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RESEARCH ARTICLE

Evaluation of Water Quality Index for the Groundwater in region around Buddha Nallah, Punjab, India.

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Abstract

Buddha Nallah is a natural water stream. It passes through Ludhiana, which is industrial town of Punjab. Effluents from industries and domestic area joins stream and cause pollution. Pollution in stream leads to ground water pollution of nearby region. Study was conducted to evaluate water quality index (WQI) of ground water in region around Buddha Nallah in Punjab in districts Rupnagar and Ludhiana, India. Water quality index was determined by taking ground water samples from different sites during four different months over span of one year and analyzing the samples for various physico-chemical parameters. For evaluating WQI, eleven water quality features were studied; pH, total hardness, total dissolved solids, electric conductivity, calcium, magnesium, sodium, sulphate, phosphate, chloride and alkalinity. Results for WQI of samples studied varies from 49.83 to 224.96. Results clearly shows that in industrial town Ludhiana, ground water is polluted. WQI results were further used to predicting ground water quality of area studied.

Introduction:-

Ground water is used everywhere in various fields such as in industries, agriculture and domestic areas. Life is not imaginable on this planet deprived of water. It perform as a media for both chemical and biochemical reactions and also as an internal and external medium for several organisms (Rajankar*et al*., 2009). One third of population is using groundwater for drinking (Nickson*et al*., 2005).Population explosion, industrial revolution and agricultural revolutions leads to huge demand for fresh water during past decades. The reasons discussed above are not only responsible for demand for ground water, but also leads to ground water pollution. Various chemicals from industries and agricultural waste are entering in ground water and polluting it. Developing countries are more vulnerable to pollution as compared to developed countries due to lack to proper facilities. The fast growing municipal areas are effecting groundwater quality at higher rate due to over exploitation of resources and improper waste disposal practices (Mohrir*et al*.,2002).

Pollution also leads to health problem for people consuming polluted water. So water quality assessment and management is very much required in developing countries. Ground water is very precious resource, once polluted than it is very hard to restore it to original state. Quality assessment of ground water is the measurement of its usability for living beings and other purposes such as in agriculture and industries. In assessment and classification of ground water physico-chemical parameters are most significant. Deficiency or excessive consumption of nutrients present in drinking water leads to destructive effects on human health (Frengstad*et al*., 2001). According to Ahmad and Qadir(2011) poor quality of water have definite effect on health of consuming population. For any motive, which needed water, quality and class of water is most vital condition. In India groundwater is very significant source of drinking water. In India 90% of water supply to towns and cities is polluted and 1.6% of it is treated (CPCB, 2007). Water quality index is very significant and easy method to assess ground water quality. Results of WQI are easy to understand even by layman. Horten(1965) was first to propose concept of water quality index.

WQI can be defined as an index, which reflect the combined impact of various water quality factors and very significant tool to provide facts on water quality to inhabitants and policy makers (Ramakrishnaiah*et al.*, 2009). Present study was aimed at evaluating water quality index of ground water in region around Buddha Nallah, Punjab and estimating appropriateness of ground water for drinking and agricultural uses.

Material and Methods:-

Study area:-

The study area is located in Ludhiana and Rupnagar districts of Punjab, India. Buddha Nallah originates near village Raipur in district Rupnagar(30°54'23.9148"N and 76°23'34.3860"E) and runs through the Ludhiana city and joins river Sutlej near village Manewal (30°58'31.5768"N and 75°37'52.2516"E).It runs parallel to river Sutlej. Study area is shown in Fig. 1. Study area around the Buddha Nallah cover many villages and two towns (Ludhiana and Machhiwara). Major occupation of inhabitants is agriculture. Main crops of region are rice and wheat.In Machhiwara there are various industries such as textile, rice selling etc. Ludhiana is famous industrial town of Punjab. Major industries are chemical, oil, cotton, food, rice and leather processing in region. Every day massive amount of water is generated and dumped in Buddha Nallah.Waste from agricultural fields also join stream. Due to lack of proper facilities, along with surface water, ground water of area also get polluted.

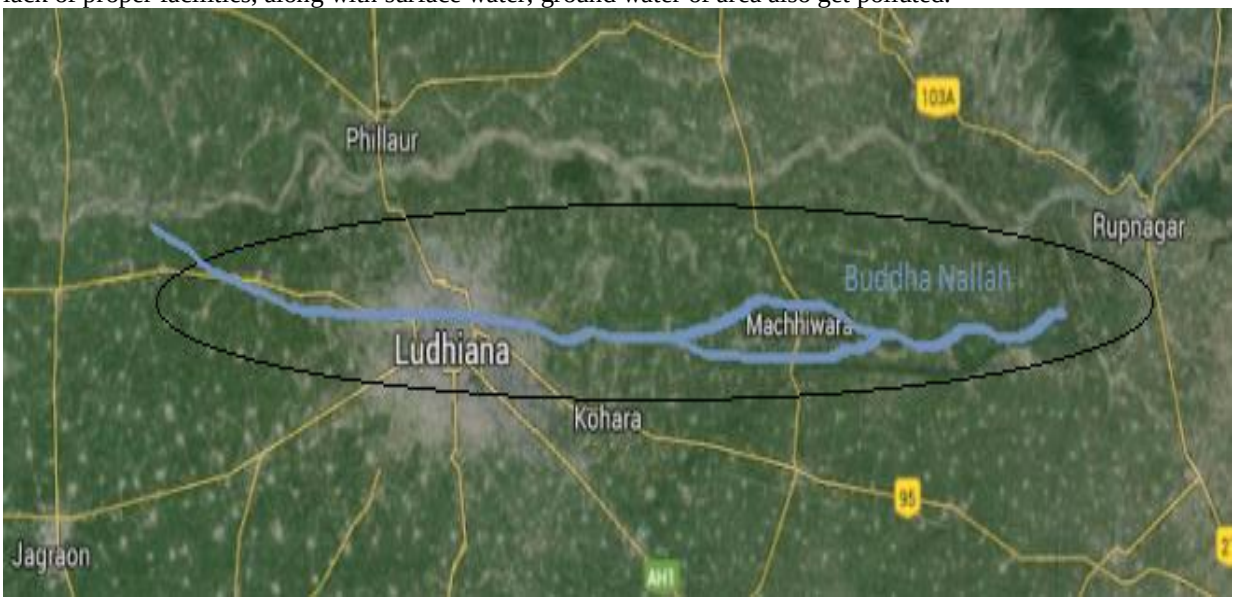

Fig 1: Location map of study area of present study.

Water sampling and analysis:-

40 Groundwater samples were taken from ten different sites during August 2013, November 2013, February 2014 and May 2014. Groundwater samples were analyzed for 11 physico-chemical parameters. Water quality parameters such as pH, total dissolved solids and electric conductivity were measures on the spot using water and soil analysis kit VSI007. Other parameters such as calcium, magnesium, sulphate, phosphate, sodium, chloride and alkalinity were determined using methods (APHA, 1995 and BIS) given in table 1.

Table 1: Methods used for physicochemical analysis of ground water samples.

S. No	Water quality parameter	Method
1	Total hardness	Titration method
2	Calcium	Titration method
3	Magnesium	Titration method
4	Alkalinity	Titration method
5	Sodium	Flame photometer method
6	Chloride	Titration method
7	Sulphate	Spectrophotometric method
8	Phosphate	Spectrophotometric method

Water quality index:-

Results obtained after physico-chemical analysis were used for calculation of water quality index. WQI was calculated by formula given by Tiwari *et al.* (1986) and Mohanta and Patra (2000).

$$WQI = \sum \text{qiwi}$$

Where,

$$\text{qi (water quality rating)} = 100 \times (\text{Va} - \text{Vi})/(\text{Vs} - \text{Vi})$$

Va is the actual value of parameter present in sample. Vi is ideal value. It is 0 for all the parameters except pH and dissolved oxygen. Vi for pH is 7 and for dissolved oxygen it is 14. Vs shown in formula is standard value of parameter (maximum permissible limit) given by regulating authorities. Wi is calculate by dividing K with Sn. Sn is number of parameters taken to calculate water quality index. K is calculated by equation written below.

K = 1/Vs1 + 1/Vs2 + 1/Vs3 + 1/Vs4…….. + 1/Vsn

Resulting values of WQI were further used to differentiate water quality indifferent categories using classification chart (Tiwari *et al.*, 2014) given in table 2.

Table 2: Water quality classification chart based on WQI value.

WQI value	Water quality
Less than 50	Excellent
50-100	Good
100-200	Poor
200-300	Very poor
More than 300	Unsuitable for consumption

Results and Discussion:-

WQI results of groundwater of study area are shown in Table 3. The values of parameter studied were average values from four sampling taken in different seasons. Least WQI value was calculated from water sample of site Raipur. At this site quality of water is excellent. Highest WQI value was calculate in water sample from site Manewal. Ground water of Manewal is of very poor quality and is unfit for human consumption. Results shows that 70% of study sites has pollution in ground water. It was noted that ground water taken from region around upstream of Buddha Nallah has better quality as compared to ground water samples from downstream area. Average WQI of study area is 138.68 which belong to water class poor. Singh *et al.* (2015) also studied water quality and reported value of water quality index within range of 29 to 139. Similarly Kavitha and Elangovan (2010) reported water quality index in range of 52 to 256.

Table 3: Water quality index of ground water of study area**.**

S.No	**Site**	**WQI**	**Water quality**
1	Raipur	49.83	Excellent
2	Birguru	64.36	Good
3	Behlolpur	89.76	Good
4	Machhiwara	107.79	Poor
5	Koom kalan	121.46	Poor
6	Dhanansu	152.15	Poor
7	Tajpur road	173.83	Poor
8	Salemtabri	183.97	Poor
9	Malakpur	218.69	Very poor
10	Manewal	224.96	Very poor

Conclusions:-

Water quality index at different sites ranged from 49.83 to 224.96. Results clearly shows that ground water of Ludhiana is very polluted and unfit for consumption. Main reason behind pollution of ground water is pollution in Buddha Nallah, which effect nearby ground water. Results shows that ground water of first three sites (Raipur, Birguru and Behlolpur) is suitable. After that in there was urban and industrial areas, and water was highly polluted.

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