

Study of Impact of Climate Change in Respect of Water Pollution of Gandak River at Sonapur

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Abstract – Water quality and ecological assorted variety and climatic changes of aquatic greenery with respect to distribution in active channels and on banks of the rivers Ghaghara and Gandak have been researched in years 2011–2012. The land use/land spread guide of year 2010 demonstrated rural land as the dominant class in both river basins. The examination of aquatic verdure has shown that the dominant plant species in numbers are as per the following: macrophytic green growth, aquatic angiosperms, aquatic pteridophytes, sedges, grasses, spices, bushes, climbers and trees gathered from the banks and active channels of rivers Ghaghara and Gandak. Altogether, 207 plants species were accounted for as basic in both river situations, and the rest of the species have demonstrated variability for the two rivers. It was seen that the algal gathering demonstrated higher species decent variety in comparison to other plant gatherings. High numbers of macrophytic species were seen because of the soluble pH and great degree of dissolved oxygen at different sampling locales of the two rivers. Further, multivariate statistical strategies, for example, group analysis and principal part/factor analysis were applied to satisfy the knowledge hole and to recognize the potential sources and types of contaminations.

Keywords: Gandak River Water, Environmental Pollution, Heavy Metals Contamination. Water Quality Index, Correlation Matrix

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INTRODUCTION

Water Resources

The concept of water resources is multidimensional. It isn't limited distinctly to its physical measure (hydro logical and hydro geological), the 'flows and stocks', however encompasses other more qualitative, environmental and financial measurements.

Rivers and Streams

Rivers and streams spread the globe and go through each country, giving drinking water and recreational areas for swimming, drifting and fishing. Precipitation and liquefying snow consistently replenish these waterways. In any case, climate patterns impact water depth. Serious droughts evaporate rivers, while a lot of precipitation can cause flooding when the water overflows a river's banks. Since rivers and streams cross national boundaries, water rights stay a subject of political debate and strife.

Lakes

Lakes are natural or man-made discouragements on the surface of land that hold water. Natural lakes

happen because of geological processes, for example, weathering and disintegration. Man-made lakes, likewise called reservoirs, happen when people dam up rivers and streams or divert the progression of these waterways so as to contain a lot of water in one region.

WATER SHORTAGES

Water shortages might be brought about by climate change, for example, modified climate patterns including droughts or floods, expanded pollution, and expanded human interest and overuse of water. A water emergency is where the accessible potable, unpolluted water inside a region is not as much as that region's interest. Water shortage includes water stress, water deficiency or deficits, and water emergency.

WATER POLLUTION

Water pollution is an intense problem in India which is the second most crowded country on the planet. It is estimated that over 70% of all India's surface water is dirtied somehow or another and a significant number of the groundwater holds have additionally been sullied because of biological and

modern contaminations. In India, water law is made of different components. It incorporates international arrangements, government and state Acts. It additionally incorporates a number of less proper game plans, including water and water-related strategies just as customary principles and regulations.

Uttar Pradesh and Bihar are the two thickly populated conditions of India with around one-fourth of the complete populace of the country (Census of India 2011). Rivers, for example, Ghaghara and Gandak are supporting huge human settle ments. During the previous twenty years, anthropological exercises, for example, setting up of spontaneous little and huge ventures, widening of parkways, dam development, tree cutting and excessive water abstraction for irrigation have been intense and have significantly affected the water quality of the rivers and in this manner the aquatic decent variety

River Water Pollution

The vast majority of the Indian rivers and their tributaries viz., Ganges, Yamuna, Godavari, Krishna, Sone, Cauvery Damodar and Brahmaputra are accounted for to be horribly contaminated because of discharge of untreated sewage disposal and mechanical effluents legitimately into the rivers. These squanders ordinarily contain a wide assortment of organic and inorganic contaminations including solvents, oils, oil, plastics, plasticizers, phenols, heavy metals, pesticides and suspended solids. The aimless unloading and arrival of squanders containing the previously mentioned risky substances into rivers may prompt environmental disturbance which could be considered as a potential source of stress to biotic community

The vast majority of the above qualities were found either beneath or shut as far as possible set by World Health Organization (WHO) and United State Public Health Survcies (USPHS). Water Quality Index (WQI) was ranged between 76-85 which shows that the water quality is acceptable. Correlation analysis among all considered Physico-chemical parameters and heavy metals shows great correlation with one another in both the years. The information produced may provide helpful data to Governmental offices to control the heavy metal pollution of the river at these urban centers which may even be most noticeably awful in future situation. The present exploratory information demonstrates that the pollution level along the river Gandak isn't extremely high however the expanding populace load in the bowl may cause hopeless ecological damage in the great danger.

The set of experiences proposes that numerous incredible human civilizations have begun close to rivers (Singh et al. 2015). Rivers uphold a tremendous biodiversity of widely varied vegetation and provide food and natural surroundings to aquatic

lives and humans, and henceforth, they keep up the ecological balance of the earth. For the most part, because of remarkable populace growth, non-arranged and unma-naged modern and agrarian improvement in the flood plain of rivers, a dangerous atmospheric devation and climate change which are additionally expected to upset the balance of water supply and request (Haddeland et al. 2014), the ecological supportability of rivers is in extraordinary peril.

Water quality of the River Gandak has been inspected in unique reference to Physico-chemical properties and seven heavy metals to be specific cobalt (Co), copper (Cu), chromium (Cr), nickel (Ni), cadmium (Cd), zinc (Zn), lead (Pb), and on occasional reason for two consecutive years 2014-15 and 2015-16. Tests were gathered from five stations in particular Bagaha, Sangrmpur, Sahibganj and Sonpur Bridge. The estimation of measured physico-chemical parameters were as per the following; Temperature (22.2-26.6 °C), pH (8.1-8.3), Total Dissolved Solids (109-219 mg/l), Alkalinity (74-129mg/l), Sulfate (15.4-25.75), phosphate (0.05-0.10mg/l), Total hardness (135-164mg/l), Chloride (3.56-6.36), Nitrate (0.16-0.44mg/l), Dessedved Oxygen (5.6-8.7 mg/l), Biological Oxygen Demond (1.67-2.73 mg/l) and Chemical Oxygen Demond (8.70-17.43mg/l). The least convergence of Co, Cu, Cr, Ni, Cd, Zn, Pb and was recorded as 0.008, 0.017, 0.002, 0.008, 0.004, 0.021 and 0.004 mg/l respectively while the maximum worth was recorded 0.018, 0.025, 0.004, 0.019, 0.034, 0.096, and 0.026 mg/l respectively at different destinations in surface water of the river Gandak

KINDS OF WATER POLLUTION

Surface Water Pollution Surface water pollution is the most obvious type of pollution and we can see it floating on our waters in lakes, streams, and seas.

Groundwater Pollution This sort of pollution is turning out to be increasingly more significant on the grounds that it influences our drinking water and the aquifers beneath the dirt.

Microbial Pollution Microbiological pollution is the natural type of water pollution that is brought about by microorganisms in uncured water.

Oxygen Depletion Pollution Microorganisms that flourish in water feed on biodegradable substances. When there is a deluge of biodegradable material from such things as waste or disintegration from cultivating, the numbers of these microorganisms increment and use the obtainable oxygen.

Chemical Pollution Because of the nature of industry nowadays and the large scale manufacturing in mechanical plants and farms, we have a ton of chemical run-off that flows into the close by rivers and water sources. Metals and solvents flow out of plants and into the water, polluting

CLIMATE CHANGE IMPACT

Tending to the impact of climate change on water availability and economy. Analysis of situations for impacts on resources and use is needed to assess water approaches. India's water emergency is predominantly a man made problem. India's climate isn't especially dry, nor is it ailing in rivers and groundwater. Very helpless management, hazy laws, government corruption, and mechanical and human waste have caused this water supply crunch and delivered what water is accessible basically futile because of the huge amount of pollution. In overseeing water resources, the Indian government must balance contending requests among urban and country, rich and poor, the economy and the earth. In any case, since people have set off this emergency, by changing their activities they have the power to prevent water shortage from destroying India's populace, agriculture, and economy

MEANING OF WATER QUALITY

Water quality is a complex subject, which includes physical, chemical, hydro logical and biological attributes of water and their complex and fragile relations. From the client's point of view, the expression "water quality" is characterized as "those physical, chemical or biological attributes of water by which the client assesses the adequacy of water". For instance for drinking water ought to be unadulterated, healthy, and potable. Similarly, for irrigation dissolved solids and toxicants are important, for outdoor bathing pathogens are important and water quality is controlled accordingly. Textiles, paper, brewing, and dozens of other industries using water, have their specific water quality needs.

Temperature: The temperature of the water is measured for several reasons. To start with, it decides the sorts of creatures that can make due in a stream.

Dissolved oxygen: Scientists measure dissolved oxygen, or DO (articulated dee-gracious). This discloses to them how much oxygen is accessible in the water for fish and other aquatic organisms to breathe.

Nutrient: Similarly as nutrients are critical for growth of the human creatures, they are critical to plants and creatures.

Toxic Substances: Scientists additionally test for some harmful (toxic) things like metal, pesticides, and oil. For instance, scientists are discovering mercury in specific types of fish, particularly in lakes and estuaries.

REVIEW OF LITERATURE

(Tripathi et al., 2013). Crude agricultural practice is considered as an important source of water pollution. Pesticides in river water have been detected by Blanchard and Lerch (2000).

(Galiulin et al., 2014). Herbicides utilized in agriculture were likewise distinguished in river water. The above has demonstrated positive test for the presence of enormous number of pesticides and heavy metals in grains, organic products, vegetables and milk. These components would have reached to such target legitimately or by implication and gathered due to bio magnification. Stays of memorial service fire (consuming of dead bodies) increases organic matter in river

(Kumar, et al., 2011) have concentrated on the River Yamuna. It is the biggest feeder of the river Ganga. It was additionally uncovered that specific stretches of River are generally contaminated because of different urban centers are arranged on the banks of Yamuna River and withdraw new river water for different exercises. The whole urban centers situated on the banks arranged off their loss into the river. The goal of the checking reads attempted for water body is to survey variation in water quality with time. Ten sampling stations were chosen along the river for sampling reason from January to June; 2010. Water examples were investigated as far as physicochemical parameters viz. Temperature, conductivity, DO, BOD, COD, alkalinity, all out hardness, Cl-and F-. The estimations of these parameters show that Yamuna River is moderately contaminated under the investigation zone.

(Krishnaram, et al., 2017) have revealed that the pH scope of 6.7 to 8.4 is viewed as safe for aquatic life to keep up productivity and pH underneath for 4.0 or more 9.6 discovered hazardous to life

(Handa, et al., 2013). They revealed a maximum grouping of 6.1 mg/l phosphate in a burrowed well of patwari of Rampur area in Uttar Pradesh. The sources of contamination were distinguished to be aimless utilization of phosphate fertilizers and sewage disposal on land surface.

(Sharma and Sharma, 2016) have examined the physico-chemical properties of homegrown sewage effluents arranged off in the river streams around Indore and Ujjain region of MP. The outcomes demonstrated that the salt burden was in the middle of 815 $\mu\text{S}/\text{cm}$ and 3530 $\mu\text{S}/\text{cm}$. Sewage effluents likewise demonstrated the higher BOD

over the BIS the BIS standard. All out practical count, E. coli and coliform count M/I were highest in the post rainstorm season and ranged from 1000 to 45000 3000 to 62500. Such waters are non-potable. Despite the fact that, the effluents contain heavy metals Pb, Co, Cr and Cd and proper weakening can make them worth utilizing in rural fields to limit its hazardous impact. Album content was discovered to be over as far as possible

(Ayachit, et al., 2012) have watched the heavy metals contamination and its potential wellbeing risk with unique reference to Narmada River at Nimar Region of Madhya Pradesh. They inferred that the Narmada River shows a critical level of contamination of heavy metal (Cr, Fe, Li, Mo, Mg, and so forth.).

(Spiewak, 2011) has revealed Pesticides as a reason for word related skin sickness in ranchers. Most pesticides related dermatoses are contact dermatitis, both allergic and irritant. They also suffer from skin hypo pigmentation, nail and hair disorders, erythema, multiforme, chloracne, porphyria, cutaneatarda, urticarial; nail dystrophy, skin cancer.

OBJECTIVES OF THE STUDY

1. To study the impact of climate change in respect of water pollution of gandak river
2. To study on kinds of water pollution and water quality

RESEARCH METHODOLOGY

MATERIALS AND METHOD

Study Area

The river Gandak a left bank major tributeries of Ganga, is an aggregate name of seven rivers, Milamchi, Bhotia, Gandak, Tamba Gandak, Likhu, Dudh Gandak, Arun and Tambur. River Arun is known as Pengehun in Tibet, starts, at an elevation of 7,000m Gosaithan run in the Himalaya, flow South-West of Sapu up to 320 km. The Gandak bowl lies between 85° E to 89° E longitudes and 25° 20'N to 29° N scopes. The all out seepage zone of the Gandak River is 74,500 sq. km out of which 11,000 sq. km lie in India, and is second just to that of Brahmaputra. It is a lasting stream whose three principle tributaries, the Sun Gandak from the west, the Arun from the north, and the Tamur from the east meet at Tribeni to shape the Sapt Gandak. These three huge tributeries depleting Mt Averest and Kanchenjunga in east Nepal join north of the Mahabharata range and structure the Gandak

Water sampling procedures

The intermittent samplings were done in rainstorm, winter and summer seasons (with three imitates) in two consecutive years 2013-2014 and 2014-2015. The site of sampling is chosen randomly by thinking about the populace, area and source of pollutions. There were five sampling stations were chosen for the examination proposes. River water tests were gathered at depths changing from 15 to 30 cm with the assistance of a water sampler which comprised of a glass bottle and a cord attached to a top. The entire assembly was brought into water down to the ideal depths and the cord of the top was pulled and delivered just when uprooted air bubble stopped to rise to the top. The entire assembly was withdrawn and the water was then transferred into pre-cleaned polypropylene bottles. All the containers which utilized in sampling intentions were completely washed and flushed with 10% HNO₃ following by double distilled water. The bottles were occupied leaving no air space, and afterward the jug was sealed to prevent any spillage. Every container was unmistakably set apart with the name and address of the sampling station, test portrayal and date of sampling. All the systems were embraced according to the standard methods recommended by APHA, (1985)

Analysis of Physico-chemical Parameters of Water Samples

The water samples were broke down for different parameters in the research facility of Botany Department, University of Allahabad. The standard methods recommended by APHA, AWWA, WPCF (1985) were received for determination of different physico-chemical parameters. Temperature, pH, Dissolved Oxygen (DO), Electrical Conductivity (EC), Alkalinity, and Total Dissolved Solids (TDS) were measured utilizing water analysis unit model ITS-701. All parameters multiprobes of the pack were adjusted together utilizing similar standards and systems.

STATISTICAL AND COMPUTATIONAL ANALYSIS

Mean

For an informational index, the mean is the aggregate of the perceptions separated by the number of perceptions. It identifies the central location of the data, sometimes referred to in English as the average. The mean is calculated by stat software Statistica 8 using, and the following formula

$$\Sigma(X) M = N$$

Where Σ = Sum of

X = Individual data points

N = Sample size (number of data points)

Water Quality Index (WQI)

A regularly utilized water quality index (WQI) was created by the National Sanitation Foundation (NSF) in 1970 (Brown and others, 1970). The NSF WQI was developed to provide a standardized method for comparing the water quality of various bodies of water. It is a 100 point scale that summarizes results from a total of nine different physico-chemical measurements completed by the data taken from the analysis of undertaken rivers water

DATA ANALYSIS

Water quality assessment

The mean values of different measured physico-chemical parameters are introduced in Table 1, and their permissible cutoff points for drinking/irrigational purposes (Tomas-zewicz 1988). Water temperature controls not just the growth, condition and endurance of biota, yet it likewise influences the rates and event of biological processes. The normal temperature of rivers Ghaghara and Gandak shows seasonal variability at different areas consistently. River Ghaghara had mean maximum temperature of 24.36°C at site 4 and 23.37°C at site 5 out of 2011 and 2012, respectively, while the mean minimum temperature was found as 19.46°C at site 1 and 20.67°C at site 2 out of 2011 and 2012, respectively, as appeared in Table 2. Be that as it may, River Gandak had a normal maximum temperature of 26°C at site 3 and 26.9°C at site 5 of every 2011 and 2012, respectively, while the normal least temperature was discovered to be 23.27°C and 22.67°C at site 1 in River Gandak in 2011 and 2012, respectively, as appeared in Table 2. The temperature variations at different locales in the two rivers are represented by fluctuation in water flow, biotic and abiotic parameters.

Radiation at the surface and conduction to or from the air and encompassing substrate control the temperature of rivers. Shallow streams are regularly very much mixed and primary tain a moderately uniform temperature, while deeper, sluggish water systems may show temperature delineation between the surface and base. Spring-took care of systems show little variation, as spring water starts from groundwater sources, which are frequently extremely near ambient temperature. The amount of concealing, climate and elevation can likewise impact the temperature of rivers. The gum based paint ture scope of River Narmada is from 27.6°C to

38.4°C as reported by Opute (1991), which uncovers the variability of temperature in this river system

Table 1 Physico-chemical parameters are presented from river Ghagra and river Gandak

| Parameter | Date | 2011 | | 2012 | | 2011 | | 2012 | | Mean | SD | CV | |
|-----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------|------|
| | | Site 1 | Site 2 | Site 3 | Site 4 | Site 1 | Site 2 | Site 3 | Site 4 | | | | |
| Temp (°C) | Max | 24.36 | 23.37 | 24.36 | 23.37 | 24.36 | 23.37 | 24.36 | 23.37 | 24.36 | 23.37 | 0.00 | 0.00 |
| | Min | 19.46 | 20.67 | 19.46 | 20.67 | 19.46 | 20.67 | 19.46 | 20.67 | 19.46 | 20.67 | 0.00 | 0.00 |
| pH | Max | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 0.00 | 0.00 |
| | Min | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 0.00 | 0.00 |
| DO (mg/L) | Max | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 0.00 | 0.00 |
| | Min | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 0.00 | 0.00 |
| TSS (mg/L) | Max | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 0.00 | 0.00 |
| | Min | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 0.00 | 0.00 |
| Hardness (mg/L) | Max | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 0.00 | 0.00 |
| | Min | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 0.00 | 0.00 |
| Chloride (mg/L) | Max | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 0.00 | 0.00 |
| | Min | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 0.00 | 0.00 |
| Sulphate (mg/L) | Max | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 0.00 | 0.00 |
| | Min | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 0.00 | 0.00 |

CONCLUSION

We observed in this examination that the investigation territory has less modern exercises. The water quality outcomes show a sound floristic assemblage in the two rivers. Algal gatherings show greater variability in comparison to the plant gatherings. Tiny fish diversity was discovered to be extensively less around the center and lower stretches of the rivers; the tiny fish diversity and bounty rely upon an assortment of factors, one of them may be anthropo-genic degradation. The LULC map shows that the most dominant LULC classification is rural land. The presence of maximum numbers of macrophytic species was reported because of the antacid pH and great degree of DO at different locales of the rivers Ghaghara and Gandak, and enormous abstraction of water influences the macrophytic species. Lesser number of full scale phytes was recorded from the locales where NO₃-3 and PO₃-4 was in limited amount. Along these lines, the change in water quality and large scale phytic diversity because of water admission point eventually influences the aquatic vegetation in the examined rivers. Further investi-gation identified with the sort of species of ions and its part in the distribution of aquatic vegetation should be done in detail.

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