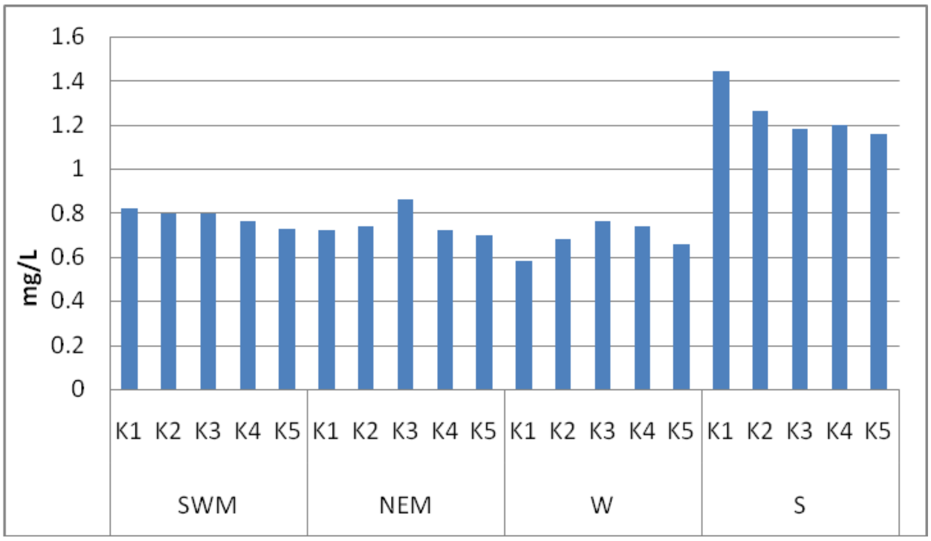


Chart – 10: Fluoride in water of Koothapar wetland

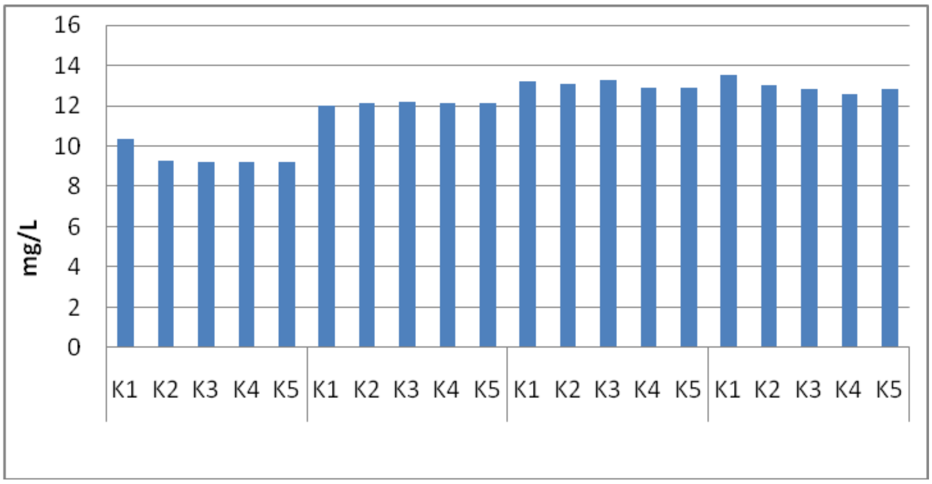


Chart – 11:Nitrate in water of Koothapar wetland

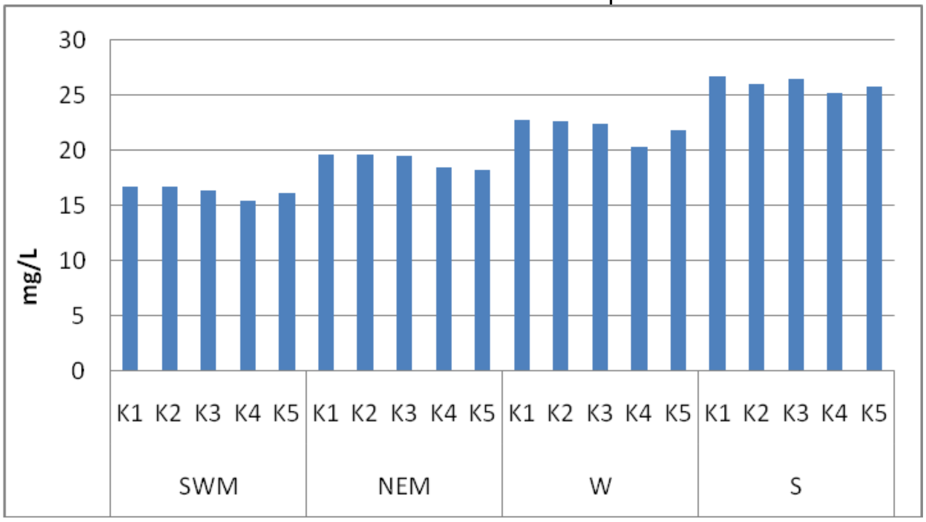


Chart – 12:Sulphate in water of Koothapar wetland

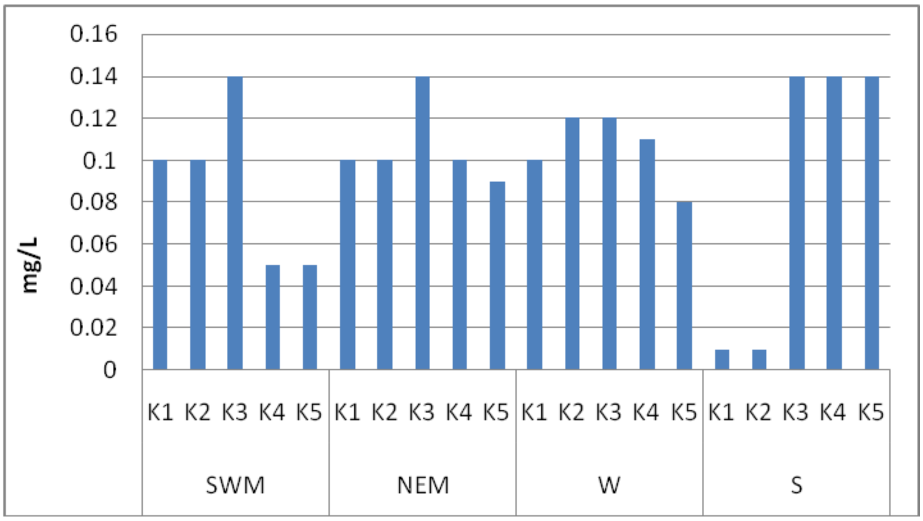


Chart – 13:Iron in water of Koothapar wetland

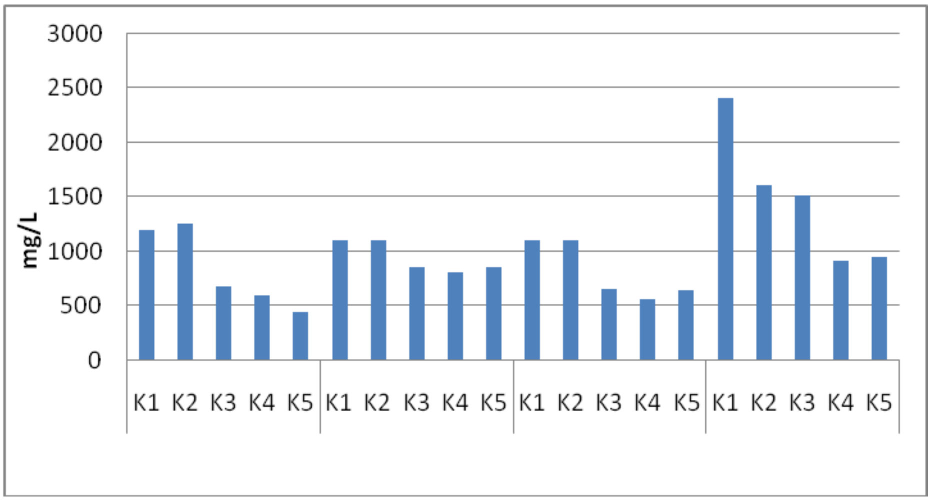


Chart – 14:Total Coliform in water of Koothapar wetland

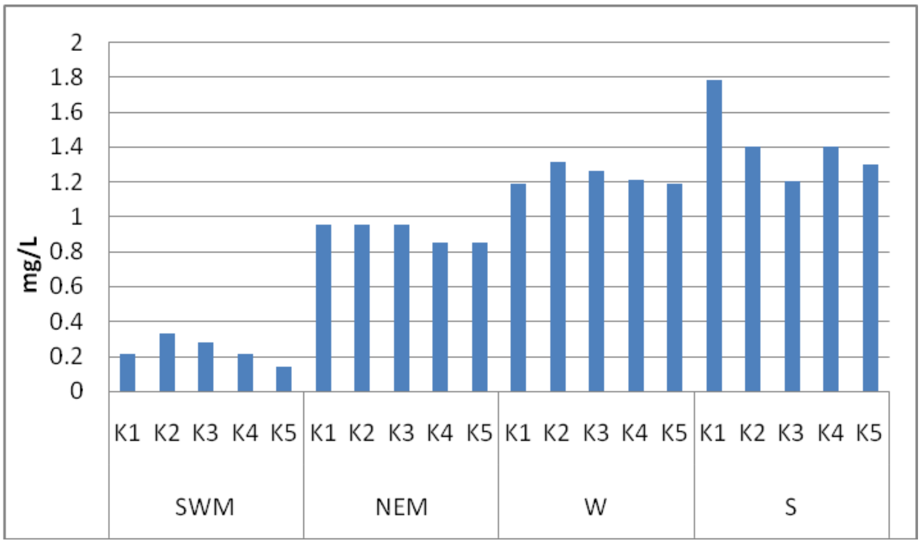


Chart – 15:Phosphate in water of Koothapar wetland

Most of the water samples were found to exceed the standard limits. It indicated severe pollution in all the seasons. Water in K1station during summer season followed by NEM was severely polluted than others.

In K1 station, DO was recorded as very low and progressively increased in downward stations of K2, K3, K4 and K5 respectively. EC, TDS, TH, BOD, Chloride, Calcium, Magnesium and TC exceeded the standards in K1 station and regressed in downward stations. The high EC, TDS, TH, BOD, Chloride, Calcium, Magnesium and TC and low DOandpHon surface water indicate severe pollution. It could due to continuous mixing of domestic sewage, industrial effluent and agricultural run-off[16-30].

The direct impact of Uyyakondan channel water and mixing of sewage from the local area may be attributed to pollution of the K1 station. Uyyakondan channel has been reported to severely polluted in due to irregular addition of domestic sewage, agricultural run-off, industrial wastes and other wastes that are let into the channel through drains without any proper treatment[31, 27].

Water in K4 and K5 stations during all the seasons were found to be less polluted. As water enters through the inlet and spreads, the natural process may improve the water quality [32, 33].*Eichorniacrassipes* was the dominant macroflora covering the wetland indicates high level of the pollution. Phosphate content more than 0.50 mg/L was observed in all the samples except that in SWM. This can lead to eutrophication [34, 35, 36].

During the NEM, heavy rains occur between October and December. This may increase more pollution to the wetland due to mixing of local run-off. Whereas, in summer, low availability of water due to evaporative loss / no inflow of water may result in severe pollution of the wetland. During all the seasons, Total Coliform count exceeded the standard limits. Presence of Coliforms in water is the indication of fecal contamination by mixing of domestic sewage and open defecation near the wetland [20].

Discharge of sewage, open defecation and solid waste dumping were the major human activities observed in and around the wetland.

Table 1: Correlation Co-efficient of water quality parameters in Koothapar wetland during SWM

	pH	EC	TDS	TH	DO	BOD	Cl^-	F^-	NO_3^-	SO_4^{3-}	Ca^{2+}	Mg^{2+}	Fe	TC
pH	1													
EC	-.936*	1												
TDS	-.997**	.953*	1											
T. H	-.943*	.834	.939*	1										
DO	.937*	-.821	-.937*	-.990**	1									
BOD	-.981**	.938*	.991**	.943*	-.956*	1								
Cl	-.532	.685	.563	.254	-.295	.556	1							
F	-.888*	.992**	.912*	.774	-.764	.903*	.729	1						
NO_3^-	-.727	.629	.742	.890*	-.914*	.803	.045	.588	1					
SO_4^{3-}	-.775	.715	.742	.748	-.655	.657	.173	.650	.417	1				
Ca^{2+}	-.738	.639	.700	.758	-.665	.620	.031	.562	.462	.988**	1			
Mg^{2+}	-.926*	.862	.904*	.807	-.764	.838	.521	.804	.453	.898*	.848	1		
Fe	-.522	.754	.543	.397	-.323	.491	.534	.793	.177	.633	.532	.584	1	
TC	-.967**	.877	.955*	.850	-.849	.922*	.609	.822	.565	.746	.698	.954*	.439	1

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Table 2:Correlation Co-efficient of water quality parameters in Koothapar wetland during NEM

	pH	EC	TDS	TH	DO	BOD	Cl^-	F^-	NO_3^-	SO_4^{3-}	Ca^{2+}	Mg^{2+}	Fe	TC
pH	1													
EC	-.915*	1												
TDS	-.963**	.938*	1											
T.H	-.689	.863	.757	1										
DO	.977**	-.873	-.976**	-.694	1									
BOD	-.042	-.347	-.051	-.406	-.146	1								
Cl	-.680	.355	.548	-.050	-.659	.574	1							
F	.055	.184	-.138	.102	.252	-.780	-.269	1						
NO_3^-	.678	-.451	-.716	-.377	.809	-.595	-.620	.771	1					
SO_4^{3-}	-.619	.863	.652	.918*	-.545	-.670	-.109	.481	-.051	1				
Ca^{2+}	-.648	.816	.750	.986**	-.688	-.346	-.086	-.037	-.454	.851	1			
Mg^{2+}	-.646	.789	.653	.964**	-.626	-.342	-.050	.173	-.298	.899*	.925*	1		
Fe	-.008	.202	-.106	.082	.199	-.699	-.155	.991**	.725	.460	-.069	.172	1	
TC	-.699	.832	.835	.926*	-.767	-.265	.032	-.183	-.591	.757	.965**	.806	-.216	1

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Table 3:Correlation Co-efficient of water quality parameters in Koothapar wetland during winter

	pH	EC	TDS	TH	DO	BOD	Cl^-	F^-	NO_3^-	SO_4^{3-}	Ca^{2+}	Mg^{2+}	Fe	TC
pH	1													
EC	.866	1												
TDS	-.832	-.762	1											
T.H	-.971**	-.775	.750	1										
DO	.940*	.978**	-.861	-.861	1									
BOD	-.791	-.571	.882*	.696	-.710	1								
Cl	.402	.687	-.054	-.363	.542	.128	1							
F	.770	.825	-.397	-.794	.781	-.229	.840	1						
NO_3^-	-.548	-.379	.593	.395	-.478	.872	.121	-.031	1					
SO_4^{3-}	-.664	-.432	.308	.616	-.491	.611	-.290	-.478	.736	1				
Ca^{2+}	-.877	-.579	.527	.922*	-.676	.644	-.300	-.711	.479	.826	1			
Mg^{2+}	-.439	-.066	.341	.622	-.212	.286	.245	-.277	-.114	.094	.583	1		
Fe	-.117	.236	.423	.106	.046	.631	.849	.520	.551	.113	.134	.374	1	
TC	-.899*	-.593	.603	.958*	-.703	.668	-.243	-.703	.431	.733	.987**	.681	.191	1

*.Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

The results of Pearson correlation matrix are presented in Tables 1 to 4. During summer and south west monsoon, there existed a high positive correlation between TDS and BOD. It indicates organic pollution during these two seasons. In Tamil Nadu, during summer and SWM, the water availability will be low when compared to NEM and winter. This has "concentrating effect" of the pollutants. The high BOD and TDS values in summer also support this.

During all the four seasons, positive correlation existed among total hardness, calcium and magnesium. It is obvious that total hardness is due to calcium and magnesium ions.In summer, there was a strong positive correlation between Total Coliform and BOD. Presence of Coliform is due to fecal contamination. BOD is due to organic pollution including sewage. In summer the "concentrating effect" might have increased the Total Coliform count which could have resulted in high positive correlation between Total Coliform and BOD.

The positive correlation coefficients between total hardness, sulphate existed very strong during SWM, NEM and summer while it existed strongly in winter. It suggests that calcium and magnesium are present in the form of sulphates.

Table 4:Correlation Co-efficient of water quality parameters in Koothapar wetland during summer

	pH	EC	TDS	TH	DO	BOD	Cl^-	F^-	NO_3^-	SO_4^{3-}	Ca^{2+}	Mg^{2+}	Fe	TC
pH	1													
EC	-.956*	1												
TDS	-.932*	.825	1											
T.H	-.908*	.939*	.890*	1										
DO	.913*	-.783	-.995**	-.848	1									
BOD	-.960**	.884*	.982**	.916*	-.961**	1								
Cl	-.951*	.951*	.783	.809	-.753	.856	1							
F	-.966**	.872	.974**	.873	-.961**	.993**	.879*	1						
NO_3^-	-.971**	.879*	.926*	.824	-.930*	.915*	.897*	.937*	1					
SO_4^{3-}	-.740	.743	.708	.769	-.714	.643	.613	.620	.792	1				
Ca^{2+}	-.948*	.955*	.919*	.987**	-.877	.959**	.870	.929*	.862	.705	1			
Mg^{2+}	-.886*	.950*	.801	.949*	-.740	.884*	.870	.850	.752	.578	.968**	1		
Fe	.895*	-.912*	-.693	-.736	.657	-.791	-.988**	-.819	-.824	-.498	-.811	-.843	1	
TC	-.967**	.951*	.922*	.954*	-.903*	.923*	.875	.908*	.945*	.871	.952*	.872	-.793	1

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

4. CONCLUSION

Based on the above findings, it is concluded that the Koothapar wetland is facing severe pollution in all seasons. The water is not suitable for human consumption such as drinking and bathing etc., but it can be use for agricultural activities, animal propagations and recreational purposes. Hence, it is recommended that necessary action by the local government should be undertaken to protect this important wetland:

1. Prevention of pollution in Uyyakondan channel
2. Banning of solid wastes disposal near the wetland
3. Educating people to abstain from open defecation.

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