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THE EFFECT OF POLLUTION ON HYDROLOGICAL PARAMETERS ANALYSIS OF EAST KOLKATA WETLAND AREA

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ABSTRACT

The East Kolkata Wetland is famous for fishery activities and receives pollutants like heavy metal, oil, grease, solid wastes etc. through effluent of different industries like tannery, electroplating, plastic and dye industries of surroundings and alters the Ecosystem. In this study all the parameters of water collected from different bheris and jhils like pH, TDS, TSS. DO, BOD, COD, turbidity, concentration of chromium and nickel was checked. Qualitative and quantitative measurements are needed from time to time to constantly monitor the quality of water from the various sources of supply and it is supposed to meet drinking water standards if it is to be considered safe because contaminated water is the main cause for pathogen-loading of fish or vegetables, posing a serious health hazard to its consumer. After checking all the parameters it can be easily said that the water samples are not so good in quality and the samples also contain traces of heavy metal chromium and nickel.

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INTRODUCTION

Wetlands are basically transitional lands between terrestrial and aquatic systems where the water table is at or near the surface and the land may be covered by shallow water. These wetlands can maintain the food chain, ecological balance and absorbs pollution, treats sewage and also fulfills the requirement of fishes. The wetland of the east Kolkata is situated at 22°27' N, 88°27'E which is spread over 12,500 hectares and comprises a large number of water bodies distributed throughout the districts of South and North 24 Parganas (Bhattacharyya *et al.,* 2008., Mahapatra and Lakra, 2014). Previously the area was like an uncultivable ground but as fresh drainage water came out of Calcutta it became suitable for raising fish and other vegetables. Currently, this wetland contains nearly 300 fish farms and ponds which cover a total area of 3,500 hectares and some individual ponds of 70 hectares. 13,000 tons of fish are produced per day annually in this wetland. It also has 264 sewage-fed fisheries with large biodiversity (Kundu *et al.,* 2008., Dasgupta and Panigrahi, 2014). The tropical climate along with average rainfall makes the area a natural incubator for a diverse group of microbes, thus making it a biodiversity rich place. As EKW is the world's largest natural recycling center for soluble and solid wastes, it can be expected to be rich source of bioremediants as well as heavy metals discharged from industries as waste water. So there may be a great possibility of presence of heavy metals like chromium, nickel etc (Nandi *et al.,* 2013).

MATERIALS AND METHODS

SAMPLE COLLECTION

Water sample was collected from the East Kolkata Wetland area for two seasons, summer (March, 2016-September, 2016) and winter (October, 2016-February, 2017) respectively from Metropolitan khal (Fig. 2), Chilparajhil (Fig. 1), Mathpukurkhal (Fig. 4), Nunebheri 1 (Fig. 3), Nunebheri 2 (Fig. 6) and Fertilizer company waste water (Fig. 5).

Figure 1. Water sample collection spot - Chilpara jhil

Figure 2. Water sample collection spot - Mtropolitan khal

Figure 3. Water sample collection spot - Nune bheri 1

Figure 4. Water sample collection spot - Mathpukur Khal

Figure 5. Water sample collection spot - Fertilizer waste water

Figure 6. Water sample collection spot - Nune Bheri 2

WATER PARAMETER TESTS

Water parameter test was done to determine the amounts of mineral, organic substances, heavy metals present in the samples that effect water quality. pH (APHA, 2002), TDS (Total Dissolved Solid) (APHA, 2002), TSS (Total Suspended Solid) (APHA, 2002), DO (Dissolved Oxygen) (APHA, 2003), BOD (Biochemical Oxygen Demand) (APHA, 2002), COD(Chemical Oxygen Demand) (APHA, 2006), Amount of Chlorine (APHA, 2003) and Turbidity (APHA, 2002) measurement are some of the chemical tests and Total Plate Count and Coliform Bacterial test are some of the microbiological tests which were done for the six water samples of summer and winter.

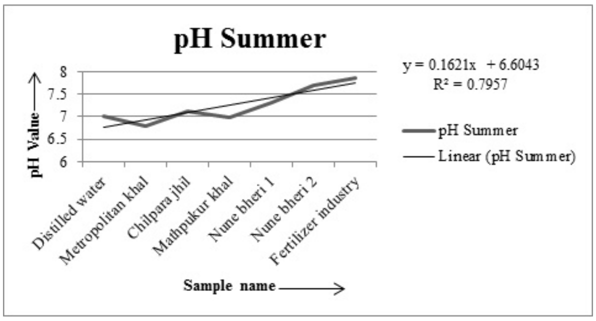

Figure 7. Trend line equation of pH values for all samples during summer season

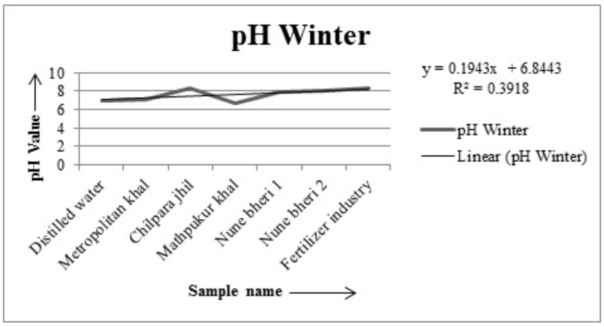

Figure 8. Trend line equation of pH value for all samples during winter season

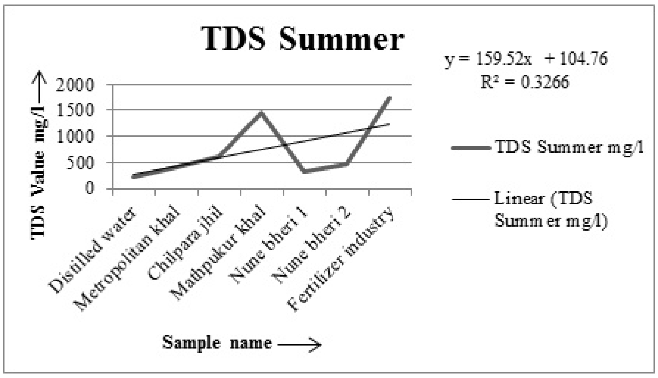

Figure 9. Trend line equation of TDS values for all samples during summer season

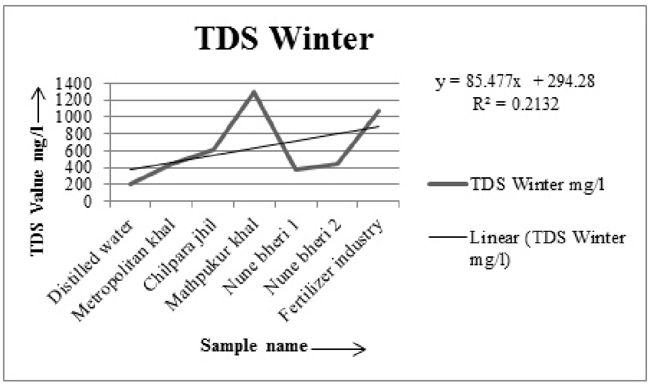

Figure 10. Trend line equation of TDS values for all samples during winter season

Also presence of heavy metals chromium and nickelwas checked by S-diphenylcarbazide (DPC) method (APHA, 1995) and dimethylglyoxime method (APHA, 1988) respectively (Sanyal *et al.,* 2015).

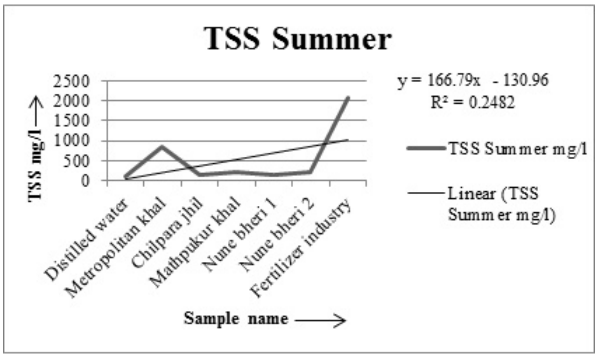

Figure 11. Trend line equation of TSS values for all samples during summer season

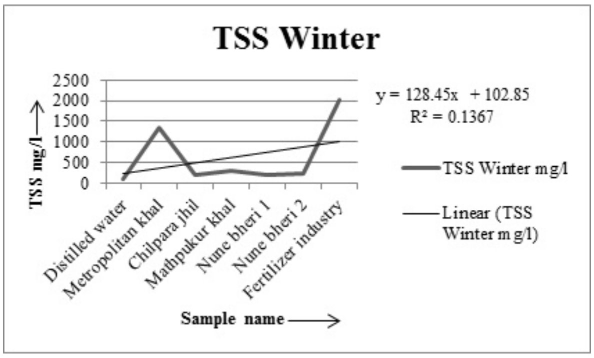

Figure 12: Trend line equation of TSS values for all samples during winter season

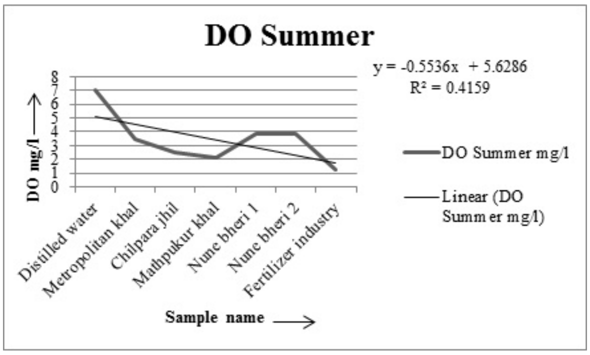

Figure 13. Trend line equation of DO values for all samples during summer season

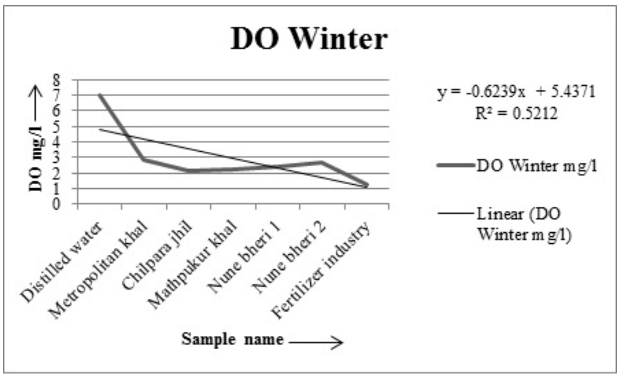

Figure 14. Trend line equation of DO values for all samples during winter season

STATISTICAL ANALYSIS

Trend line analysis was performed for each of the selected samples separately for two seasons (summer and winter) to evaluate the R^2 values. R^2values provides understanding about the level of significance of the linear trend line equations (Roy *et al.,* 2016).

RESULTS

CHEMICAL TEST

pH: For summer season all the seven samples are nearly neutral but the waste water of fertilizer industry can be said as basic in nature. On the other hand all the pH values have increased except Mathpukurkhal and all the samples are showing nearly basic nature. So it can be easily said that pH value of all the samples are high in winter season. All the pH values were analyzed for the trend line equation which reflects the equation to be y = 0.1621x + 6.6043, R^2= 0.7957during summer (Fig: 7) and y = 0.1943x + 6.8443, R^2 = 0.3918 during winter (Fig:8). Due to climate change the R^2 values of summer and winter were observed to be slightly different from each other.

Total Dissolved Solid: Total dissolved solid of the seven samples for both the seasons were checked, where the amount of solid is very high in the fertilizer industry waste water and mathpukurkhal in summer and winter respectively.The TDS values of the seven samples were analyzed for the trend line equation which reflects the equation to be y = 159.52x + 104.76, R^2 = 0.3266 during summer (Fig: 9) and y = 85.477x + 294.28, R^2 = 0.2132 during winter (Fig:10). Here also the R^2 value of summer is not much higher from winter, thus climate change is not a big factor affecting the R^2 values.

Total Suspended Solid: The amount of Total suspended solid of the seven samples for both the seasons showed high amount of solid in the fertilizer industry waste water for both the seasons. The TSS values of the seven samples were analyzed for the trend line equation which reflects the equation to be y = 166.79x-130.96, R^2 = 0.2482during summer (Fig: 11) and y = 128.45x + 102.85, R^2 = 0.1367 during winter (Fig: 12). Here also the R^2 value of summer is not much higher from winter, thus climate change is not a big factor affecting the R^2 values.

Dissolved Oxygen: From the observed results it can be concluded that the DO value of Fertilizer industry waste water is very low hence the water quality is very poor and aquatic lives can not survive in this environment. The DO value of NuneBheri is near to 4mg/l but not so good in respect to aquatic lives. The DO values of the seven samples were analyzed for the trend line equation which reflects the equation to be y = -0.5536x + 5.6286, R^2 = 0.4159 during summer (Fig: 13) and y = -0.6239x + 5.4371, R^2 = 0.5212 during winter (Fig: 14). Here the R^2 value of winter is not much higher from summer, thus climate change is not a big factor affecting the R^2 values.

Biological Oxygen Demand: According to the results BOD value is very high in the fertilizer industry and it can be concluded that the water quality is very poor.The BOD values of the seven samples were analyzed for the trend line equation which reflects the equation to be y = 3.4286x + 5, R^2 = 0.3235 during summer (Fig: 15) and y = 1.6429x + 16.571, R^2 = 0.058 during winter (Fig: 16). Here the R^2 value of summer is much higher from winter, thus climate change is a big factor affecting the R^2 values.

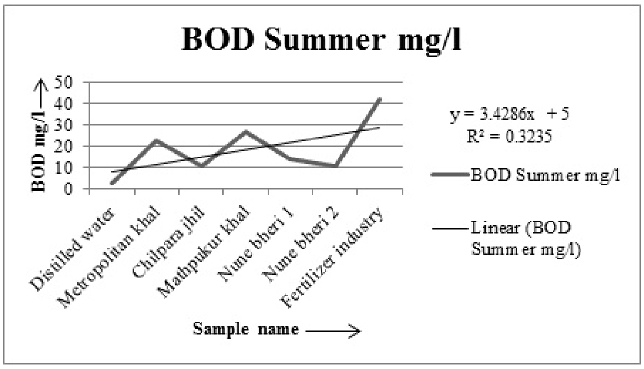

Figure 15. Trend line equation of BOD values for all samples during summer season

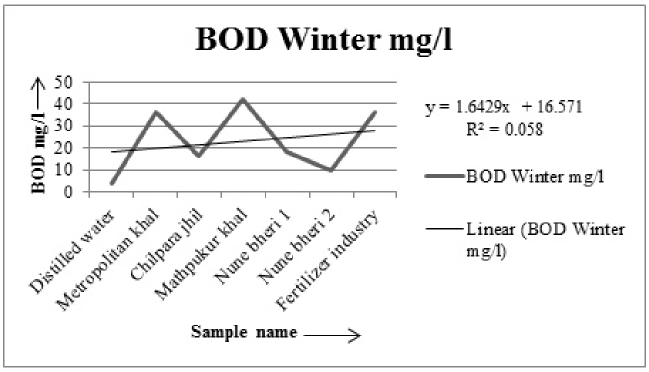

Figure 16. Trend line equation of BOD values for all samples during winter season

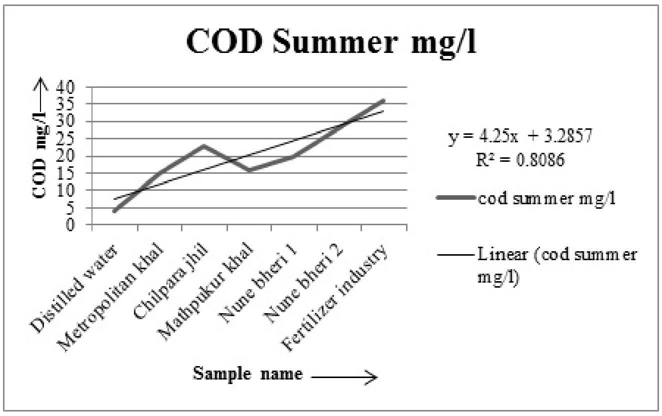

Figure 17. Trend line equation of COD values for all samples during summer season

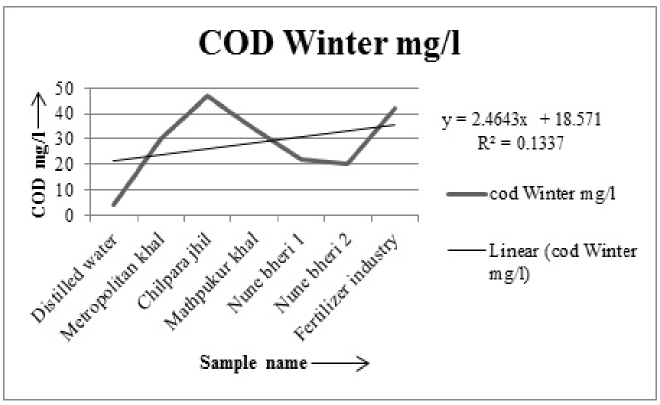

Figure 18. Trend line equation of COD values for all samples during winter season

Chemical Oxygen Demand: The COD value for summer season is very high in fertilizer industry and in Metropolitan khal respectively whereas for the winter season it is high in fertilizer industry and Mathpukurkhal. The COD values of the seven samples were analyzed for the trend line equation which reflects the equation to be $y = 4.525x + 3.2857$, $R^2 = 0.8086$ during summer (Fig: 17) and $y = 2.4643 + 18.571$, $R^2 = 0.1337$ during winter (Fig: 18). Due to climate change the R^2 values of summer and winter were observed to be different from each other, thus the climate change is a factor affecting R^2value.

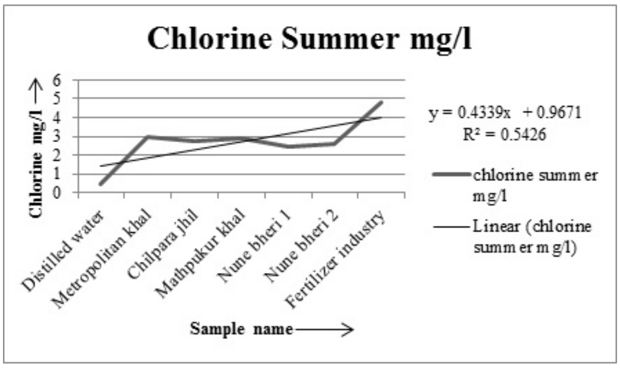

Figure 19. Trend line equation of Chlorine test for all samples during winter season

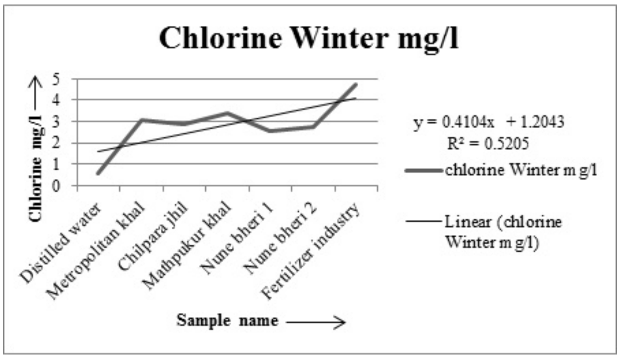

Figure 20. Trend line equation of Chlorine test for all samples during winter season

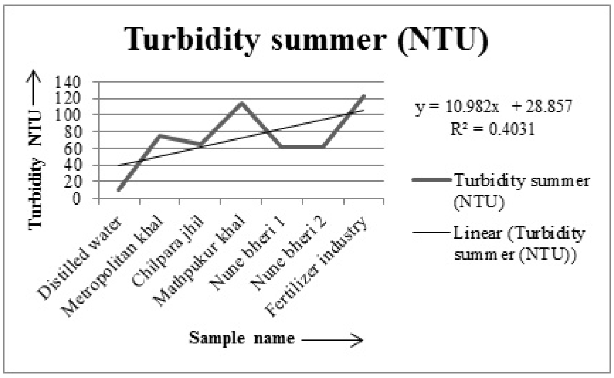

Figure 21. Trend line equation of Turbidity test for all samples during summer season

Residual chlorine test: In water sample the amount of residual chlorine should be 0.2mg/l but tables below shows high amount of chlorine in Metropolitan khal in summer and Mathpukurkhal in winter season. Not only these two all the samples except distilled water shows high concentration of chlorine. The chlorine values of the seven samples were analyzed for the trend line equation which reflects the equation to be $y = 0.4339x + 0.9671$, $R^2 = 0.5426$during summer (Fig: 19) and $y = 0.4104x + 1.2043$, $R^2 = 0.5205$ during winter (Fig: 20). Here the R^2 value of summer is not much higher from winter, thus climate change is not a big factor affecting the R^2 values.

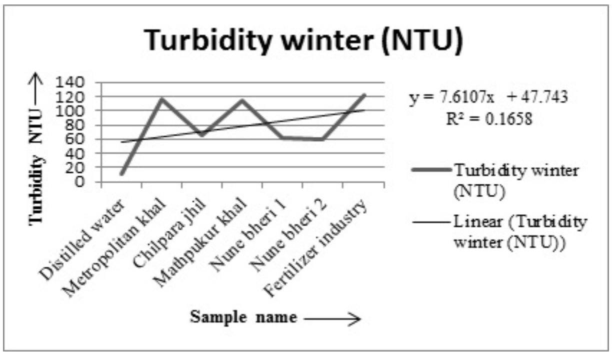

Figure 22. Trend line equation of Turbidity test for all samples during winter season

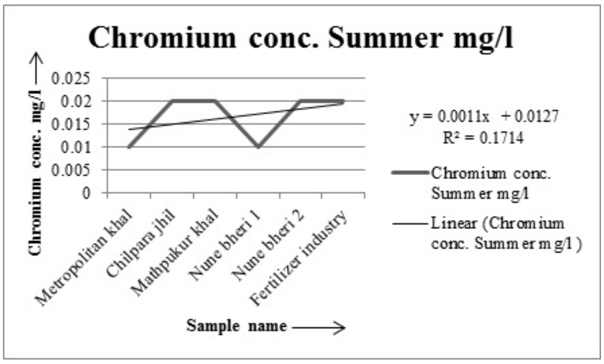

Figure 23. Trend line equation of chromium concentration for all samples during summer season

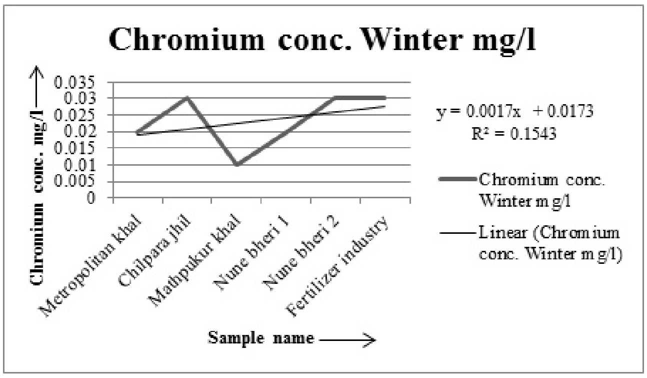

Figure 24. Trend line equation of chromium concentration for all samples during winter season

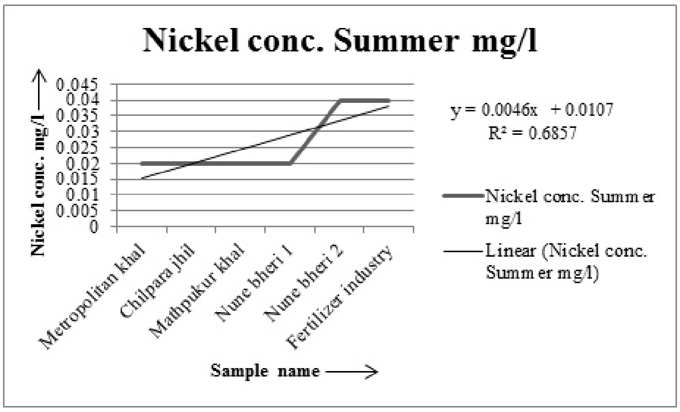

Figure 25. Trend line equation of nickel concentration for all samples during summer season

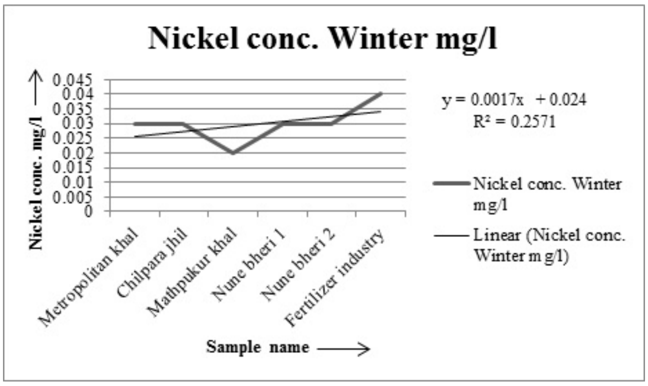

Figure 26. Trend line equation of nickel concentration for all samples during winter season

Turbidity: From the following graph it can be easily seen that for summer season the value of turbidity is high in mathpukurkhal and in winter season Metropolitan khal respectively.The Turbidity values of the seven samples were analyzed for the trend line equation which reflects the equation to be $y = 10.982x + 28.857$, $R^2 = 0.4031$ during summer (Fig: 21) and $y = 7.6107x + 47.743$, $R^2 = 0.1658$ during winter (Fig: 22). Here the R^2 value of winter is slightly lower from summer, thus climate change is not a big factor affecting the R^2 values.

Assay of chromium and nickel concentration: Among the examined samples high concentration of chromium was observed in Chilparajhil and mathpukurkhal for summer and winter respectively. On the other hand for all the samples nickel concentration was higher than chromium and among them fertilizer industry showed higher concentration for both the seasons. The chromium values of the seven samples were analyzed for thetrend line equation which reflects the equation to be $y = 0.0011x + 0.0127$, $R^2 = 0.1714$ during summer (Fig: 23) and $y = 0.0017x + 0.0173$, $R^2 = 0.1543$ during winter (Fig: 24). Due to climate change the R^2 values of summer and winter were observed to be slightly different from each other.
The nickel values of the seven samples were analyzed for the trend line equation which reflects the equation to be $y = 0.0046x + 0.0107$, $R^2 = 0.6857$during summer (Fig: 25) and $y = 0.0017x + 0.024$, $R^2 = 0.2571$ during winter (Fig: 26). Due to climate change the R^2 values of summer and winter were observed to be slightly different from each other.

Conclusion

The Kolkata Municipal Corporation area generates roughly 600 million litres of sewage and waste water every day and more than 2500 metric tonnes of garbage daily. All the six samples were collected from the East Kolkata Wetland area in two different seasons, i.e summer and winter. The present study clearly reflects the gradual increment of all the water parameter in the three samples, i.e Metropolitan khal, Chilparajhil and Nunebheri 1. have increased in winter than summer. In the aquatic phase of the selected sampling station which may be attributed to increase of municipal wastes and agricultural runoff also for all the samples there is huge difference between the R square values of summer and winter in BOD and COD tests. The value is higher in summer than winter. The Water samples also showed traces of heavy metals chromium and nickel because of the waste water which gets released from the industries and other solid wastes as this is also a big dumping ground of Kolkata. These pollutions causing serious ecological problems and its removal from the waste waters are serious issues now days. Thus, control of waste generation at the point sources and recycling of the nutrients through pisciculture and agricultural activities may serve to suppress the increasing trend to water pollution with seasonal variation in the present geographical area.

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