Analysis of Physicochemical Parameters of Sewage Water body Sabella Talab used for Irrigation in District Dungarpur, Rajasthan

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Abstract: This study was carried out to investigate the physicochemical parameters of the sewage water body, which used to irrigate villagers' farmlands in Dungarpur. Sewage water was collected seasonally from the Sabella Talab from selected sampling sites. Temperature (23 – 25 ºC), pH (8.5 above), turbidity (2.4-15), total dissolved solids (1130-1700), total hardness (340 mg/L – 380 mg/L), alkalinity (270 mgCaCO3/L – 400 mgCaCO3/L), nitrate (11.0, 17.0 and 38.0 ppm), chloride (320, 370 and 700 mg/L), Magnesium hardness (70, 100 and 120), calcium hardness(200 during rainy month, 140 in winter and 70 in summer), fluoride (0.38, 030 and 0.45 ppm) were determined in sewage water samples in the study areas. In Gap Sagar samples, the temperature was similar to other water bodies but water was highly turbid in the rainy season. Alkalinity was comparatively low in the rainy season but similar values were recorded in winter and summer. All the physicochemical parameters determined were within FAO/WHO standard limits for irrigation water except for hardness and nitrate. The high values of these three parameters obtained from the study areas may indicate that the sewage water samples contain more plant nutrients than the Gap Sagar water sample, where these values were all lower than the permissible limits. It may also indicate a higher pollution level compared to the Gap Sagar.

Keywords: Dungarpur, Irrigation. Physicochemical parameters, Sewage water.

1. INTRODUCTION

Sewage contains essential nutrients that enhances soil fertility and plants growth. However, the impacts of such activity on environment and human health are a matter of concern and thus it has been identified as an area of study. Besides providing supplemental irrigation, sewage water has been reported as a useful source of plant nutrients particularly the nitrogen, phosphorous and organic matter for improved fertility and physical properties of soil (Nauman and Khalid, 2010 and Gibbs *et al*., 2006). However, besides these beneficial effects, wastewater often contains appreciable amounts of organic and inorganic toxic materials. The organic pollutants being biodegradable are less persistent, and presumably have transient and less serious effects in soil environment as they eventually metabolize to carbon dioxide and other simpler products. The inorganic substances, such as heavy metals are often present in substantial quantities chelated by the organic matter in sewage water (Nauman and Khalid, 2010). Crop production involves a complex interaction between the environment, soil parameters, and nutrient dynamics. Failure to understand these complexities has resulted in lack of good crop production and management techniques; hence agricultural production has tended to be low (Ololade *et al*., 2010)

The Sabella Pond of Dungarpur city has spread over an area of about 32 hectares. Dungarpur bypass road in the north and west of the pond located near Sabella bypass, agricultural land in the east and residential area in the south. Its watershed area is 3.25 sq. km. Its attractions that nestle on its lakeside and a good variety of migratory birds that considers this location as their home. Here site is established and large number of sewage cannels pours their content in it. Water is used for the irrigation, animal washing, as well as human purpose. Overflow of Gap Sagar reaches to this pond during heavy rainfall.

In the present study, physicochemical characterization namely, Temperature, pH, hardness, alkalinity, nitrate and phosphate were determined in sewage water in the Sabella and Gap Sagar.

The study of sewage which is used for irrigation in Surpur and Rajpur villages in Dungarpur, possess great significance due to its adverse effects on irrigated field, farmers exposed directly with this activity and consumers eating crops grown from sewage irrigated field. Along with its application, the quality of sewage used for the irrigation is also utmost important as the inadequate quality of sewage

causes the deterioration in the quality of soils as well as the agricultural crops grown on such soils. The prolonged use of contaminated sewage results in soil hazards, toxicity to plants due to build-up of heavy metals, contamination of ground water and ultimately to the consumer's health. Hence, adequate water and irrigation management practices are required for sustainable use of sewage for irrigation. Thus, the specific objective of the study was to evaluate the physicochemical parameters of sewage water in Sabella Pond in order to find out its fertility level and\or suitability for crop production.

2. MATERIALS AND METHOD

Study area - Total Area Of = 33.11 Catchment Area/Zone of Influence of Sabella Talab Wetland falling within the boundary limit of Dungarpur, Rajasthan.

Activities in Sabella Wetland: -

1. Fisheries; 2. Plying of boats; 3. Desilting; 4. Construction of temporary structures; 5. Water extraction for certain purposes.

Gap Sagar - It is getting perpetually polluted from the fugitive wastewater from the town. Algae, water hyacinth, lotus and water lilies are seen on one side of the lake with the other side quite neat.

Samples Collection, storage and Pre-treatment

Water samples were collected in HDPE (High-density polyethylene) screw capped bottles and stored at 4°C until further analysis. Samples for microbiological analysis were collected in sterile bottles, stored at 4°C and utilized within 4 hours of collection. Samples were collected in sufficient volumes from five sites in early hours of the day during every season, taking care to avoid spilling of water and air bubbling during sampling. Temperature, pH and conductivity were measured immediately

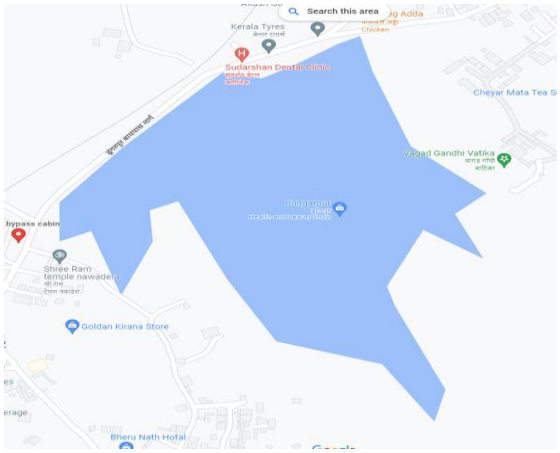

Figure 1- Sabella Talab
23°50'56.0"N 73°42'09.9"E

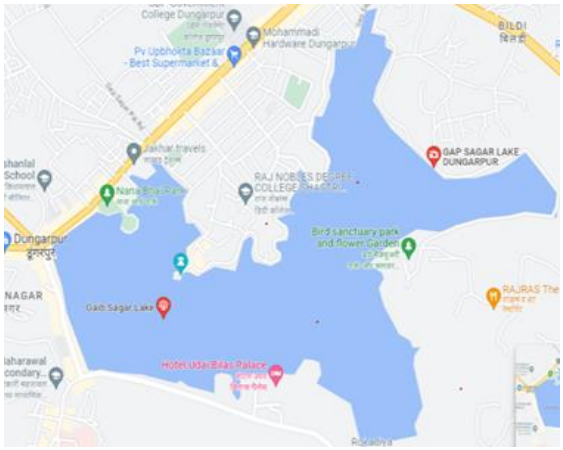

Figure 2- Gapsagar Lake
23°50'24.1"N 73°43'08.0"E

before acidifying with 1.5 cm3 concentrated HNO3/dm3 of sample (APHA, 1992). Collection time were the pre-monsoon (February to May), post-monsoon (October to January) and monsoon (June to September) seasons.

Precautions were taken while collecting the samples: The plastic bottles of 2-liter capacity were used for water sample collections

The stopper bottles containing samples was systematically labeled and tightly packed (no air space) and stored at a temperature between 6 to 100ºC for analysis of various physicochemical parameters within 72 hrs.

For *E.coli* analysis sample bottles transferred to the laboratory immediately.

The parameters such as Temperature, Colour, Odour was recorded immediately on the sites, as these factors are labile to change during the transport. Physical measurement and chemical analysis were carried out triplicate for each sample and the average values were recorded. The Guideline state that drinking-water must not contain waterborne pathogens. Most specifically, *E.coli* or thermotolerant coliforms should not be present in 100 ml samples of drinking-water at any time, for any type of water supply.

3. ANALYSIS PROCESS

Instrumental Analysis:

pH, TDS, salinity and turbidity were performed immediately after the samples reached the laboratory using standard methods (Dojlido and Best, 1993). pH

was measured with a calibrated Systronics, CL 361, India pH meter. Turbidity was measured with digital HANNA turbidity meter.

Titrimetric Analysis:

All the physico-chemical parameters were analyzed by the methods given by Trivedi and Goel (1992) and APHA (2005). Determination of residual chlorine, alkalinity, total hardness, calcium and chloride were performed using titrimetric methods described below (Chhabra, 2008 and Hossain, 2006). The instruments were calibrated before analysis for each parameter. All the stock solutions were prepared with double ionized distilled water. All the chemicals used for analysis were of analytical grade (Merck and BDH) and were used without any further purification.

Micro-Biological parameters: -

The microbiological parameters studied were pathogen detection, total coliform count and total viable count. Microbiological analysis of water samples was performed as described in Standard Methods for the Examination of Water and Wastewater (APHA - AWWA, 2005) and Chhabra, 2008). All chemicals and dehydrated culture microbiological media used in testing were of Merck Ltd.

Microbial parameters included Total Coliform (TC), *E. coli* test etc. In order to compare the treatment efficacy, water was also simultaneously tested for the same parameters. Water parameters varied significantly between spring and summer due to less dilution and concentration of organic substances, which support the growth, and multiplication of bacteria in winter. Microbial counts were typically high in the warmer months and decreased through winter, followed by a steady increase through the spring. While the Physicochemical parameters of treated water were within relevant guideline limits, microbial contamination levels in most of the samples exceeded the guideline values posing a risk of water borne diseases to consumers.

4. RESULTS AND DISCUSSION

Physicochemical Parameters of Sabella (Sewage) and Gap Sagar Water Samples The values of the physicochemical parameters observed may serve as an indicator of the fertility or pollution level of the study area sewage water as compared to the Gap Sagar clean water and international standards for water suitable for irrigation. The pH of the water is known to influence the availability of micro-nutrients as well as trace metals (Kirkham, 2006). Alkalinity measures the amount of carbonate in water and reflects the ability of water to neutralize the acidity of soil. Alkalinity also serves as pH reservoir for inorganic carbon. It is usually taken as a productive potential of water (Manahan, 1994). Alkalinity is an indicator of the ability of the sewage water to support algal growth. Determination of hardness helps to reveal the nature of the water to be classified as hard or soft. The NO3 -N and PO4 3- P values may imply fertility or otherwise of the sewage or clean water.

Sabella Talab sample exhibited no much variation in pH and temperature when compared to other stations, but, alkalinity, hardness, chloride, nitrate and TDS was distinctly higher. And microbiologically it was most contaminated in all the seasons. So, microbial and other load was very high in this talab. This was the most polluted and contaminated water body. pH in Sabella was found highest in winter and summer. Total alkalinities of water samples were found to be lowest in rainy season and highest in summer. Highest value in summer was recorded 400 mg/L as $CaCO_3$ in sample of Sabella talab. Still, it was lesser than the permissible limit of 600 mg/L. In Sabella talab highest value of total hardness was observed to be 380 (as $CaCO_3$) mg/L in summer, less in winter and least in rainy season. In Sabella Pond interestingly Calcium hardness value was highest in rainy season with substantial fluctuation in three different seasons. Magnesium hardness also displayed varied seasonal pattern of fluctuation and least magnesium value was shown in rainy season in all samples. Maximum magnesium hardness was recorded either in summer or in winter. In Sabella Pond the trend of seasonal fluctuation was just opposite to that of calcium hardness. Chloride value was found to be exceptionally high in Sabella Pond where it recorded the value of 700 mg/L. In rainy and winter season also the chloride value was greater than the highest seasonal value in any other water body. Maximum chloride value was noted in summer and minimum in rainy season. Still, it was within the prescribed acceptable limit. Highest Nitrates values were observed in Sabella Pond. These values were very much below the permissible limit. Maximum permissible limit of fluoride in drinking water is 1.5 mg/ L for drinking water. And, Dungarpur district is known for high fluoride values in ground water, but, in all these open water bodies the maximum fluoride

content was found to be as 0.5 mg/ml. The seasonal variations were also rather strange as the minimum of fluoride content were noted in winter and maximum in summer. samples recorded the highest fluoride in Sabella Pond. Total dissolved solids (TDS) were found to be as high as 1700 mg/L in summer in Sabella Pond. Maximum variation in TDS value was recorded in Sabella Pond. Total coliform value as illustrated in table-1 was the real matter of concern. It was from over 200 MPN/ 100 ml in winter to more than 1600 (over the measurable limit) in rainy season in three water bodies. Least coliform value was measured in winter and highest in rainy season.

Another reason for high pH values could be due to waste discharge from domestic waste and waste generated due to religious activities. This phenomenon was noted in Sabella talab where religious activity waste is disposed. The pH of water affects the solubility of many toxic and nutritive chemicals; therefore, the availability of these substances to aquatic organisms is affected. As acidity increases, most metals become more water soluble and more toxic. High value of pH may result due to waste discharge, microbial decomposition of organic matter in the water body **(**Patil *et al.*, 2012). The fluctuations in optimum pH ranges may lead to an increase or decrease in the toxicity of poisons in water bodies (Ali J., 1991). So, pH values recorded above 8.5 (noted in Sabella talab) is the matter of concern. Sabella talab receiving the discharge of waste and old city sewerage, used for animal bathing and fishing like activities, is rather most polluted among the surveyed reservoirs, hence the maximum total hardness registered at this pond may be associated with the polluting contaminants of water. Lack of water hardness has been associated with cardiovascular disease (Pruss-Ustun *et al.*, 2008) as drinking-water can be a contributor to calcium and magnesium intake that is why bottled and packaged waters can be naturally mineralized. High degree of hardness of drinking-water is not a major health concern; still, it is important for potability and aesthetic acceptability by consumers (WHO, 2017).

5. CONCLUSION

The wastewater which would have been disposed of in natural streams can be diverted for reuse for irrigation purposes, thus reducing the pollution load on the environment. Sewage is a good source for irrigation in water scare conditions. It has been reported that crop yield and productivity increase with the use of sewage for irrigation.

6. RECOMMENDATION

The higher values obtained for some physicochemical properties of sewage water revealed that Necessary mechanism should be put in place to monitor and evaluate periodically sewage water content used for irrigation purposes in order to prevent potential risk to the receiving soil and subsequent transfer to vegetables grown on such sewage water irrigated soils. Other sources of irrigation water like boreholes, tube wells should be developed by the farmers or be provided to the farmers by government and other environmentally concerned national/international organizations.

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8. ANNEXURE

Sabella Talab Images

Image :1

Image :2

Image :3

Image :4

Table 1: Sabella Talab Samples

S. No.	Parameter	Rainy season	Winter season	Summer season
1.	pH	7.60	8.40	9.00
2.	Turbidity (NTU)	15.0	2.4	2.9
3.	Temperature (˚C)	29.4	26.5	33.50
4.	Colour (Hazen Units)	N.O.	N.O.	N.O.
5.	Odour	N.O.	N.O.	N.O.
6.	Total Alkalinity (as $CaCO_3$), mg/l	270	350	400
7.	Total Hardness (as $CaCO_3$), mg/l	340	350	380
8.	Calcium Hardness (mg/l)	200	140	70
9.	Magnesium Hardness (mg/l)	140	210	310
10.	Chloride (as Cl^-), mg/l	320	370	700
11.	Nitrates (as NO_3^-), mg/l	11.00	17.00	38.00
12.	Fluoride (as F^-), mg/l	0.38	0.30	0.45
13.	Total Dissolved Solids, mg/l	1130	1220	1700
14.	Residual Chlorine (mg/l)	0.0	0.0	0.0
15.	Total Coliform Organism/100ml	>1600	900	1600
16.	E-coli Organism/100 ml.	500	240	300

Table 2: Gap Sagar Samples

S. No.	Parameter	Rainy season	Winter season	Summer season
1.	pH	7.80	8.0	8.40
2.	Turbidity (NTU)	19.2	2.6	3.7
3.	Temperature (˚C)	29.8	26.8	33.50
4.	Colour (Hazen Units)	N.O.	N.O.	N.O.
5.	Odour	N.O.	N.O.	N.O.
6.	Total Alkalinity (as $CaCO_3$), mg/l	100	220	250
7.	Total Hardness (as $CaCO_3$), mg/l	180	220	200
8.	Calcium Hardness (mg/l)	100	110	80
9.	Magnesium Hardness (mg/l)	80	110	120
10.	Chloride (as Cl^-), mg/l	120	140	200
11.	Nitrates (as NO_3^-), mg/l	5.00	7.00	18.00
12.	Fluoride (as F^-), mg/l	0.45	0.39	0.50
13.	Total Dissolved Solids, mg/l	510	580	940
14.	Residual Chlorine (mg/l)	0.0	0.0	0.0
15.	Total Coliform Organism/100ml	1600	900	900
16.	E-coli Organism/100 ml.	110	70	90

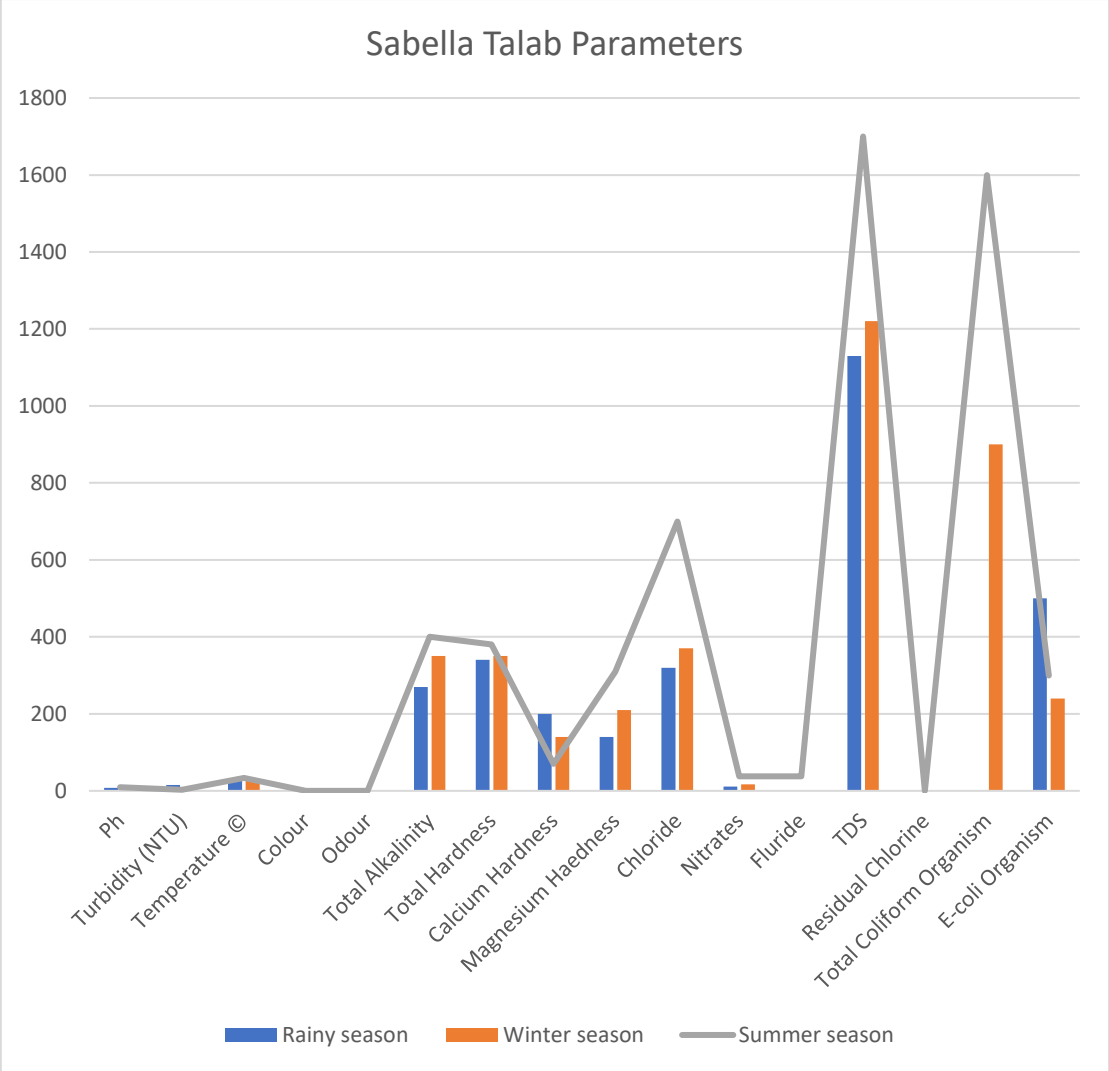

Figure 3. – Comparison Graph of Three Season in Sabella Talab