BICARBONATE CONCENTRATION IN GROUND WATER OF PUNJAB SATLUJ FLOODPLAIN (INDIA): 1970-2011

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Abstract

Bicarbonate concentration in groundwater is essential but its increased value enhances the alkalinity level. Excessive amount has been added to the groundwater from the crop fields as it produces carbon dioxide. Water containing high values of carbonate and bicarbonate ions when applied for irrigation left calcium and magnesium carbonate (lime) at the soil through evaporation process, which increased the hardness of water and affects the suitability of water for further uses. Spatial-temporal analysis of the bicarbonate ion concentration in groundwater from 1970 to 2011 depicts variations. Mean Bicarbonate concentration in Punjab Satluj floodplain is 491.42 mg/L which left 353.38 mg/L for 2011. Standard deviation was 134.12 mg/L in 1970 and increased to 180.39 mg/L in 2011.

Introduction

Punjab Satluj Floodplain area stretched between 30°32' N to 31°35' N and 75°05' E to 76°44' E latitudes and longitudes respectively and covers 1042.75 square kilometers. This natural entity overlapped by the parts of Phillaur Block of Jalandhar District; Aur, Nawanshahr and Balachaur Block of Shahid Bhagat Singh Nagar District; Chamkaur Sahib Block of Rupnagar District and Machhiwara, Ludhiana II and Ludhiana I Block of Ludhiana District of State Punjab Country India. In this area 151.01% agricultural increase has been noticed. This tremendous expansion took place as a result of successful execution of Green Revolution in this area. That made accessible the High Yielding Varieties of seeds, fertilizers, pesticides, irrigation facilities, low interest rate agricultural loans and subsidized electricity to farmers (Gill, 2015). Expanded crop cover produces carbon dioxide, which added carbonate to the soil and water, further this

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contaminated water with high values of carbonate and bicarbonate ions used for agricultural purposes such as irrigation applied for irrigation left calcium and magnesium carbonate (lime) at the soil through evaporation process (James, 2001). Elevated values of calcium and magnesium increased the hardness of water (Skipton and Dvorak, 2009), which affects its suitability in various uses.

Methodology

Bicarbonate ion concentration has been checked for fifty identified wells of Punjab Satluj floodplain. Secondary data has been taken from Department of Soil and Conservation, Punjab and Central Groundwater Board, India for 1970 to 2011. Analysis and interpretation has been done in Geographic Information System and further isoline maps have been generated through spline interpolation technique.

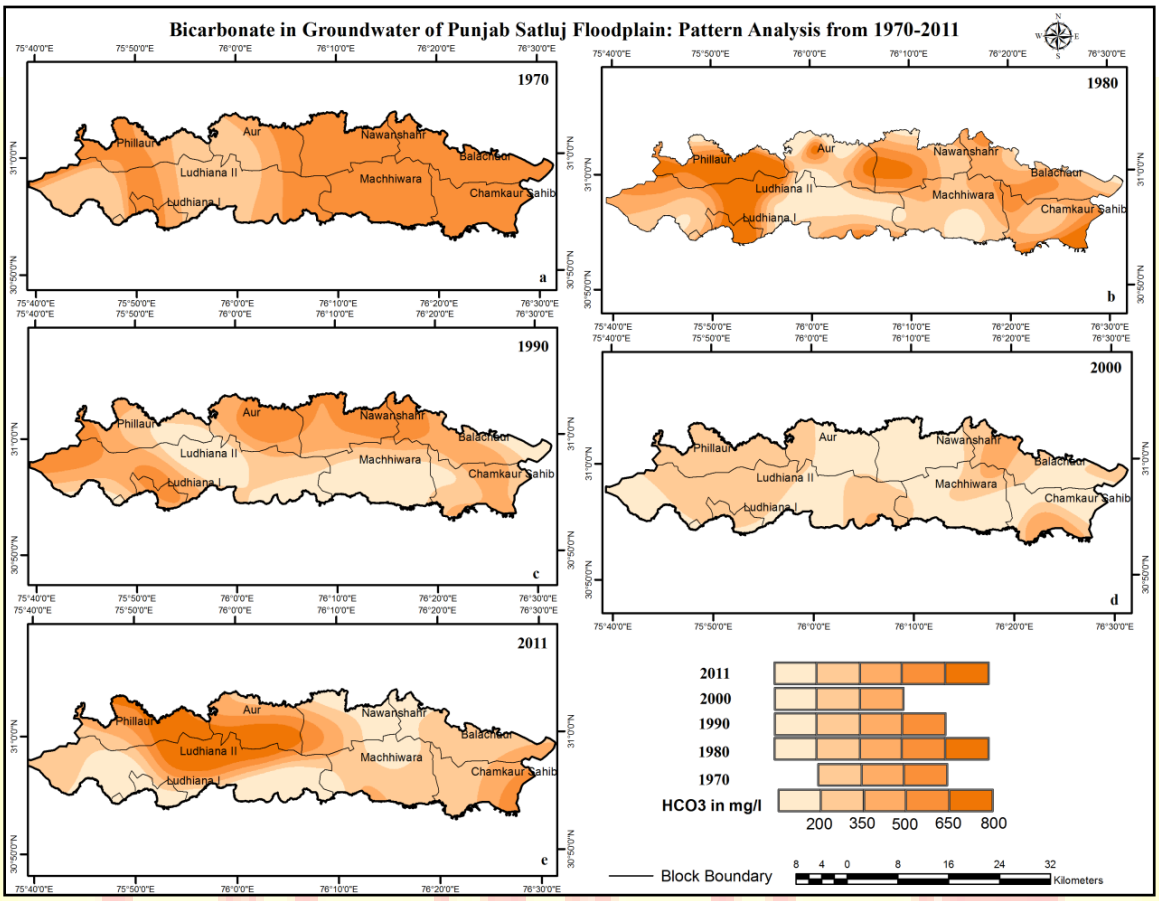
Discussion and Analysis

In Punjab Satluj floodplain Bicarbonate ion concentration in groundwater varied with time. Mean value of Bicarbonate concentration in groundwater was 491.42 during 1970, 407.71 for 1980, 336.86 in 1990, 245.77 in 2000 and 353.38 in 2011. Standard deviation was 134.12, 138.22, 150.48, 116.78 and 180.39 during 1970, 1980, 1990, 2000 and 2011 respectively.

During **1970**, bicarbonate concentration ranged between 259 to 650 mg/L. Maximum analyzed range for this period was 500 to 650 mg/L, which was found in the eastern part of the floodplain and consists eastern part of the Aur Block, whole Nawanshahr and Balachaur Block of Shahid Bhagat Singh Nagar District; Chamkaur Sahib Block of Rupnagar District; Machhiwara Bock of Ludhiana District and eastern part of Ludhiana II Block of Ludhiana District. A north-south strip was also attributed with same range and contains western part of Phillaur Block of Jalandhar District and central part of Ludhiana II and Ludhiana I Block of Ludhiana District (figure 1 (a)).

For **1980**, maximum bicarbonate ion concentration was reached at 782 mg/L. Area earlier under 500 to 650 mg/L becomes dense in carbonate concentration and with a decadal gap, it ranged under 650 to 800 mg/L. Area under this category was observed in four distinctive patches of the study area. One covers the south-eastern part of Chamkaur Sahib Block of Rupnagar District; a circular patch was observed in the central part of floodplain consisting eastern part of Nawanshahr Block and western part of Aur Block of Shahid Bhagat Singh Nagar District; along

with this a small circular patch was also found in the Aur Block of Shahid Bhagat Singh Nagar District and a prominent north-south strip was also characterized by this category, which includes east-west spread central part of Phillaur Block of Jalandhar District and central part of Ludhiana II and Ludhiana I Block of Ludhiana District (figure 1 (b)).



Source: Interpreted from data provided by Central Groundwater Board, India

Figure 1: Punjab Satluj Floodplain: Pattern Analysis of Bicarbonate Ion Concentration from 1970-2011

For **1990**, upper limit of bicarbonate was reduced and reached at 607 mg/L. High range for this period was 500 to 600 mg/L and covered upper portion of study area, that includes northern part of Nawanshahr and Aur Block of Shahid Bhagat Singh Nagar District; northern part of Ludhiana I Block of Ludhiana District and western part of study area, which consists south western part of

Phillaur Block of Jalandhar District and north-western part of Ludhiana II Block of Ludhiana District (figure 1 (c)).

During **2000**, maximum limit was further reduced and reached at 483 mg/L (figure 1 (d)). In **2011**, maximum bicarbonate limit was again increased and reached at 768 mg/L. Areas consisting high range i.e. 650-800 mg/L was specifically found in two patches. One incorporates the south eastern part of Chamkaur Sahib Block of Rupnagar District and other includes the southern part of Aur Block of Shahid Bhagat Singh Nagar District, eastern part of Phillaur Block of Jalandhar District and northern part of Ludhiana II Block of Ludhiana District (1 (e)).

Conclusion

In Punjab Satluj floodplain spatial temporal variation in Bicarbonate ion concentration is within World Health Organization set permissible limit. As groundwater alkalinity level is normal and water is basic in character. Maximum Bicarbonate ion concentration for 1970 was 650 mg/L, which increased to 768 mg/L in 2011.

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