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Pollution status of Gandha Nallaha with reference to effluents discharged from small scale industries of Kalpi, Jalaun (U.P.)

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Abstract
This paper presents the Physico-chemical characteristics of water of Ganda Nallaha of Kalpi City receiving waste waters of many small scale industries. The water samples were collected from two sites and were analyzed and compared with the Indian EPA standards. The average Temperature, pH. TSS, TDS, DO, BOD, COD, Nitrate, Sulphate and Chloride were 25.95 mg/l, 6.9 mg/l, 198.5 mg/l, 625 mg/l, 4.1 mg/l, 156.5 mg/l, 332.5 mg/l, 80.0 mg/l, 73.5 mg/l, 228.5 mg/l, respectively. The heavy metals like chromium, lead, nickel, copper, zinc and cadmium were also present in the water of Ganda Nallaha but within the permissible limit. The high BOD, COD and TSS contribute to the decrease in oxygen supply in the receiving water and increases organic pollutants. The acidic water should ensure that their waste effluents released into water bodies do not cause detrimental effects.

Keywords: Ganda Nallaha, industrial waste water, Physico-chemical parameters, heavy metals

Introduction
Water occupies about 71% of the earth's surface and only 2.5% of this amount can be considered as freshwater. However, these limited freshwater resources are under threat from the pollution, chiefly generated by human factors. The agricultural sector, industrial production, mining, power generation and other factors are some of the contributors to the pollution of water bodies, which will eventually affect humans in general (UN-Water, 2001) [13].

Water pollution is the change in physico-chemical and biological properties of water quality that is harmful to living things. It is caused by pollutants drawn from point and non-point sources of pollution including industrial and agricultural effluents. It can also be attributed to inappropriate use of chemicals and haphazard disposal of waste. Industrial effluents are major contributors to a variety of water pollution problems. Most cities of developing countries like India generate on an average 30-70 mm^3 of wastewater per person per year. Owing to lack of or improper wastewater treatment facilities, wastewater as industrial effluents and domestic waste are often discharged into fresh water bodies, resulting to aquatic pollution.

The poor quality of wastewater of industries is responsible for the degradation of the receiving water body (Afroz and Singh, 2014) [2]. The discharges from the industries constitute biohazard to man and other living organisms in the environment because they contain toxic substances detrimental to health. It influences the water quality and fish distribution (Prakash *et al.*, 2015; Verma and Praksh, 2016; Prakash and Verma, 2016; Verma, 2016a, 2016b, 2017) [10, 18, 11, 14, 16, 15]. Now it has become a global concern due to the lethal and sub lethal effects on fauna and flora. So, industrial effluent should be treated efficiently prior to discharge into water bodies to avoid adverse health risk of the user of these water resources and the aquatic ecosystem. The release of raw and improperly treated wastewater onto water courses has both short- and long-term effects on the environment and human health.

It is truly stated that the Ganda Nallaha is a highly polluted lotic freshwater body because it receives huge amount of untreated industrial effluents from various small scale industries especially handmade paper mills and domestic sewage waste water, automobile washing waste etc. from different sites, therefore, the aim of present study was evaluated the physico-chemical characteristics of water of Ganda Nallaha to know the pollution status. The result of the present study provide baseline information for aware the people and government to take action for treatment of the polluted water of Ganda Nallaha.

Materials and Methods

Study area: The present study area, Kalpi is a historical city of district Jalaun of Uttar Pradesh located in between Jhansi and Kanpur on NH-25 lies to the south east bank of Yamuna and falls under 260 7' 14" N latitude to 790 44' 59" E longitude with an average elevation of 112 meters. Ganda Nallah is a polluted small perennial lotic fresh water body of Kalpi U.P. (India). Now a day Ganda Nallaha is more polluted because it receives huge amount of effluents released from various small scale industries especially handmade paper mills. After travelling a distance of about 5 km., it ultimately joins the river Yamuna.

The water sample were collected from two site of Ganda Nallaha in glass stopper bottle. The selected sites were

Site 1: Point of emerging of Ganda Nallaha from Kalpi city.

Site 2: Point of discharge of Ganda Nallaha into Yamuna River near the Kalpi.

The collected samples were transported immediately to the laboratory for the estimation of physico-chemical properties of sample water. The collected samples were analyzed for temperature, pH. Dissolved oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen demand (COD) and TSS, TDS, DO, BOD, COD, Nitrate, Sulphate, chloride and heavy metals like chromium, lead, nickel, copper, zinc & cadmium by following standard methods given by APHA (2005) [4].

Site 1: Point of emerging of Ganda Nallaha from Kalpi city.

Site 2: Point of discharge of Ganda Nallaha into Yamuna River near the Kalpi

Results and Discussion

The samples collected from both sites of Ganda Nallaha were subjected to physicochemical characterization for parameters such as Temperature, pH, TSS, TDS, DO, BOD, COD, nitrate, sulphate, chloride and heavy metals as per standard methods. The mean values and standard deviation of studied physicochemical parameters of the Ganda Nallaha are presented in Table 1.

Table 1: Physico-chemical characteristics of water sample (N=3) of Ganda Nallaha

Parameters	Study Sites (Mean ± SD)			Permissible Limit EPA, India
	Site 1	Site 2	Average	
Temperature (ºC)	26.52±1.5	25.38±1.33	25.95	-
pH	6.7±1,3	7.1±1.4	6.9	5.5-9.0
TSS (mg/l)	202±2.5	195±2.4	198.5	100
TDS (mg/l)	632±3.5	618±2.8	625	-
Dissolved Oxygen (mg/l)	3.4±1.4	4.8±1.2	4.1	-
BOD (mg/l)	168±4.5	145±4.0	156.5	30-50
COD (mg/l)	440±4.5	225±3.5	332.5	250
Nitrate (mg/l)	85.0±2.5	75.0±1.5	80.0	50.0
Sulphate (mg/l)	75.0±3.5	72.0±3.4	73.5	2.0
Chloride (mg/l)	245±3.4	212±2.4	228.5	250
Chromium (mg/l)	0.0078±0.992	0.0070±0.921	0.0074	3.0
Nickel (mg/l)	0.00411±0.22	0.00370±0.14	0.00391	2.0
Lead (mg/l)	0.00009±012	0.00005±0.23	0.00007	-
Copper (mg/l)	0.0014±0.11	0.0010±0.12	0.0012	0.1
Zinc (mg/l)	0.0027±0.21	0.0019±0.20	0.0023	-
Cadmium (mg/l)	0.00003±0.12	0.00001±0.13	0.00002	-

Temperature: The water temperature is one of the most important physical characteristics of aquatic ecosystem, as it affects the organisms (Sankpal and Naikwade, 2012) [12]. Increase in temperature also increases the rate of microbial activity. Temperature increase may become the barrier to fish migration and in this way seriously effect on reproduction of species. In the present study, waste water temperature was recorded in range of 26.52±1.5 ºC to 25.38±1.33 ºC with an average water temperature 25.95 ºC. Temperature of waste water is commonly high because of addition of warm water from industrial activities (Mohan *et al*., 2013) [8].

pH: The pH value is a measure of acidity and alkalinity of water sample and help to determining the efficiency of treatment plant of any industry. Effluent of different small scale industries of Kalpi city are discharged into Ganda Nallaha may have both acidic and alkaline nature. In this study, the nature of Ganda Nallaha water was acidic in nature with the average value of pH 6.9 and the range from 6.7 to 7.1.

TSS: The suspended solids determination is particularly useful in the analysis of waste waters and it is used to evaluate the strength of domestic waste water and efficiency of treatment plant. Suspended solids containing much organic matter may cause putrefaction and consequently the stream may be devoid of dissolved oxygen (Verma and Saksena, 2010) [19]. In the present study the average value of TSS was 198.5 mg/l that is higher than the permissible Limit EPA, India.

TDS: The amount of salt content in water is a measure for salinity. A large number of salts are found dissolved in natural waters, the common ones are carbonates, bicarbonates,

chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron, and manganese, etc. A high content of dissolved solid elements affects the density of water, influences osmoregulation of freshwater organisms, reduces solubility of gases (like oxygen) and utility, of water for drinking, irrigational, and industrial purposes. Waters can be classified based on the concentration of TDS as, desirable for drinking (up to 500 mg/L), permissible for drinking (up to 1,000 mg/L), useful for irrigation (up to 2,000 mg/L), not useful for drinking and irrigation (above 3,000 mg/L) (Lokhande, *et al*. 2011) [7]. In the present study the average total dissolved salts (TDS) is 625 mg/l which was higher than the desirable limit of drinking water.

BOD: The average biological oxygen demand (BOD) values for Ganda Nallah was 156.5 mg/l, while the EPA standard. The high BOD values are attributed to the discharge of industrial effluent with high levels of organic compounds. Monney *et al*. (2013) [9] reported that BOD concentration has direct influence on dissolved oxygen content of water body. The impact of releasing effluents with high BOD concentrations into water bodies is anaerobic conditions which could influence an aquatic environment, leading to fatality of aquatic animals, stench and unpleasant environmental imbalances and disturbances. It is important here to note that low BOD content is an indicator of good quality water, while a high BOD indicates polluted (poor quality) water. In this study the effluents from the factories caused highly pollution in the water.

COD: Chemical Oxygen Demand (COD) determination measures the oxygen equivalent of that portion of an organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. The average COD values for Ganda Nallaha was 332.5 mg/l. Comparing these values to the standard EPA value of 250 mg/L, COD measure of effluent in the receiving waters from the many small factories is very high. This shows that effluents of the factories contain high oxidable organic materials. The use of organic raw materials like fatty acids, surfactants, glycerine, phenolic compounds, polyalcohols, nitrogenous and phosphorus compounds and colorants in soap formulation, lead to the production of excess organic and mineral matter waste. When such effluents are discharged into streams, the consequences are that they impair light penetration, oxygen depletion and leads to reduction in photosynthesis in plant. The fauna and flora are thus affected adversely.

Nitrate: The average nitrate level for Ganda Nallaha was 80.0 mg/l while the standard allowable EPA value is 50 mg/L showing that moderate amounts of nitrate are released into the environment by these small scale industries. High levels of nitrate could lead to the development of a condition that doctors call methemoglobinemia (Irick, 2014) [6]. The condition is also called blue baby syndrome because the skin appears blue gray or lavender in colour and also causes the death of fishes in water. According to Aboyeji (2013) [1], nitrate is relatively nontoxic for fish health, except when the concentration of nitrate exceeds 90 mg/L in water.

Sulphate: The mean values of sulphate for Ganda Nallaha was 73.50 mg/l. These values when compared to EPA value of 2.0 mg/L showed that sulphate level from these industries choke the water body, and use up large amounts of precious oxygen.

Chloride: The average chloride content for Ganda Nallaha was 228.5 mg/l. comparing these values to the EPA permissible value for chloride (i.e. 250 mg/L), the obtained chloride values in this study is within acceptable levels. The implication is that the chloride levels in the effluents from the all the factories might not pose risk to the water quality as far as plants, animals and humans who depend upon the receiving water are concerned.

Heavy Metals: The average values of heavy metals in the sample of Ganda Nallaha ranged as follows: Chromium (0.0074 mg/l), Nickel (0.00391 mg/l), Lead (0.00014 mg/l), Copper (0.0012 mg/l), Zinc (0.0023 mg/l) and Cadmium (0.00002 mg/l). These values of heavy metals are within the permissible limits of drinking water but these are potentially toxic and in long term they accumulate in the tissues and may be harmful. According to Amomeso *et al*., (2010) [3] the heavy metals have been associated with the industrial effluents and linked with the heavy metal contamination of an area to industrial effluent discharge.

Conclusion

Based on present findings, it could be concluded that measured parameters such as BOD, COD, TSS nitrate and sulphate, for the combined effluents of small scale industries were above the EPA standard. pH of the water of Ganda Nallaha was acidic or near to neutral and within the acceptable limits. Also, the high amount of nitrate could affect the hatching and growth rates of fishes hence reducing their population. As observed by Hanson *et al*. (2007) [5] polluted waters could affect the reproduction rate adversely in fishes. The high BOD, COD and TSS contribute to the decrease in oxygen supply in the receiving water and increases organic pollutants. The acidic water should ensure that their waste effluents released into water bodies do not cause detrimental effects. Also, EPA and other environmental agencies should intensify their monitoring on industries to ensure that their wastes are well treated before discharge into the environment.

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