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Ground Water Quality Test in Punjab Doaba Region

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Abstract: An increase in groundwater stress in Bist-Doab region of Punjab due to increase in irrigation demand, domestic requirement and reduction in surface water-bodies has caused a decline in groundwater level. These have resulted in a large amount of groundwater abstraction per unit area in central region of Bist-Doab, i.e., Jalandhar and Kapurthala districts. For improving the groundwater resources, it becomes vital to understand the availability of water resources and water level. In the present paper, an overview on groundwater resources in Beas-Sutlej Doab region is discussed. Groundwater is well thought-out to be the most vital natural and fresh resource on earth which is used for drinking and irrigation purposes. Groundwater quality studies become unavoidable since its poor quality may badly affect its users. Various processes affecting the water quality may be natural like evaporation and weathering and or anthropogenic like agricultural activities, domestic-industrial effluents and minor amount of atmospheric fallout. In this project we have analyses and tested the data for groundwater including its characteristic and constituents present in the water sample collected from the different districts of Doaba region, Punjab. We have performed experiments on the sample collected from the districts i.e. Jalandhar, Hoshiarpur, Nawanshehar and Kapurthala. The aim of the experiments was to find out the entity and quantity of constituents involved in the samples of ground water collected from these districts. The methodology followed in performing experiments were traditional laboratorial method consisting of tests performed on every individual constituent with regards to Physio-chemical, Heavy Metals, and Conductivity and for complete ingredients present in water sample collected.

Key Words: - ***Bist-Doab region, Groundwater level, Punjab.***

I. INTRODUCTION

Groundwater quality refers to the nature of water that is present beneath Earth's surface. Groundwater can found in cracks of the subsurface rocks and in between soil particles. Since many compounds can dissolve in water and others can be suspended in water, there is a potential for contamination with toxic compounds. These include petroleum, hydrocarbons(oil), pesticides, minerals, and disease-causing (pathogenic) microorganisms. Numerous epidemiological studies and outbreak investigations globally have found a direct association between poor water quality and infectious diarrhoea. This causal relationship has been documented from outbreaks in industrialized countries as well as from studies in developing countries where it is not only water contaminated at the source or during distribution that is an issue, but also water stored within the home which may become contaminated. Punjab literally meaning the Land of Five Rivers ('punj' means five and 'ab' Means Rivers) that refers to the rivers: Jhelum, Chenab, Ravi, Sutlej and Beas where by all are tributaries of the Indus River. The Bist-doab was expanding to farming area, increase in cropping usage, and use of high yielding chemical in filed, expansion in canal and well irrigated area. Bist-doab was the most exporter of food compared to all other state and was also name to the state as bread basket of India. The state occupies only 1.6% of India's land but, produces about 21% of India's wheat, 8.5% of its rice, and 7.5% of its cotton. Punjab has been able to improve agricultural output; its blind use has also led to some serious consequences like depletion in ground water level, deterioration of soil & water quality, soil salinity, water-logging and other environmental issues. Groundwater contamination is much higher than that of surface waters such as streams, rivers, and lakes because the contaminants have been percolated through the ground to reach the water. Nevertheless, contamination can occur, especially if there are cracks in overlying soil and rock through which the toxic compounds can more easily flow. Consumption of contaminated groundwater can be serious, especially if the water is supplied through untreated distribution system for drinking purposes. For example, the contamination of groundwater in parts of Bangladesh by naturally occurring arsenic. The increased use of the groundwater has increased the amount of this poisonous mineral leaching into the water from the surrounding ground. Tens of millions of people have been poisoned. Groundwater quality will become even more important as global climate change increases the frequency of drought in some areas of the world. And in addition when the surface water passes through the bed of rocks and soil it still

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www.ijprse.com

have some amount of substances that is harmful for when consumed for drinking purposes without been treated. The net groundwater availability in Bist-Doab region is much smaller than the total groundwater draft (CGWB, 2007 a-d), which is exerting pressure on groundwater resources. Therefore, for improving the groundwater resources, it becomes vital to understand the availability of water resources, water level behavior and measures to be adopted for its management. National institute of Hydrology, Roorkee has conducted many studies on water quality and depleting water levels in Punjab (Krishanet al., 2013a, b, 2014a, b; Puroshotaman et al., 2013; Rao et al., 2014; Sharma et al., 2014). In the present paper, an overview of the water resources of Beas-Sutlej Doab region is discussed. Water that is far underground is less prone to contamination. This is mainly because the water that is percolating down from the surface is filtered as it passes through soil. Toxic compounds can bind to soil particles or can be too large to pass very far into the subsurface. This is particularly true for bacteria. However, if the surface water passing through rocks and soil particle which are dens can reduce the degree of contamination of groundwater, as the contaminated substances get retained in the rocks and soil particles. The capacity of filtration of water through soil and rocks can get slow if there are a large amount of contaminants present in water. Although some of the toxic material can be filtered out as it moves downward. Another example is the contamination of groundwater is the pounds or shallow wells which is not constructed properly or has a crack, then contaminants entering the well from the surface (during heavy rainfall and running surface water) which cannot be filtered as it does not move through rocks bed and soil particles.

II. Review Of Literature

A. Groundwater Related Issues and Problems

Over-Exploitation: With the adoption of modern drilling techniques, construction of bore wells has become a common practice in the district to meet domestic as wells as agriculture needs. This increase in tube wells resulted in more groundwater draft from potential alluvial aquifers of Aur, Nawanshahar and Banga blocks. In addition to excess draft, these blocks also show decline in water level during pre and post-monsoon. These scenario leads to over-exploitation in these blocks.

Study Area: The state Punjab extends from the latitudes 29.30° N to 32.32° N and longitudes 73.55° E to 76.50° E and is bounded by Jammu and Kashmir in the north-east, by Himachal Pradesh in east and south-east, by Haryana in south, by Rajasthan in south and west and shares the international boundary with Pakistan. On western side, Punjab state is divided into 22 districts which are further divided into 77 tehsils and 141 development block. Depth to water level in the area ranges from 1.5 to 31 meter below ground level (mbgl).

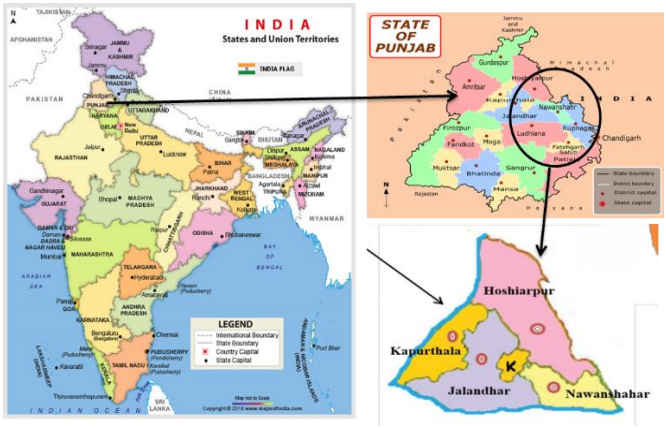

Fig.1. (a) India & (b) Doab region

Water table is at shallow depth at several areas of Muktsar, Ferozepur, Bathinda and Mansa districts where it ranges from 1.5 to 7.5 mbgl causing water logging at many places. The bores drilled in the area up to 60 m depth reveal the presence of predominance of fine sand occasionally associated with 'kankar' and comprising of two main aquifer zones each ranging in thickness from 4 to 25 m separated by clay layers of 3 to 5 m thickness. Water table has been rising in the area comprising blocks of Muktsar, Lambi, Kot Bhai, Khuiyan sarwar, Abhor and Fazilka creating water logging at many places. There has been erratic rainfall distribution in Punjab for the last two decades during which the annual average rainfall has decreased by 40-50% from 755 mm in 1990 to 385 mm in 2009 and 472 mm in 2010.

B. Study About Doaba Region Punjab

The Bist- Doab is a triangular region and covers an area of 9060 km2, 17.6% of total area of Punjab. The area lies between 30°51′ and 30°04′ N latitude and between 74°57′ and 76°40′ E longitude. It comprises the Hoshiarpur, Kapurthala, Jalandhar and SBS Nagar districts of Punjab State, India. It is bounded by Shivaliks in the north-east, the river Beas in the north east-south west and the river Sutlej in south east-south west. There is a choe ridden (ravine ridden) belt in the area bordered by the Shivaliks called the Kandi area. This area is a bhabhar, or a piedmont plain, lying at the foothills of the Shivaliks and formed by the coalescence of various alluvial fans resulting from the deposition of sediments by various choe at the foothills. Doaba has the highest road density of all the regions in Punjab. The area is drained by the perennial rivers Sutlej and Beas and their tributaries. The Sutlej and Beas rise in the high Himalayas and after traversing through

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Volume-1, Issue-5, August-2020
www.ijprse.com

long courses of several hundred kilometres enter the state of Punjab. The Sutlej enters Punjab near Nangal, moves on to plains at Ropar, passes through district Ludhiana (where the highly polluted Buddha Nallah merges with it) and joins Beas at Harike before crossing over to Pakistan. Its total length is 440 km in the state. The Beas enters Punjab near Talwara and enters the plains and discharges into the river Sutlej at Harike. Its total length is 470 km and catchment area is 20,303 km^2.

C. Climate

Temperature: June is generally the hottest month with the mean daily temperature at about 45˚C and the mean daily minimum at about 27˚C. January is generally the coldest month with the mean daily maximum temperature at about 19•C and the mean daily minimum at about 6˚C.

Humidity: During the brief south-west monsoon months and for spells of a day or two in association with the passing western disturbances high humidity prevails in the district. In the rest of the year, the humidity is low. The driest part of the year is the summer season when in the afternoons the relative humidity is 30 %or less.

*Rainfall***:** Average rainfall of the study area was 546mm. The highest average annual rainfall is

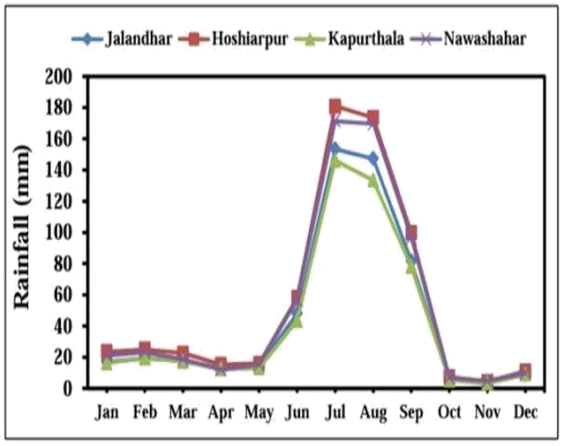

Figure 3.1: Average monthly rainfall (mm) from 1901- 20011 in Bist- Doab region

estimated 661mm and lowest 379mm annually.

*Winds***:** Winds are generally light in the district. In the south-west monsoon season, winds from direction, between north-east and south-east, are common but on many days in the afternoons westerly to north-westerly winds predominate, except in the latter half of summer, when easterlies and south easterlies blow on some days.

III. Geomorphology And Soil Types

Geomorphological, the Bist- Doab is divisible into three zones, i.e.

- The Shivaliks and the Kandi Watershed
- The interfluvial plain between the Beas and Sutlej
- The flood-plain area

The north-eastern portion of the Bist- Doab tract forming the boundary with the sub mountainous zone where upper Shivaliks rocks are exposed and cover about 1200 km^2, out of which about 900 km^2 lie in the Punjab portion of this tract. The altitude of these low hills varies from 300-600 m. These hills are made up of predominating bands of clays alternated with sands of varying grade.

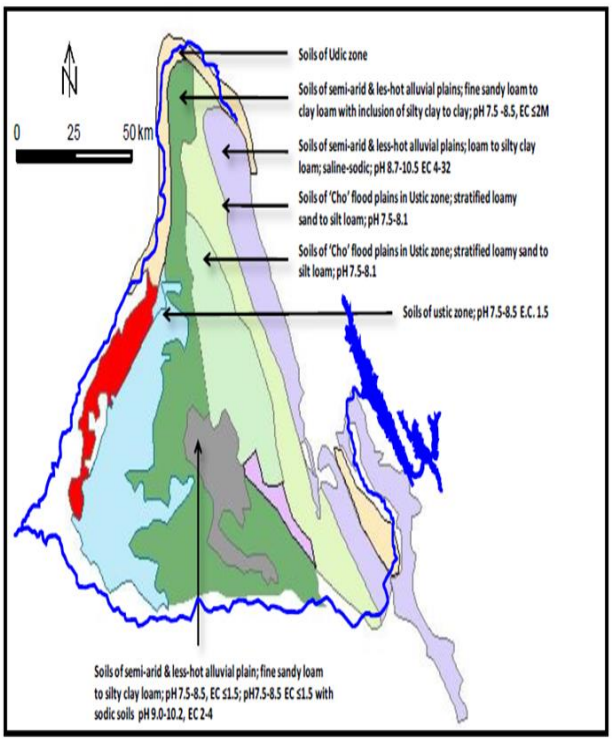

Figure 2.7: Geomorphological map of Bist-Doab tract, Punjab (after Singh, 1987)

IV. Research Methodology

A. Chemical Process

PH of water: PH of water is a measure of amount of hydrogen ions that is present in the water. It determines if the water is alkaline or acidic in nature. PH stands for potential of hydrogen. As per the World Health Organization (WHO), value of pH for the water is 6.5 to 8.5.

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Fig.2. Chemical Process

B. Determination of Total hardness of water:

Hardness of water is measure of its capacity to produce later with soap. Which was thought happen due to calcium and magnesium ions but now it is believed that it is due to all divalent cautions. Surface water is softer than ground water. The hardness water indicated the nature of the geological formations; it has been in contact with. Hardness of water can have divided into temporary and permanent hardness. Temporary water is due to the presence of calcium, magnesium in the form of the bicarbonate ion which can be removed by boiling the water. But permanent hardness can't be removed by boiling water because it contains sulphates and chlorate of calcium and magnesium. Water containing calcium carbonate at concentrations below 60 mg/l is generally considered as soft; 60–120 mg/l, moderately hard; 120–180 mg/l, hard; and more than 180 mg/l, very hard (McGowan, 2000). Hardness of study area is given in table 2 which show that a majority of sample collected from the region fall under very hardness. The optimum range of hardness in drinking water is from 80 to 100 mg/L. Water with hardness greater than 200 mg/L is considered.

C. Determination of conductivity of water:

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulphides and carbonate compounds.

Fig.3. Determination of conductivity of water

Fig.4. Determination of dissolved oxygen (DO) of water

D. Determination of the Biological Oxygen Demand (BOD) of water sample:

This test measures the oxygen utilized for the biochemical degradation of organic material (carbonaceous demand) and oxidation of inorganic material such as sulphides and ferrous ions during a specified incubation period. It also measures the oxygen used to oxidize reduced forms of nitrogen (nitrogenous demand) unless their oxidation is prevented by an inhibitor.

E. Determinations of the Chemical Oxygen Demand (COD) of the water sample:

Chemical Oxygen Demand (COD) test determines the oxygen requirement equivalent of organic matter that is susceptible to oxidation with the help of a strong chemical oxidant. It is important, rapidly measured parameters as a means of measuring organic strength for streams and polluted water bodies. The test can be related empirically to BOD, organic carbon or organic matter in samples from a specific source taking into account its limitations. The test is useful in

studying performance evaluation of wastewater treatment plants and monitoring relatively polluted water bodies. COD determination has advantage over BOD determination. COD results can be obtained in 3-4 hrs. As compared to 3-5days required for BOD test.

V. Results And Discussion

Water level in doab region varies from 3 to 15meter depth, each district has its own water level. Kapurthala- 10 to 15 m, Hoshiarpur- more than 15 meter, Jalandhar- 10 to 15 m and Phagwara- 10 m. Groundwater in doab region development is exceeds 100% making it over exploited. Though some groundwater dissolves substances from rocks and may contain traces of old seawater, most groundwater is free of pathogenic organisms, and purification for domestic or industrial use is not necessary.
Furthermore, groundwater supplies are not seriously affected by short droughts and are available in many areas that do not have dependable surface water supplies. However, aquifers and other groundwater supplies are at risk of chemical pollution from franking, agricultural chemicals, leaking or unfit landfills and septic tanks, and other point and nonpoint sources of pollution. Such contamination can render groundwater unfit for use and is expensive and difficult to clean up. To understand the region water shortage test are done.

VI. Conclusion And Future Scope

In the analysis we came to the conclusion that the water samples vary on large scale with each other regarding the presence of ingredients in it. Jalandhar has the highest variation as compared with all the samples collected. This clearly shows that Jalandhar is on the verge of abnormality with regards to the standard range of constituents maintained and formed by WHO for drinking water in this region. This report can be a reference for the further study in these regions and can also help in data analysis for framing the norms for drinking water in these regions. To maintain the groundwater purity and safe guard its natural form and quantity it can be a helpful data to take the decision for designing the maintenance and safety norms of groundwater preservation. In this experiment we have analysed the data for all the test carried out on each and every constituent present in water sample. According to the data we have found out that there is huge variation in the constituents present in ground water of these districts. Among all four districts Jalandhar has the highest variations. Jalandhar have also got slight turbidity in the water sample. This clearly shows that urbanization has made a direct impact on water quality of ground water. Jalandhar is known as highest fertile land in the world this also clarifies that it has the mainstream economy depended on agriculture and is highly depended on agriculture. Due to this major dependency, demand for groundwater is high. The inorganic agriculture has influenced the chemical percolation inside the ground degrading the water quality of ground water. Our result clearly states that water quality in Jalandhar region has got affected due to inorganic agriculture and industries. Hoshiarpur and Kapurthala has almost nil turbidity. The water quality is slightly at the better side. Iron content in Hoshiarpur is slightly higher but lower than Nawanshahar. Nawanshahar has Iron content on higher side among all the district. While water quality is approximately similar to those of Hoshiarpur and Kapurthala Districts. While Jalandhar varies in all parameters as compared to them. Jalandhar is more urban and industrial and populated then all the districts. Groundwater quality in Punjab region is depleting and Doaba Region analysis proves that. It's time to endorse and full fledge the agriculture towards the organic side. The industrial waste should be treated before discharging it in mainstream which affects the surface water and also the ground water.

References

[1]. Aggarwal, R., S. Kaur, and P. Miglani. 2009. Block wise assessment of water resources in Jalandhar district of Indian Punjab. Journal of Soil and Water Conservation8 (3).

[2]. S. Gupta, A.K. Bhatia, S. Marwah, Y.B. Kaushik, M.P. Angurala and G.P. SinghCentral Ground Water Board (CGWB), India

[3]. CENTRAL GROUND WATER BOARD Ministry of Water Resources Government of India North Western Region CHANDIGARH 2012.

[4]. Krishna Gopal, Lap worth D. J., Rao M. S., Kumar C. P., Smilovic M. and Semwal P. 2014a. Natural (Baseline) Groundwater Quality in The Bist-Doab Catchment, Punjab, India: A Pilot Study Comparing Shallow and Deep Aquifers. International Journal of Earth Sciencesand Engineering, 7 (01): 16-26.

[5]. Aulakh, K. S. 2004. Resource conservation and sustainability under Punjab conditions. In National symposium on Resource Conservation and Agricultural Productivity, Nov., 22-25, 2004, Ludhiana

[6]. Bowen, R. (1985). "Hydrogeology of the Bist Doab and Adjacent Areas, Punjab, India.

[7]. Rao, M. S., P. Purushothaman, Gopal Krishna, Y. S. Rawat and C. P. Kumar. 2014. Hydro chemical and Isotopic Investigation of Groundwater Regime in Jalandhar and Kapurthala Districts, Punjab, India.

[8]. International Journal of Earth Sciences and Engineering, 7 (01): 06-15.

[9]. Sharma, Manishi, M. S. Rao, D.S. Rathore, Gopal Krishna. 2014. An integrated approach to augment the depleting ground water resource in bist-doab, region of Punjab, India. International Journal of Earth Sciences and Engineering, 7 (01).

[10]. Amarasinghe, U. A.; Shah, T.; Malik, R. P. S. (Eds.) 2008. India's water future: scenarios and issues. Colombo, Sri Lanka: international water management institute.

[11]. Central Ground Water Board (2004) Dynamic Ground Water Resources of India (As on March, 2004). Ministry of Water Resources, Govt. of India.

[12]. Chaudhri, R. S., and Dhanda, J. S. (1980) Sedimentology and genesis of the Pinjore sediments (North-western Himalayas), Bull. Ind. Geol. Ass., Vol. 13, p. 45-56.

[13]. Chopra, R.,Venna, V. K and Sharma, P.K, 1998. Assessment of Natural Resources for conservation of Harike Wetland (Punjab), India through Remote Sensing Technology. In proceedings of the 18th Asian Conference on Remote Sensing, 20-24 October 1997, Malaysia.

[14]. Critical economic indicators Punjab- India. 2006-2007; 2007-2008. Field Operation Section, Economic and Statistical Organization Punjab, Chandigarh.

[15]. Das, B. K., & Kaur, P. (2001). Major ion chemistry of Renuka lake and weathering processes, Sirmaur district, Himachal Pradesh, India. Journal of Environmental Geology40: 908–917.