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# Geographical Analysis Of Underground Water Quality In Gurugram District (2015-2020)

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**Abstract:**

This study conducts a comprehensive geographical analysis of underground water quality in Gurugram district, Haryana, India, for the period from 2015 to 2020. Gurugram, a rapidly urbanizing region, has witnessed significant growth and environmental changes during this timeframe, warningfears about the state of its underground water resources. Using an extensive dataset of water quality parameters collected from monitoring stations throughout the district, the research examines spatial and temporal trends in water quality. The study identifies significant spatial variations in underground water quality within Gurugram district, with areas near industrial and urban centers exhibiting higher levels of contamination, including heavy metals, nitrates, and salinity exceeding permissible limits. In contrast, rural and agricultural areas tend to have better water quality. The analysis also indicates temporal trends in water quality, with certain contaminants showing fluctuations and gradual increases, potentially linked to urbanization, industrialization, and changes in land use practices.The research contributes to a better understanding of the dynamics of underground water quality in an urbanizing region and offers insights for policymakers, local authorities, and environmental organizations to develop strategies for water quality preservation and management. Given the critical importance of clean water for both public health and the environment, addressing the issues identified in this study is crucial for the sustainable development of Gurugram district.

**Keywords:** Underground Water Quality, Water Quality Parameters, Spatial Variations, Temporal Trends, Heavy Metals, Nitrates, Salinity and Sustainable Development.

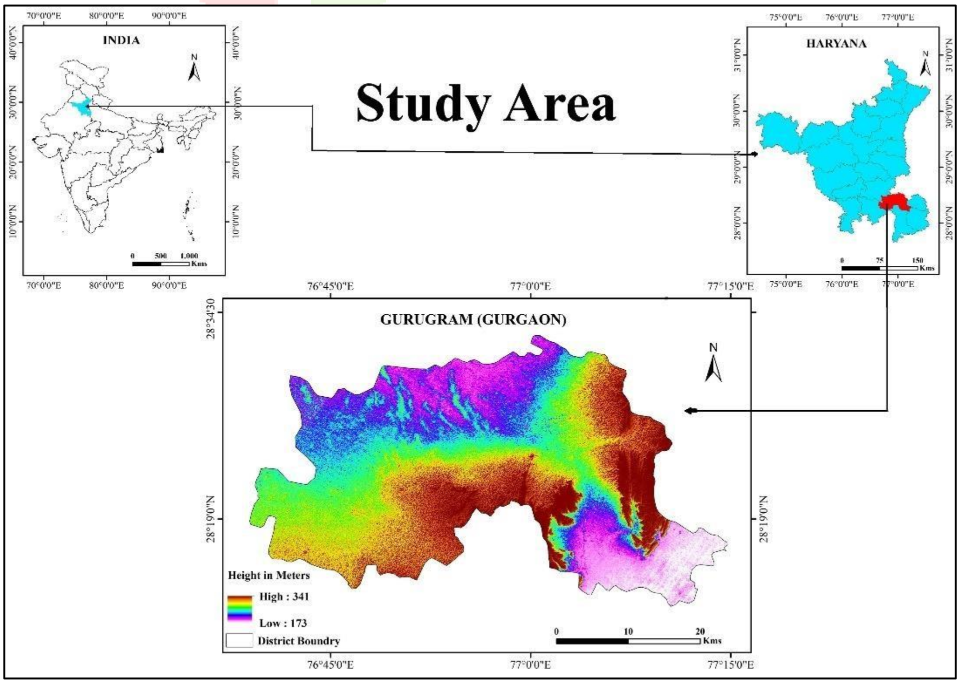
## Introduction

Most of the Earth's liquid fresh water is found, not in lakes or rivers, but is stored underground in the aquifers. Indeed, these aquifers provide a valuable base flow supplying water to rivers during periods of no rainfall. They are therefore an essential resource that requires protection so that groundwater can continue to sustain the human race and the various ecosystems that depend on it. The contribution from groundwater is vital; according to Morris and et.al, two billion people depend directly upon aquifers for drinking water, and 40 percent of the world‘s food is produced by irrigated agriculture that relies largely on groundwater. In the future, aquifer development will continue to be fundamental to economic development and reliable water supplies will be needed for domestic and irrigation purposes. Water stored in the ground beneath our feet is invisible and so its depletion or degradation due to contamination can proceed unnoticed, unlike our rivers, lakes and reservoirs, where drying up or pollution rapidly becomes obvious and is reported (Morris et al. 2003).

Groundwater Quality Depletion is growth has led to an increased demand for water resources, primarily met through groundwater extraction. However, this unregulated and excessive groundwater extraction has resulted in the depletion of groundwater resources and a concurrent decline in water quality. Groundwater is a vital natural resource that plays a crucial role in supporting various human activities, including drinking water supply, agriculture, and industrial processes. However, the quality of groundwater is constantly under threat due to various factors. This literature review aims to explore the key factors contributing to groundwater quality depletion. By examining existing research and empirical evidence, this review will provide a comprehensive understanding of the complex interplay of factors that impact groundwater quality. Excessive pumping of groundwater for various purposes can lead to the intrusion of low-quality water from surrounding areas, resulting in a decrease in overall groundwater quality (Smith & Brown, 2019). Weak or inadequate regulatory frameworks can contribute to groundwater contamination by not adequately monitoring or controlling potential pollution sources (EPA, 2021). Poor land-use planning and management practices can exacerbate groundwater quality depletion (Jones, 2017). Groundwater quality depletion is a multifaceted issue with a range of contributing factors. Addressing these issues requires a combination of stricter regulations, sustainable management practices, and a greater awareness of the potential consequences of groundwater contamination. Understanding these factors is critical for safeguarding this invaluable resource and ensuring its availability for future generations. The expansion of urban areas can increase the risk of groundwater contamination due to increased impervious surfaces and the release of pollutants from infrastructure (Gupta & Sharma, 2018). Rapid urban development and industrial expansion have led to over-extraction of groundwater. This excessive pumping disrupts the natural replenishment of aquifers, leading to a lowering of the water table and increased salinity in the remaining groundwater. Pollution from industrial effluents, agricultural runoff, and improper disposal of waste has resulted in contamination of the groundwater. The indiscriminate use of pesticides and fertilizers in agriculture has also contributed to the presence of heavy metals and other harmful substances in the groundwater. Industries often release harmful chemicals, heavy metals, and pollutants into the environment, which can infiltrate groundwater (Smith & Johnson, 2017). Due to overpumping and excessive extraction, saltwater intrusion from the nearby Yamuna River and other saline sources has been observed, especially in the southwestern parts of Gurugram District. This has significantly deteriorated groundwater quality in these areas.

## Study Area

Gurugram is located in the Aravalli Range, which is a geological formation with hard rocks. These rocks have low porosity and permeability, which means that they cannot store much water or allow water to flow through them easily. This can make it difficult for groundwater to recharge. Understanding the geological factors shaping the hydrogeology of the region is essential for sustainable groundwater management. Geology plays a pivotal role in shaping the hydrogeological characteristics of the region. Geological factors, such as the presence of certain minerals in the bedrock, can contribute to the natural degradation of groundwater quality.The Aravalli Range dominates the geology of Gurugram, comprising Proterozoic metasedimentary rocks. These rocks play a crucial role in storing and transmitting groundwater in the region. The district also hosts alluvial deposits in the form of river terraces and floodplain deposits. These deposits are significant contributors to the groundwater storage capacity. In the southwestern part of Gurugram, Tertiary rocks are present, influencing the hydrogeological dynamics of the area. The Aravalli metasedimentary rocks function as important basement aquifers, storing significant quantities of groundwater. The fracture system in these rocks allows for the accumulation and movement of water. The alluvial deposits along the river terraces and floodplains are the most exploited sources of groundwater, owing to their high permeability and accessibility. Tertiary rocks in the southwestern region of Gurugram also contribute to groundwater storage, although to a lesser extent. Some parts of Gurugram have reported arsenic contamination, primarily attributed to the presence of arsenic-bearing minerals in the Aravalli rocks. Elevated fluoride levels have been detected in groundwater from certain regions due to the dissolution of fluoride-bearing minerals in the geological formations. Alluvial aquifers are susceptible to salinity and high Total Dissolved Solids (TDS), particularly in areas where the groundwater table has lowered due to over-extraction. Rapid urbanization and industrialization have led to excessive groundwater extraction from alluvial aquifers. Proper management strategies are essential to prevent further depletion. The geological factors in Gurugram district, Haryana, have a profound influence on the availability, quality, and sustainability of groundwater resources. A comprehensive understanding of the geological setting is vital for effective groundwater management in this rapidly developing region.




**Map 1: Study Area**

## Objective

- To examine the spatial analysis of Ground Water Quality in Gurugram District.

## Database and Methodology

Database and research methodology for a study on groundwater quality in Gurugram district from 2015 to 2020 was prepared. Gather groundwater quality data for Gurugram district from the Atal Bhujal portal (Government of India).The primary objective of the study was to evaluate groundwater quality by examining various parameters. Data collection was executed through the Atal Bhujal portal, which provided data from 2015 to 2020. The data included parameters such as pH, Electrical Conductivity (EC), Total Hardness, Calcium, Magnesium, Sodium, Potassium, Carbonate, Bicarbonate, Sulphate, Chloride, Fluoride, and Nitrate, resulting in the creation of a comprehensive dataset. Multiple data sources, including the Atal Bhujal portal, remote sensing, and GIS, were consolidated into a single dataset to facilitate comprehensive analysis. Spatial analysis was employed to detect trends and patterns, supported by spatial statistics. Microsoft Excel was utilized to generate graphs, charts, and tables to visually represent these trends. Interpreting the results involved comparing statistical findings with GIS and remote sensing data to identify the key factors influencing changes in groundwater quality. Visual representations, such as maps, graphs, and tables, were crafted to effectively communicate the findings. The study culminated in the compilation of a comprehensive scientific report, which included sections covering the introduction, data sources, methods, results, discussion, and conclusions. Peer review was considered to validate the scientific rigor of the study.

## Result and Discussion Groundwater Quality of Various Villages in Gurugram District, Haryana 2015

The table 1 provides comprehensive information about the groundwater quality in Gurugram district, Haryana, with a focus on several key parameters for the year 2015. The data is presented for different villages in the district, and the parameters include pH, Electrical Conductivity (EC), Total Hardness, Calcium, Magnesium, Sodium, Potassium, Carbonate, Bicarbonate, Sulphate, Chloride, Fluoride, and Nitrate. The pH levels of groundwater in the various villages range from 7.59 to 8.85. The pH values are an important indicator of water's acidity or alkalinity, with values above 7 indicating alkaline conditions. Overall, the groundwater is slightly alkaline in most of the villages. Electrical Conductivity measures the water's ability to conduct electrical current and is related to the presence of ions. In this dataset, EC values range from 700.00 µS/cm to a significantly higher 12,300.00 µS/cm, indicating substantial variability in ion content across different villages. Total Hardness, which is typically due to the presence of calcium and magnesium ions, varies between 80.86 mg/L to 3,709.67 mg/L. This parameter indicates how hard or soft the water is, with higher values suggesting hard water. Calcium and magnesium concentrations are directly linked to water hardness. Calcium levels range from 4.05 mg/L to 538.39 mg/L, while magnesium levels vary from 9.83 mg/L to 574.78 mg/L. High calcium and magnesium levels contribute to water hardness. Sodium and potassium concentrations in the groundwater also exhibit variation across the villages. Sodium values range from 98.00 mg/L to 1,175.00 mg/L, and potassium levels range from 0.00 mg/L to 9.40 mg/L. Carbonate and bicarbonate concentrations in the groundwater vary. Some villages have higher carbonate values, while others have minimal or no bicarbonate content. These parameters are important for understanding the water's alkalinity and buffering capacity. Sulphate, Chloride, Fluoride, and Nitrate: The data shows considerable variability in the concentrations of these anions across the villages. Sulphate values range from 0.00 mg/L to 3,599.17 mg/L, chloride values range from 0.00 mg/L to 675.00 mg/L, fluoride values vary from "BDL" (Below Detectable Limit) to 2.75 mg/L, and nitrate concentrations range from 0.00 mg/L to 675.00 mg/L.

**Table No. 1; Ground Water Quality of Gurugram District Haryana 2015**

| Village | pH | EC | Total Hardness | Calcium | Magnesium | Sodium | Potassium | Carbonate | Bicarbonate | Sulphate | Chloride | Fluoride | Nitrate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chandu** | 8.60 | 1580.00 | 212.27 | 48.58 | 22.11 | 265.00 | 7.90 | 55.50 | 146.75 | 98.00 | 312.67 | 1.06 | 40.00 |
| **Jamalpur** | 8.24 | 955.00 | 181.95 | 36.43 | 22.11 | 150.00 | 2.70 | 0.00 | 349.95 | 30.00 | 104.22 | BDL | 53.00 |
| **Kheda Khurmpur** | 8.04 | 6522.00 | 1324.16 | 250.98 | 169.49 | 980.00 | 5.40 | 0.00 | 169.33 | 625.00 | 1625.88 | 0.87 | 458.00 |
| **Sewani** | 7.59 | 2525.00 | 869.29 | 129.54 | 132.64 | 190.00 | 3.30 | 0.00 | 112.89 | 98.00 | 757.35 | 0.34 | 22.00 |
| **BasondaTripati** | 8.18 | 2915.00 | 283.03 | 56.67 | 34.39 | 560.00 | 8.10 | 0.00 | 372.53 | 252.00 | 646.18 | 0.33 | 34.00 |
| **Fazilpurbadli** | 8.25 | 1402.00 | 293.13 | 56.67 | 36.84 | 190.00 | 2.20 | 0.00 | 180.62 | 78.00 | 270.98 | 0.09 | 114.00 |
| **Jhanjrola** | 7.96 | 12300.00 | 3709.67 | 538.39 | 574.78 | 1175.00 | 8.20 | 0.00 | 67.73 | 568.00 | 3599.17 | 0.50 | 675.00 |
| **Wazirpur** | 8.65 | 1475.00 | 151.62 | 20.24 | 24.56 | 310.00 | 1.50 | 66.60 | 462.84 | 72.00 | 152.86 | 1.58 | 50.00 |
| **Gurgaon** | 8.80 | 930.00 | 90.97 | 4.05 | 19.65 | 186.00 | 1.30 | 55.50 | 395.10 | 0.00 | 34.74 | 0.38 | 28.00 |
| **Machana** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Manesar** | 8.10 | 805.00 | 212.27 | 52.63 | 19.65 | 98.00 | 2.90 | 0.00 | 214.49 | 42.00 | 97.27 | 0.35 | 85.00 |
| **Noorgarh** | 8.50 | 1615.00 | 272.92 | 52.63 | 34.39 | 250.00 | 0.40 | 55.50 | 158.04 | 210.00 | 257.08 | 2.75 | 3.00 |
| **Kasan** | 8.15 | 700.00 | 202.16 | 40.48 | 24.56 | 70.00 | 9.40 | 0.00 | 146.75 | 98.00 | 62.53 | 0.51 | 60.00 |
| **Pataudi** | 8.50 | 1155.00 | 131.41 | 28.34 | 14.74 | 220.00 | 3.40 | 44.40 | 259.64 | 75.00 | 114.65 | 0.08 | 105.00 |
| **Lokra** | 8.85 | 730.00 | 111.19 | 16.19 | 17.19 | 134.00 | 3.50 | 66.60 | 237.06 | 8.00 | 41.69 | 0.11 | 36.00 |
| **Haila Mandi** | 8.65 | 2000.00 | 80.86 | 16.19 | 9.83 | 450.00 | 1.70 | 77.70 | 383.82 | 148.00 | 288.35 | 0.62 | 60.00 |

**Source:** ataljal.hid.gov.in

**Groundwater Quality of Various Villages in Gurugram District, Haryana, for the Year 2020**

The table 2 provides data on the groundwater quality in various villages of Gurugram district, Haryana for the year 2020. The table includes various parameters that are important for assessing water quality. The pH values in the table indicate the acidity or alkalinity of the groundwater. It ranges from 7.56 to 8.81. Most values are slightly alkaline, with Pataudi having the highest pH at 8.81, indicating very alkaline water, while Sewani has the lowest at 7.56, suggesting slightly acidic water. Electrical Conductivity (EC): EC measures the ability of water to conduct an electrical current. It is an indicator of the total dissolved solids in water. The values vary significantly, with Kheda Khurmpur having a very high EC of 6071.00 µS/cm, indicating high levels of dissolved minerals, while Noorgarh has the lowest EC at 23.02 µS/cm. Total hardness is a measure of the concentration of calcium and magnesium ions in the water. It ranges from 120.10 mg/L in Chandu to 2261.81 mg/L in Sewani, with a wide variation in between. These two elements are important constituents of total hardness. Calcium and magnesium values differ from village to village. Jamalpur, for instance, has a high magnesium content (41.34 mg/L), while Sewani has high levels of both calcium (342.91 mg/L) and magnesium (423.00 mg/L). Sodium and potassium levels also vary considerably. Kheda Khurmpur has the highest sodium concentration (635.00 mg/L), while Sewani has the highest potassium concentration (7.00 mg/L). These are alkalinity indicators. Carbonate levels are low or absent in most villages, while bicarbonate levels vary. Sewani has the highest bicarbonate content at 256.28 mg/L. These parameters are significant in determining water quality. Sulphate concentrations range from 0.00 mg/L in Kheda Khurmpur to 478.00 mg/L in Machana. Chloride varies significantly, with Sewani having the highest at 2112.82 mg/L. These are important for health considerations. The fluoride content is generally low but varies. Nitrate concentrations are mostly within safe limits, although Kheda Khurmpur has a higher value at 0.11 mg/L, and Haila Mandi has the highest nitrate level at 135.00 mg/L.

The groundwater quality in Gurugram district in 2015 varies significantly across villages. Some areas have water that is high in mineral content, alkalinity, and specific ions like sodium, while others have lower mineral content and more neutral pH levels. The data serves as a valuable resource for understanding the water quality in different regions of Gurugram and can be used for making informed decisions regarding water treatment and usage in these areas. It's important to note that some of the values may be of concern in terms of drinking water standards, particularly high levels of chloride, nitrate, and fluoride in some villages.

**Table No. 2; Ground Water Quality of Gurugram District Haryana 2020**

| Village | pH | EC | Total Hardness | Calcium | Magnesium | Sodium | Potassium | Carbonate | Bicarbonate | Sulphate | Chloride | Fluoride | Nitrate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chandu** | 8.60 | 240.00 | 120.10 | 32.06 | 9.73 | 8.50 | 2.70 | 60.00 | 24.41 | 0.00 | 21.27 | 1.80 | 0.08 |
| **Jamalpur** | 8.47 | 803.00 | 230.18 | 24.05 | 41.34 | 91.00 | 1.90 | 36.00 | 183.06 | 15.00 | 85.08 | 0.27 | 92.00 |
| **Kheda Khurmpur** | 7.77 | 6071.00 | 1681.34 | 312.62 | 218.88 | 635.00 | 6.00 | 0.00 | 146.45 | 89.00 | 1971.02 | 0.11 | 17.00 |
| **Sewani** | 7.56 | 6150.00 | 2261.81 | 340.68 | 342.91 | 423.00 | 7.00 | 0.00 | 256.28 | 14.00 | 2112.82 | 0.01 | 0.10 |
| **BasondaTripati** | 8.61 | 2039.00 | 160.13 | 16.03 | 29.18 | 415.00 | 0.81 | 48.00 | 329.51 | 109.00 | 397.04 | 0.22 | 26.00 |
| **FazilpurBadli** | 8.38 | 989.00 | 230.18 | 24.05 | 41.34 | 124.00 | 1.90 | 36.00 | 158.65 | 61.00 | 127.62 | 0.27 | 92.00 |
| **Jhanjrola** | 7.81 | 6259.00 | 1541.23 | 304.61 | 189.70 | 761.00 | 19.00 | 0.00 | 109.84 | 241.00 | 1956.84 | 0.06 | 58.00 |
| **Wazirpur** | 8.68 | 2120.00 | 320.26 | 20.04 | 65.66 | 371.00 | 2.00 | 96.00 | 475.96 | 0.00 | 382.86 | 0.00 | 0.62 |
| **Gurgaon** | 7.87 | 3713.00 | 800.64 | 321.00 | 389.12 | 485.00 | 10.00 | 0.00 | 109.84 | 114.00 | 1169.85 | 0.08 | 18.00 |
| **Machana** | 8.17 | 5960.00 | 870.70 | 104.21 | 148.35 | 975.00 | 14.00 | 0.00 | 280.69 | 478.00 | 1588.16 | 0.19 | 32.00 |
| **Manesar** | 8.12 | 215.00 | 130.10 | 28.06 | 14.59 | 5.20 | 2.10 | 0.00 | 109.84 | 0.00 | 14.18 | 0.60 | 0.20 |
| **Noorgarh** | 8.54 | 23.02 | 520.42 | 64.13 | 87.55 | 331.00 | 1.00 | 60.00 | 158.65 | 0.00 | 460.85 | 0.00 | 1.11 |
| **Kasan** | 8.37 | 370.00 | 160.13 | 24.05 | 24.32 | 23.00 | 1.90 | 36.00 | 97.63 | 0.00 | 14.18 | 0.31 | 53.00 |
| **Pataudi** | 8.81 | 1144.00 | 120.10 | 12.02 | 21.89 | 231.00 | 1.50 | 60.00 | 195.26 | 76.00 | 127.62 | 0.26 | 109.00 |
| **Lokra** | 8.61 | 642.00 | 170.14 | 16.03 | 31.62 | 94.00 | 2.00 | 60.00 | 207.47 | 0.00 | 42.54 | 0.18 | 41.00 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Haila Mandi** | 8.71 | 2561.00 | 200.16 | 20.04 | 36.48 | 517.00 | 1.90 | 84.00 | 439.34 | 119.00 | 397.04 | 0.55 | 135.00 |

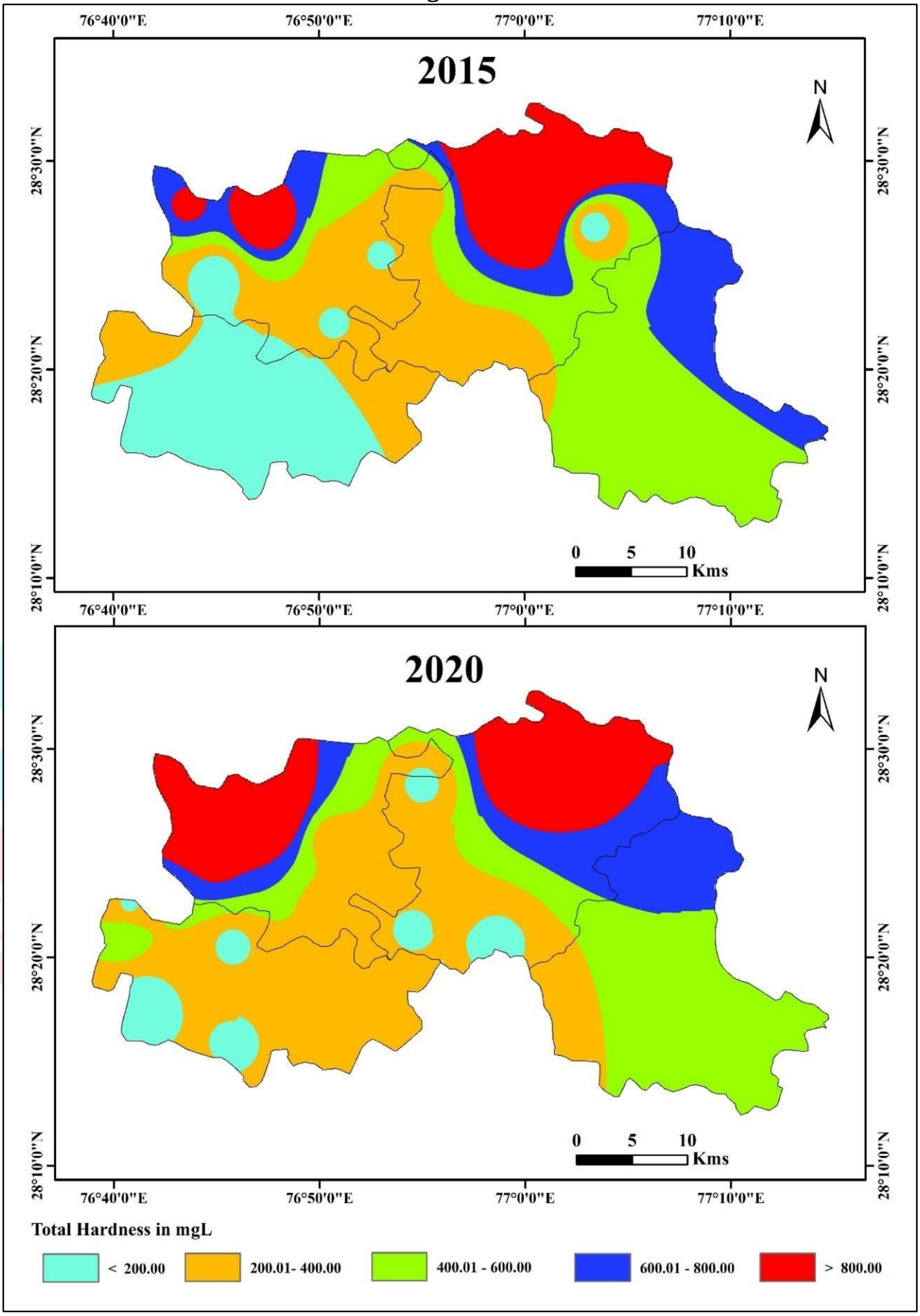
**Sources:**ataljal.hid.gov.in

**Total Hardness of Groundwater in Gurugram District from 2015 to 2020**

The map 1 be shows the total hardness of groundwater in Gurugram District all blocks from 2015 to 2020. The map is divided into different color-coded zones to represent different total hardness levels. The legend at the bottom of the map shows the total hardness ranges in milligrams per liter (mg/L). The overall total hardness in groundwater quality in Gurugram District has increased over the past 5 years. In 2015, the average total hardness was between 100 and 200 mg/L. However, by 2020, the average total hardness had increased to between 200 and 300 mg/L. This represents an increase of 50 to 100 mg/L over the past 5 years. The increase in total hardness has been uneven across the district. The highest total hardness levels are now found in the northern and western parts of the district, where the total hardness is greater than 300 mg/L. The lowest total hardness levels are found in the southern and eastern parts of the district, where the total hardness is less than 100 mg/L. The increase in total hardness has accelerated in recent years. For example, between 2015 and 2017, the average total hardness increased by 50 mg/L. However, between 2017 and 2020, the average total hardness increased by 100 mg/L.The map 1 also shows that the increase in total hardness has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map also shows that the increase in total hardness has been more pronounced in recent years.

The increase in total hardness in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water. There are a number of possible reasons for the increase in total hardness in groundwater quality in Gurugram District. Gurugram District is a rapidly developing area with a growing population and economy. This has led to an increase in water demand, which has put pressure on groundwater resources. This increased pressure on groundwater resources can lead to the extraction of water from deeper aquifers, which typically have higher total hardness levels.Hard water can cause a number of health problems, such as skin irritation, hair loss, and kidney stones. It can also make it more difficult to absorb nutrients from food. Hard water can damage plumbing fixtures and appliances, such as pipes, faucets, and water heaters. Hard water can reduce the productivity of agricultural crops by making it difficult for plants to absorb water and nutrients.

**Map 1: Total Hardness in Groundwater in Gurugram District**



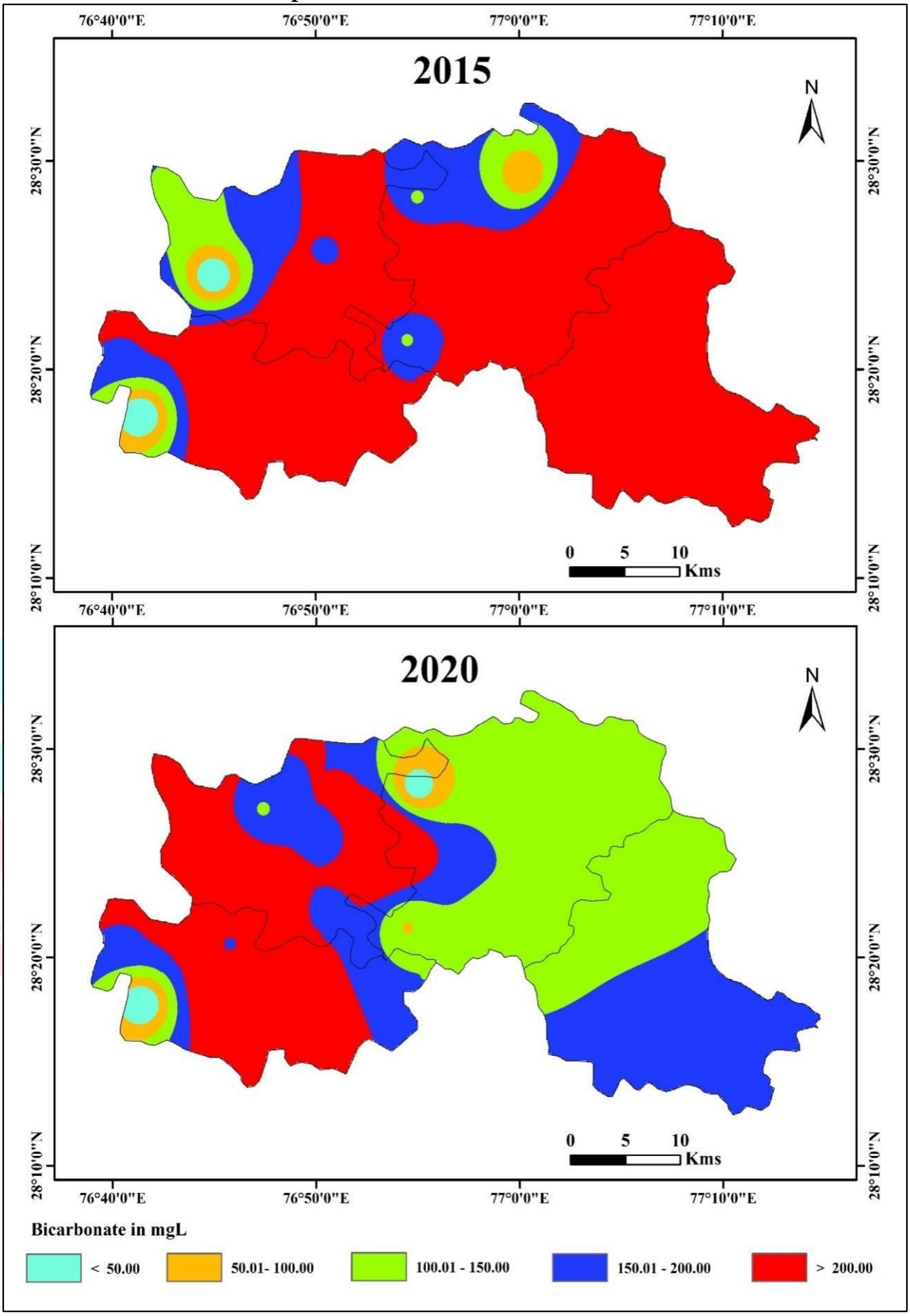

**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

**Bicarbonate in Groundwater in Gurugram District from 2015 to 2020**

The map 2 shows the bicarbonate in groundwater in Gurugram District all blocks from 2015 to 2020. The map is divided into different color-coded zones to represent different bicarbonate levels. The legend at the bottom of the map shows the bicarbonate ranges in milligrams per liter (mg/L). The overall bicarbonate in groundwater in Gurugram District has decreased over the past 5 years. In 2015, the average bicarbonate level was between 200 and 300 mg/L. However, by 2020, the average bicarbonate level had decreased to between 100 and 200 mg/L. This represents a decrease of 50 to 100 mg/L over the past 5 years.

The decrease in bicarbonate has been uneven across the district. The lowest bicarbonate levels are now found in the northern and western parts of the district, where the bicarbonate level is less than 100 mg/L. The highest bicarbonate levels are found in the southern and eastern parts of the district, where the bicarbonate level is greater than 300 mg/L. The decrease in bicarbonate has accelerated in recent years. For example, between 2015 and 2017, the average bicarbonate level decreased by 50 mg/L. However, between 2017 and 2020, the average bicarbonate level decreased by 100 mg/L. The map also shows that the decrease in bicarbonate has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map also shows that the decrease in bicarbonate has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem. The decrease in bicarbonate in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water. In addition to the above, it is important to note that bicarbonate is a natural buffer that helps to neutralize acids in the groundwater. Gurugram District is a rapidly developing area with a growing population and economy. This has led to an increase in water demand, which has put pressure on groundwater resources. This increased pressure on groundwater resources can lead to the extraction of water from deeper aquifers, which typically have lower bicarbonate levels. Climate change is leading to more extreme weather events, such as droughts and floods. These events can have a significant impact on groundwater quality. For example, droughts can lead to a decrease in groundwater levels, which can increase the concentration of minerals in the groundwater, including bicarbonates.

***Map2*: Bicarbonate in Groundwater**



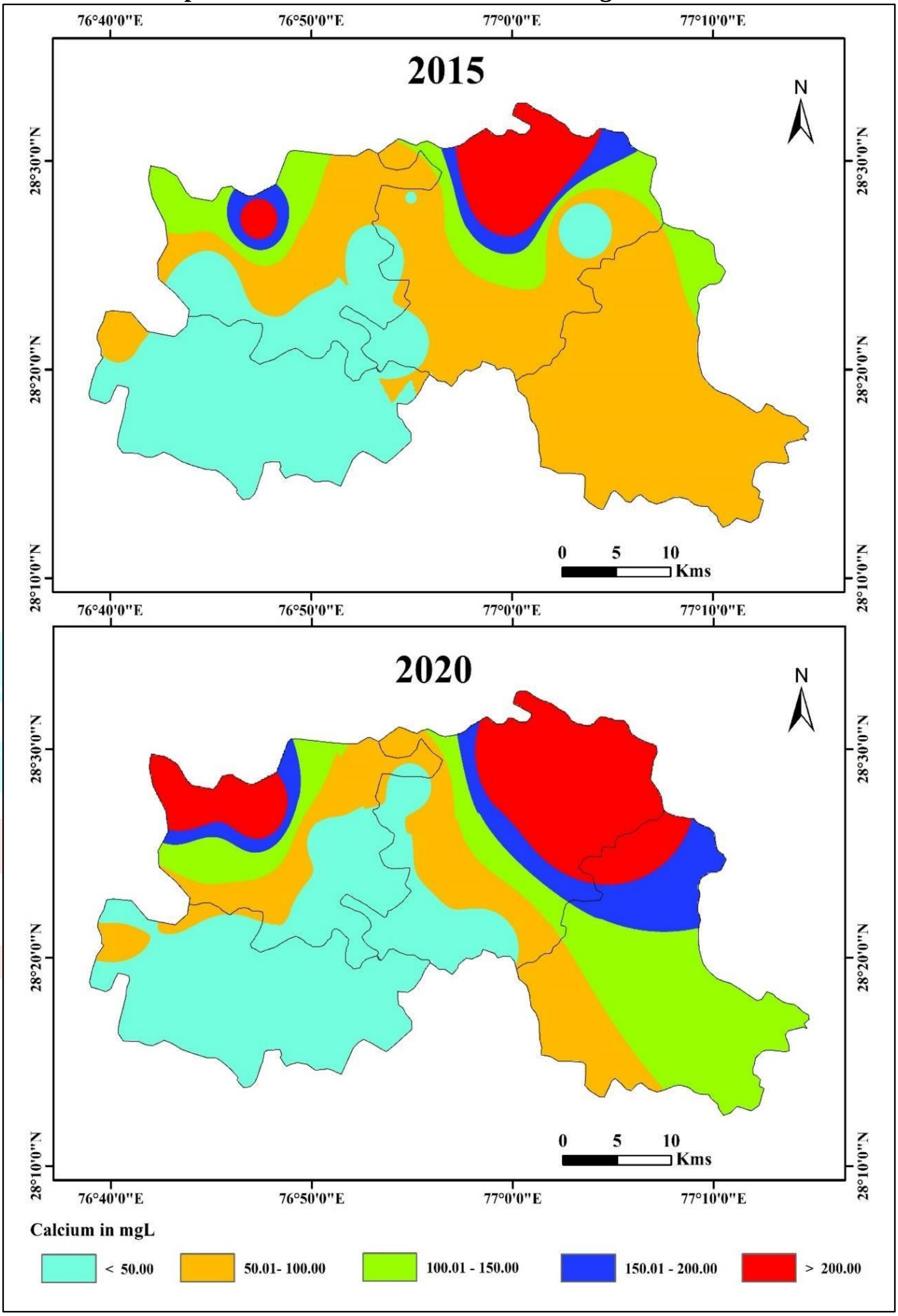

**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

**Calcium in Groundwater in Gurugram District from 2015 to 2020**

The map 3shows the amount of calcium in groundwater in all blocks of Gurugram District from 2015 to 2020. The map is divided into different color-coded zones to represent different calcium levels. The legend at the bottom of the map shows the calcium ranges in milligrams per liter (mg/L). The overall calcium in groundwater in Gurugram District has increased over the past 5 years. In 2015, the average calcium level was between 50 and 100 mg/L. However, by 2020, the average calcium level had increased to between 100 and 150 mg/L. This represents an increase of 50 to 100 mg/L over the past 5 years.

The increase in calcium has been uneven across the district. The highest calcium levels are now found in the northern and western parts of the district, where the calcium level is greater than 150 mg/L. The lowest calcium levels are found in the southern and eastern parts of the district, where the calcium level is less than 50 mg/L. The increase in calcium has accelerated in recent years. For example, between 2015 and 2017, the average calcium level increased by 50 mg/L. However, between 2017 and 2020, the average calcium level increased by 100 mg/L. The map also shows that the increase in calcium has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map also shows that the increase in calcium has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem. The increase in calcium in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water. Gurugram District is a rapidly developing area with a growing population and economy. This has led to an increase in water demand, which has put pressure on groundwater resources. This increased pressure on groundwater resources can lead to the extraction of water from deeper aquifers, which typically have higher calcium levels. Climate change is leading to more extreme weather events, such as droughts and floods. These events can have a significant impact on groundwater quality. For example, droughts can lead to a decrease in groundwater levels, which can increase the concentration of minerals in the groundwater, including calcium. Inefficient irrigation practices and lack of wastewater recycling can also lead to the increase of calcium in groundwater. For example, the use of saline water for irrigation can increase the calcium content of the groundwater.

**Map 3: Calcium in Groundwater in Gurugram District**



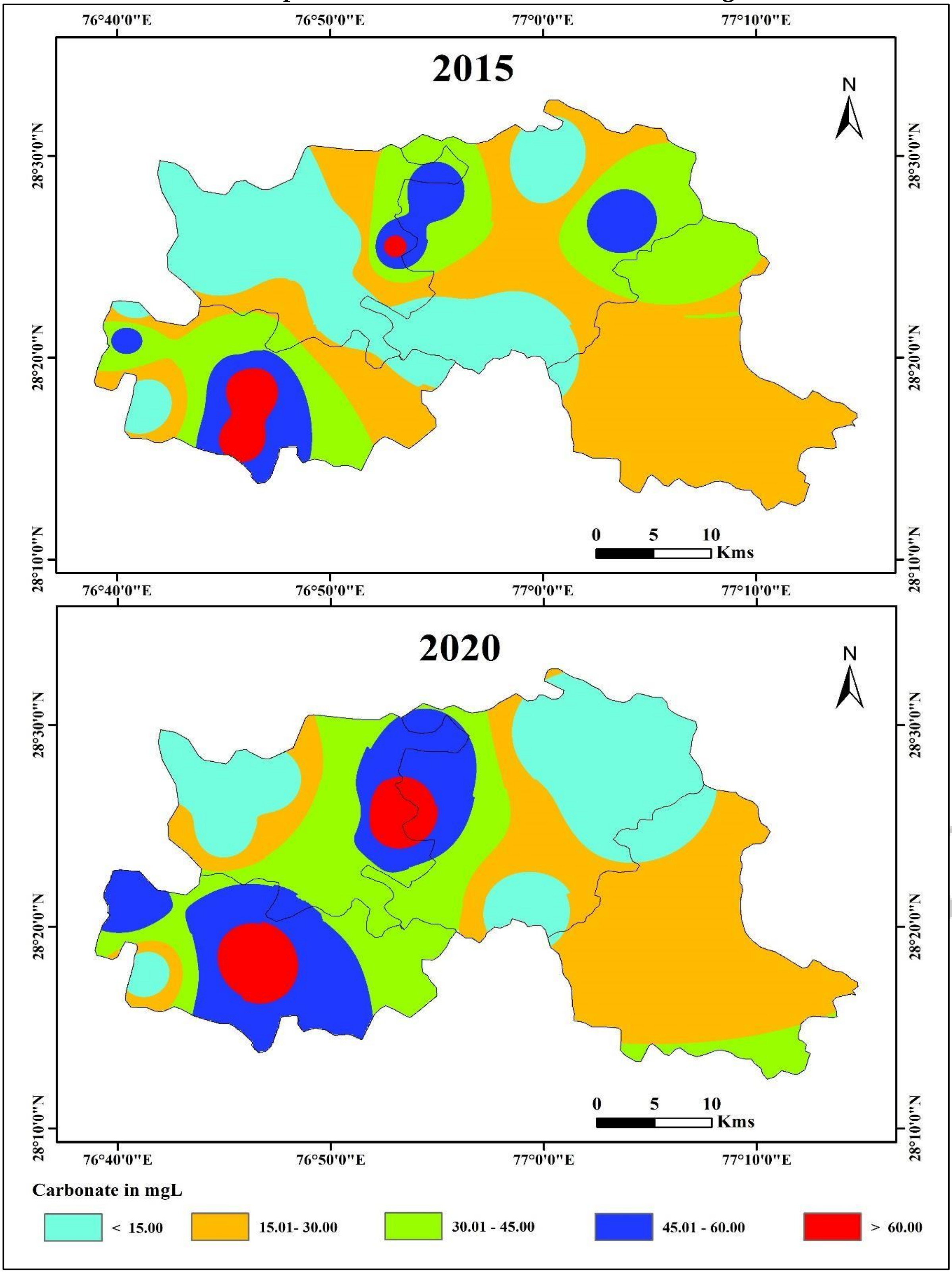

**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

**Carbonate in Groundwater in Gurugram District from 2015 to 2020**

The map 4 shows the amount of carbonate in groundwater in all the blocks of Gurugram District from 2015 to 2020. The map is divided into different color-coded zones to represent different carbonate levels. The legend at the bottom of the map shows the carbonate ranges in milligrams per liter (mg/L). The overall carbonate in groundwater in Gurugram District has decreased over the past 5 years. In 2015, the average carbonate level was between 50 and 100 mg/L. However, by 2020, the average carbonate level had decreased to between 25 and 50 mg/L. This represents a decrease of 25 to 50 mg/L over the past 5 years. The decrease in carbonate has been uneven across the district. The lowest carbonate levels are now found in the northern and western parts of the district, where the carbonate level is less than 25 mg/L. The highest carbonate levels are found in the southern and eastern parts of the district, where the carbonate level is greater than 50 mg/L. The decrease in carbonate has accelerated in recent years. For example, between 2015 and 2017, the average carbonate level decreased by 25 mg/L. However, between 2017 and 2020, the average carbonate level decreased by 50 mg/L. Gurugram District is a rapidly developing area with a growing population and economy. This has led to an increase in water demand, which has put pressure on groundwater resources. This increased pressure on groundwater resources can lead to the extraction of water from deeper aquifers, which typically have lower carbonate levels. Climate change is leading to more extreme weather events, such as droughts and floods. These events can have a significant impact on groundwater quality. For example, droughts can lead to a decrease in groundwater levels, which can increase the concentration of minerals in the groundwater, including carbonate. Inefficient irrigation practices and lack of wastewater recycling can also lead to the decrease of carbonate in groundwater. For example, the use of saline water for irrigation can decrease the carbonate content of the groundwater.

The map 4 also shows that the decrease in carbonate has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map also shows that the decrease in carbonate has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem. The decrease in carbonate in groundwater quality in Gurugram District is a serious problem.

**Map 4: Carbonate in Groundwater in Gurugram District**

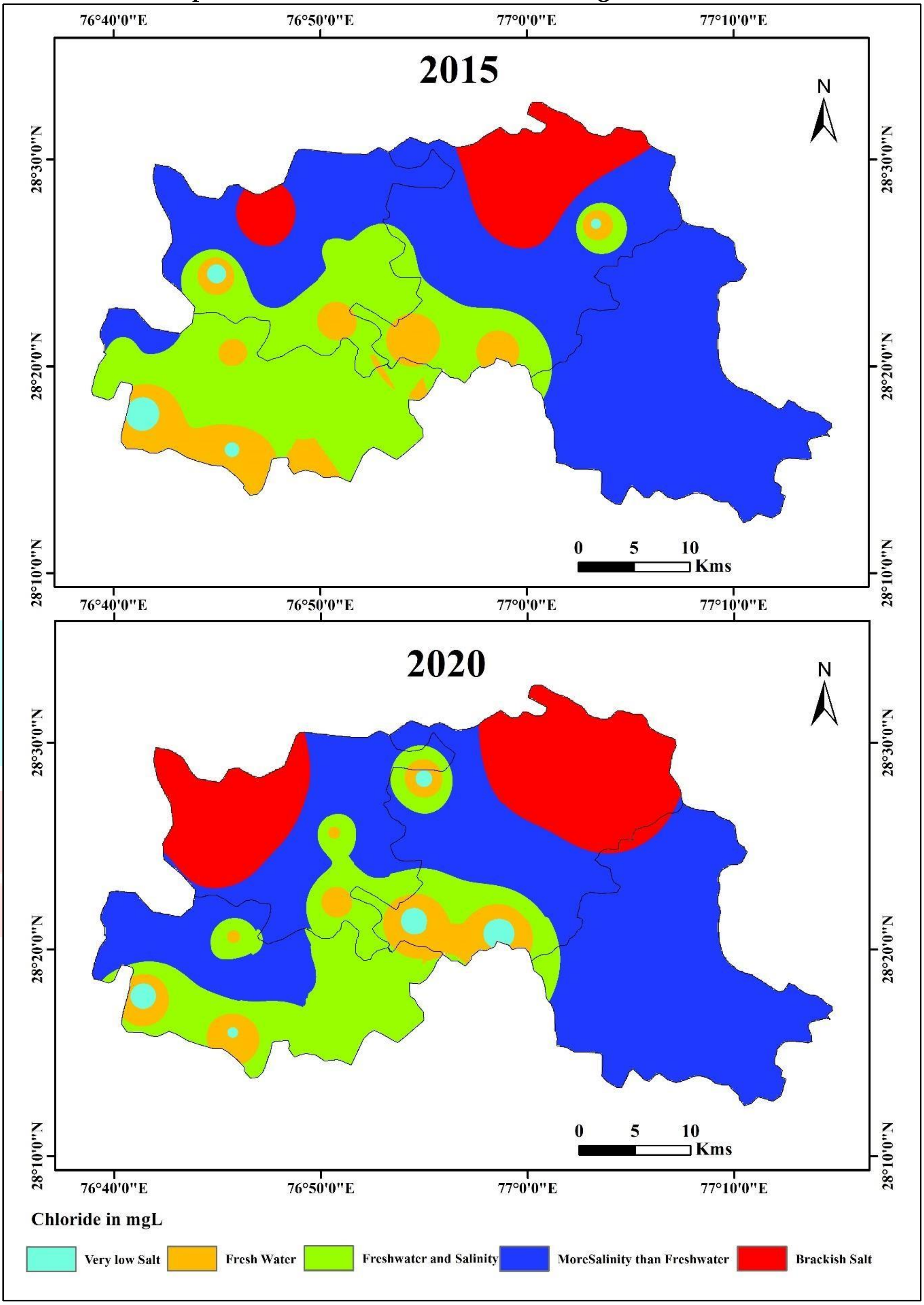



**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

**Chloride in Groundwater in Gurugram District from 2015 to 2020**

The map 5 shows the amount of chloride in groundwater in Gurugram District from 2015 to 2020. The map is divided into different color-coded zones to represent different chloride levels. The legend at the bottom of the map shows the chloride ranges in milligrams per liter (mg/L). The overall chloride in groundwater in Gurugram District has increased over the past 5 years. In 2015, the average chloride level was between 100 and 200 mg/L. However, by 2020, the average chloride level had increased to between 200 and 300 mg/L. This represents an increase of 50 to 100 mg/L over the past 5 years.The increase in chloride has been uneven across the district. The highest chloride levels are now found in the northern and western parts of the district, where the chloride level is greater than 300 mg/L. The lowest chloride levels are found in the southern and eastern parts of the district, where the chloride level is less than 100 mg/L.The increase in chloride has accelerated in recent years. For example, between 2015 and 2017, the average chloride level increased by 50 mg/L. However, between 2017 and 2020, the average chloride level increased by 100 mg/L.The map also shows that the increase in chloride has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map 5 also shows that the increase in chloride has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem. The increase in chloride in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water. In addition to the above, it is important to note that chloride is also an important nutrient for plants. However, too much chloride can be toxic to plants.The increase in chloride in groundwater quality in Gurugram District has a number of implications for the local population and environment. High chloride levels in drinking water can cause a number of health problems, such as high blood pressure, heart disease, and stroke. Chloride is corrosive and can damage plumbing fixtures and appliances. High chloride levels in soil can reduce the productivity of agricultural crops.Gurugram District is a rapidly developing area with a growing population and economy. This has led to an increase in water demand, which has put pressure on groundwater resources.

**Map 5: Chloride in Groundwater in Gurugram District**




**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

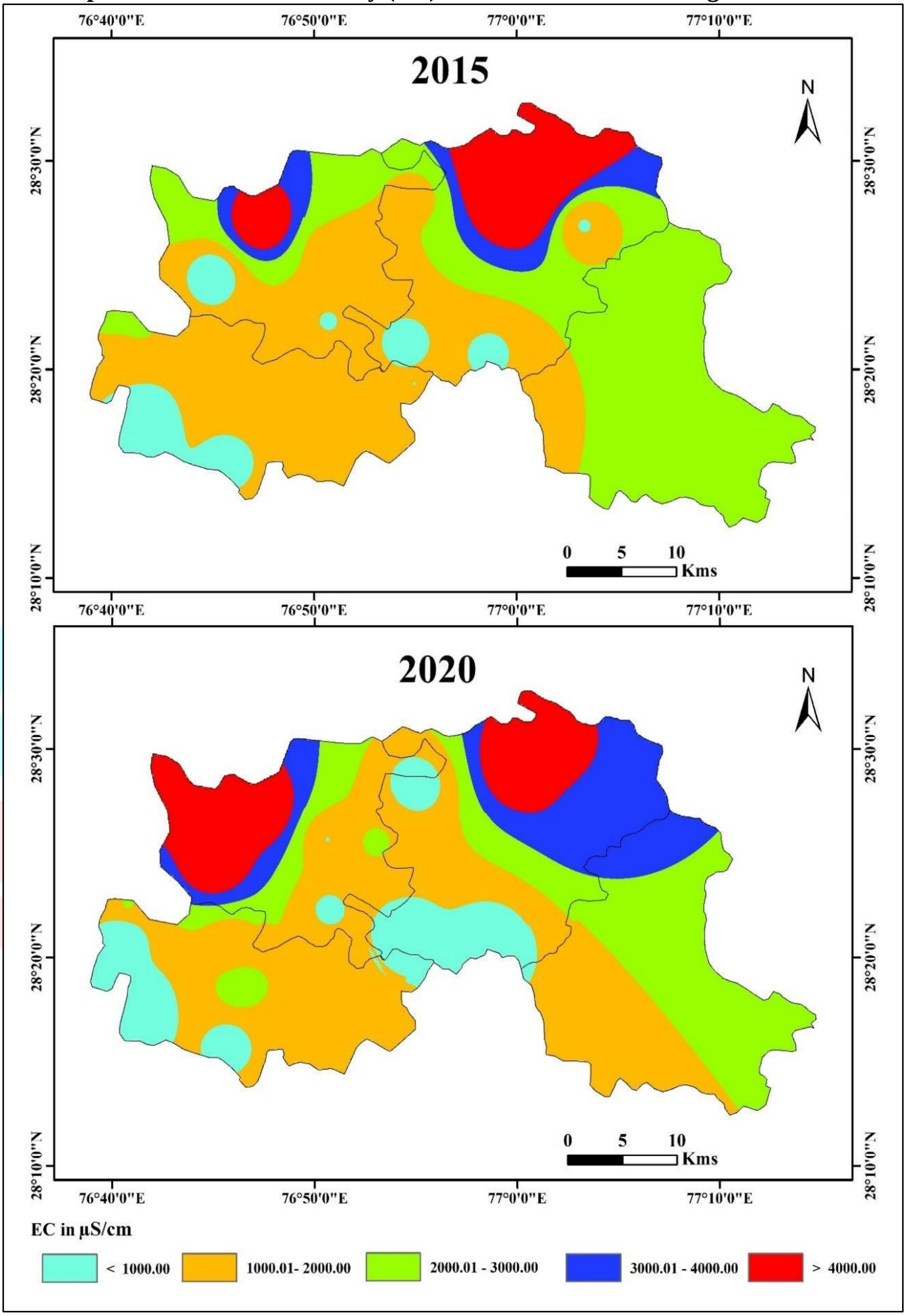
**Electrical Conductivity (EC) in Groundwater from 2015 to 2020**

The map 6 shows the Electrical Conductivity (EC) in groundwater in Gurugram District from 2015 to 2020. The map is divided into different color-coded zones to represent different EC levels. The legend at the bottom of the map shows the EC ranges in micro siemens per centimetres (µS/cm). The overall EC in groundwater in Gurugram District has increased over the past 5 years. In 2015, the average EC level was between 1000 and

2000 µS/cm. However, by 2020, the average EC level had increased to between 2000 and 3000 µS/cm. This represents an increase of 500 to 1000 µS/cm over the past 5 years. The increase in EC has been uneven across the district. The highest EC levels are now found in the northern and western parts of the district, where the EC level is greater than 3000 µS/cm. The lowest EC levels are found in the southern and eastern parts of the district, where the EC level is less than 1000 µS/cm.

The increase in EC has accelerated in recent years. For example, between 2015 and 2017, the average EC level increased by 500 µS/cm. However, between 2017 and 2020, the average EC level increased by 1000 µS/cm. The map 6 also shows that the increase in EC has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map also shows that the increase in EC has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem. The increase in EC in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water. The EC of water is a measure of its ability to conduct electricity. It is influenced by the presence of dissolved salts and minerals in the water. Higher EC levels indicate higher concentrations of dissolved salts and minerals. The increase in EC in groundwater quality in Gurugram District has a number of implications for the local population and environment. High EC in drinking water can cause a number of health problems, such as high blood pressure, heart disease, and stroke. Hard water, which is water with high EC, can damage plumbing fixtures and appliances. High EC in soil can reduce the productivity of agricultural crops. This can be done through a variety of measures, such as promoting water conservation awareness, improving irrigation practices, and recycling wastewater. This can be done through rainwater harvesting, artificial recharge, and afforestation.

**Map 6: Electrical Conductivity (EC) in Groundwater in Gurugram District**




**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

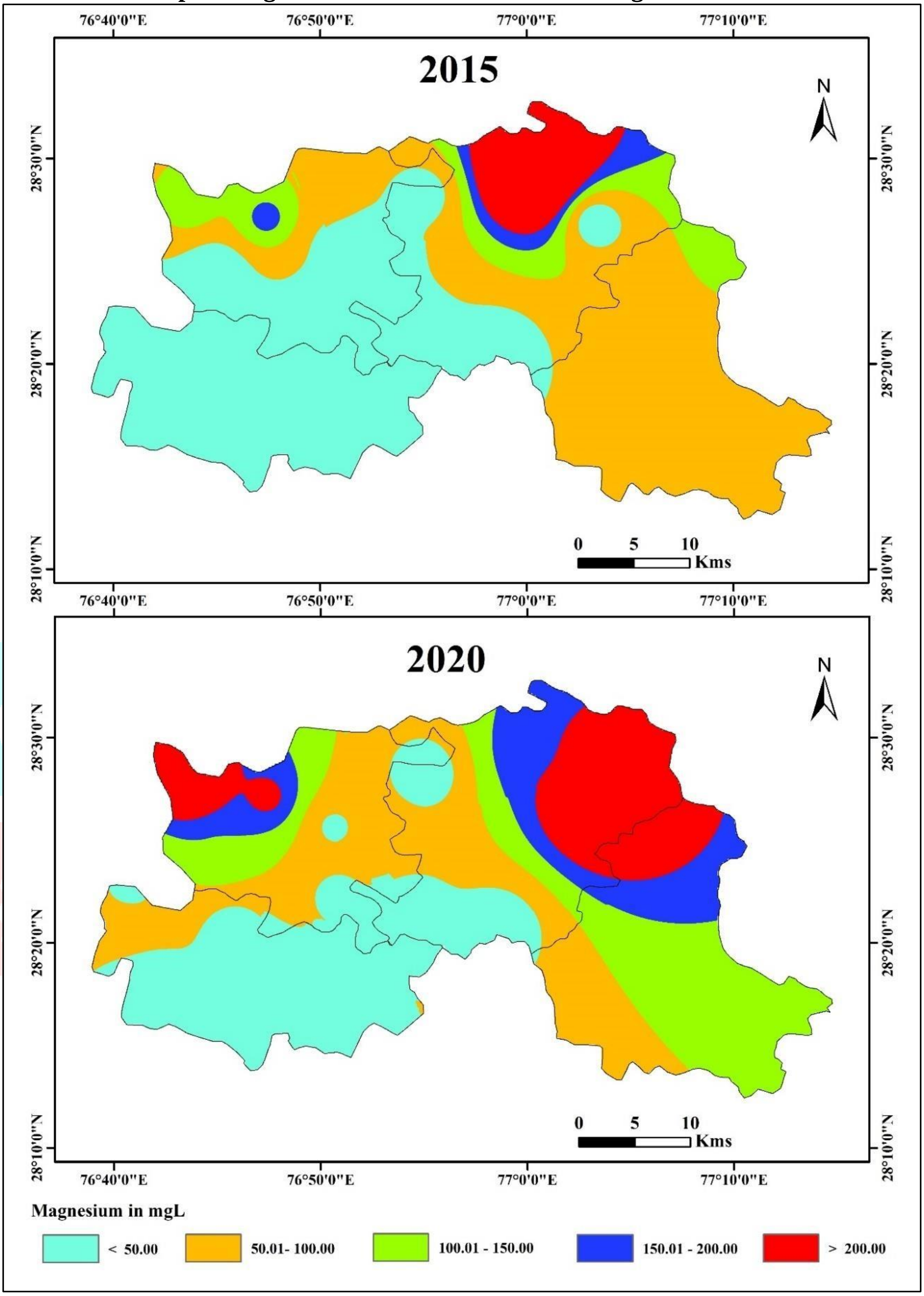
**Magnesium in Groundwater in Gurugram District from 2015 To 2020**

The map 7 shows the magnesium concentration in groundwater in Gurugram District from 2015 to 2020. The map is divided into different color-coded zones to represent different magnesium levels. The legend at the bottom of the map shows the magnesium ranges in milligrams per liter (mg/L). The overall magnesium in groundwater in Gurugram District has decreased over the past 5 years. In 2015, the average magnesium level was between 50 and 100 mg/L. However, by 2020, the average magnesium level had decreased to between 25 and 50 mg/L. This represents a decrease of 25 to 50 mg/L over the past 5 years. The decrease in magnesium has been uneven across the district. The lowest magnesium levels are now found in the northern and western parts of the district, where the magnesium level is less than 25 mg/L. The highest magnesium levels are found in the southern and eastern parts of the district, where the magnesium level is greater than 50 mg/L. The decrease in magnesium has accelerated in recent years. For example, between 2015 and 2017, the average magnesium level decreased by 25 mg/L. However, between 2017 and 2020, the average magnesium level decreased by 50 mg/L.

The map 7 also shows that the decrease in magnesium has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map also shows that the decrease in magnesium has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem. The decrease in magnesium in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water. In addition to the above, it is important to note that magnesium is also an important nutrient for plants. It helps to improve plant growth and yield.

The decrease in magnesium in groundwater quality in Gurugram District has a number of implications for the local population and environment. Magnesium is an essential nutrient for human health. It is involved in a number of important bodily functions, such as muscle contraction, nerve function, and blood pressure regulation. A low magnesium level in the blood can lead to a number of health problems, such as muscle cramps, fatigue, and headaches. Magnesium is an important nutrient for plants. A low magnesium level in the soil can reduce the productivity of agricultural crops.

**Map 7: Magnesium in Groundwater in Gurugram District**




**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

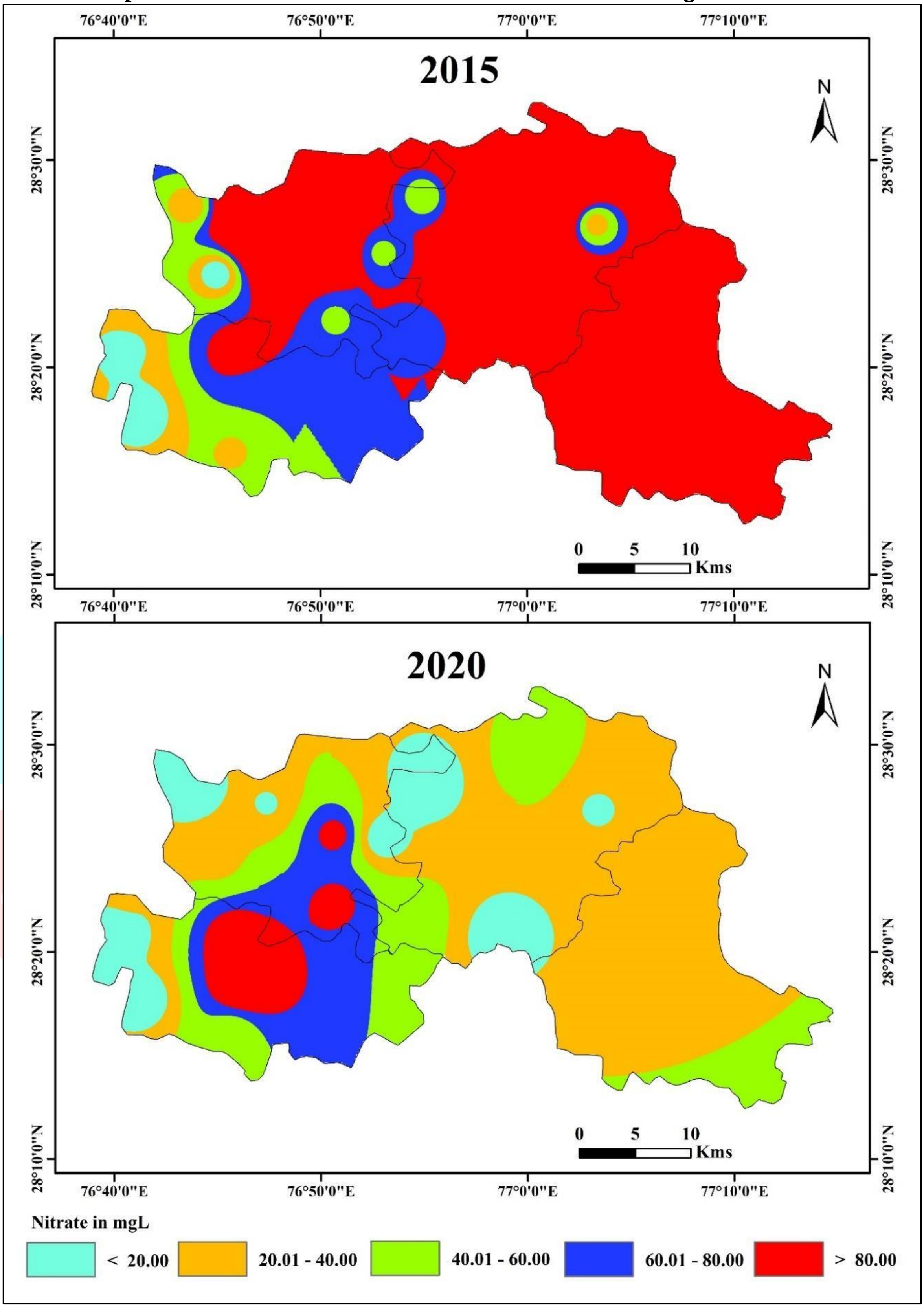
**Nitrate Concentration in Groundwater Quality from 2015 To 2020**

The map 8 shows the nitrate concentration in groundwater quality from 2015 to 2020. The map is divided into different color-coded zones to represent different nitrate levels. The legend at the bottom of the map shows the nitrate ranges in milligrams per liter (mg/L).The overall nitrate in groundwater quality in Gurugram District has increased over the past 5 years. In 2015, the average nitrate level was between 25 and 50 mg/L. However, by 2020, the average nitrate level had increased to between 50 and 100 mg/L. This represents an increase of

25 to 50 mg/L over the past 5 years.The increase in nitrate has been uneven across the district. The highest nitrate levels are now found in the northern and western parts of the district, where the nitrate level is greater than 100 mg/L. The lowest nitrate levels are found in the southern and eastern parts of the district, where the nitrate level is less than 25 mg/L.

The increase in nitrate has accelerated in recent years. For example, between 2015 and 2017, the average nitrate level increased by 25 mg/L. However, between 2017 and 2020, the average nitrate level increased by 50 mg/L.The map also shows that the increase in nitrate has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater use of fertilizers in agriculture.The map 8 also shows that the increase in nitrate has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem.The increase in nitrate in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water.It is important to note that nitrate is a naturally occurring substance in the environment. However, human activities, such as the excessive use of fertilizers and the improper disposal of sewage and manure, can lead to elevated nitrate levels in groundwater. This can pose a risk to human health and the environment.There are a number of possible reasons for the increase in nitrate in groundwater quality in Gurugram District. Nitrate is a common component of fertilizers. Excessive use of fertilizers can lead to the leaching of nitrate into groundwater. Sewage and manure contain high levels of nitrate. Runoff from sewage and manure can contaminate groundwater with nitrate. Septic tanks can leak nitrate into groundwater, especially in areas with high population density and shallow groundwater tables.There are a number of things that can be done to address the increase in nitrate in groundwater quality in Gurugram District.

***Map* 8: Nitrate Concentration in Groundwater in Gurugram District**




**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

**Potassium Concentration in Groundwater from 2015 To 2020**

The map 9 shows the potassium concentration in groundwater in Gurugram District, from 2015 to 2020. The map is divided into different color-coded zones to represent different potassium levels. The legend at the bottom of the map shows the potassium ranges in milligrams per liter (mg/L).The overall potassium in groundwater in Gurugram District has decreased over the past 5 years. In 2015, the average potassium level was between 50 and 100 mg/L.

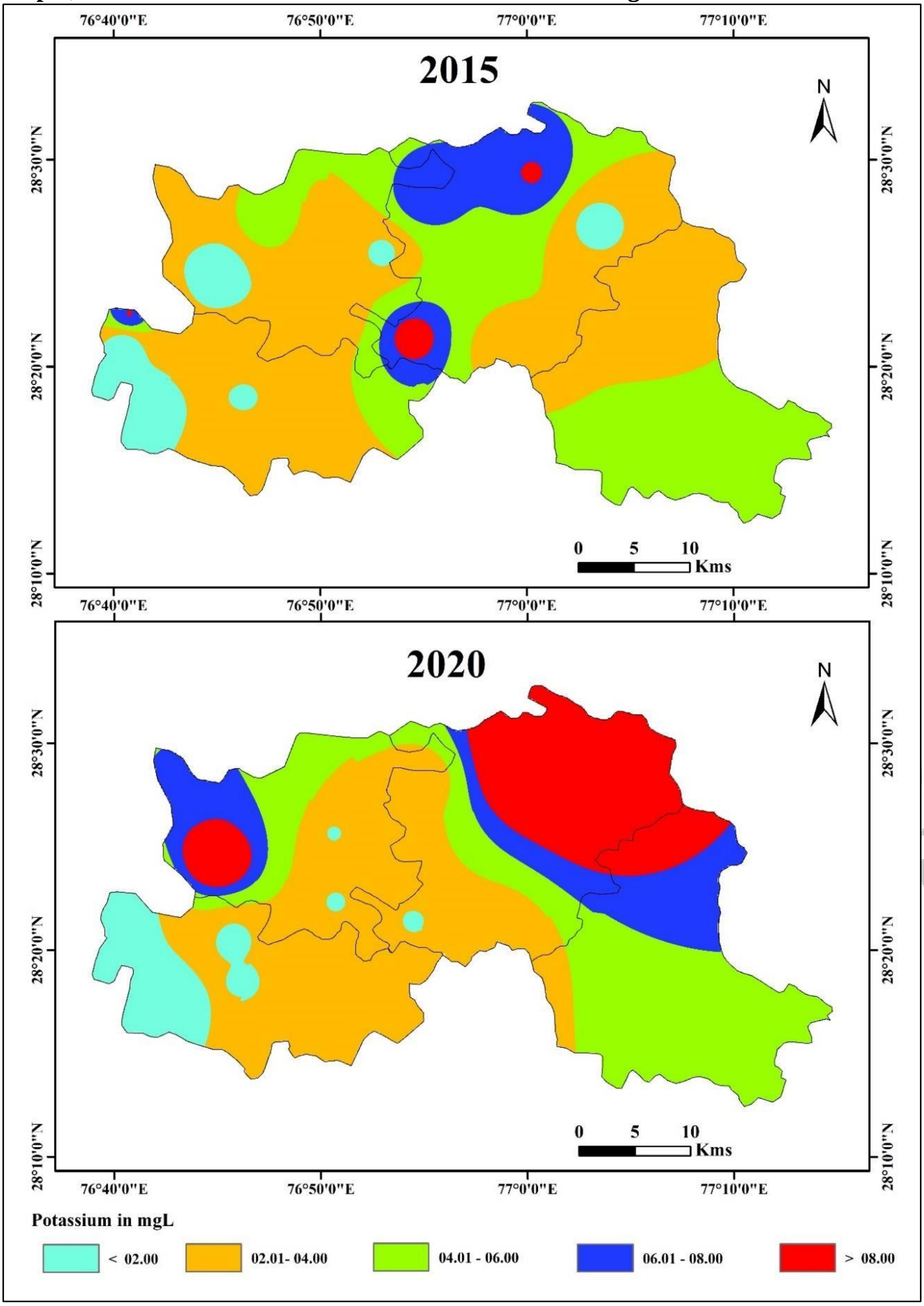
However, by 2020, the average potassium level had decreased to between 25 and 50 mg/L. This represents a decrease of 25 to 50 mg/L over the past 5 years.The decrease in potassium has been uneven across the district. The lowest potassium levels are now found in the northern and western parts of the district, where the potassium level is less than 25 mg/L. The highest potassium levels are found in the southern and eastern parts of the district, where the potassium level is greater than 50 mg/L.The decrease in potassium has accelerated in recent years. For example, between 2015 and 2017, the average potassium level decreased by 25 mg/L. However, between 2017 and 2020, the average potassium level decreased by 50 mg/L.

The map 9 also shows that the decrease in potassium has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry.The map also shows that the decrease in potassium has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem.

The decrease in potassium in groundwater in Gurugram District has a number of implications for the local population and environment. Potassium is an essential nutrient for plants. A low potassium level in the soil can reduce the productivity of agricultural crops. Potassium is an important mineral for human health. It helps to maintain fluid balance, nerve function, and muscle contraction. A low potassium level in the blood can lead to a number of health problems, such as muscle cramps, fatigue, and headaches.

There are a number of things that can be done to address the decrease in potassium in groundwater quality.Reducing water demand can be done through a variety of measures, such as promoting water conservation awareness, improving irrigation practices, and recycling wastewater. Recharging groundwater resources can be done through rainwater harvesting, artificial recharge, and afforestation.

**Map 9; Potassium Concentration in Groundwater in Gurugram District**




**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

**Sodium Concentration in Groundwater from 2015 to 2020**

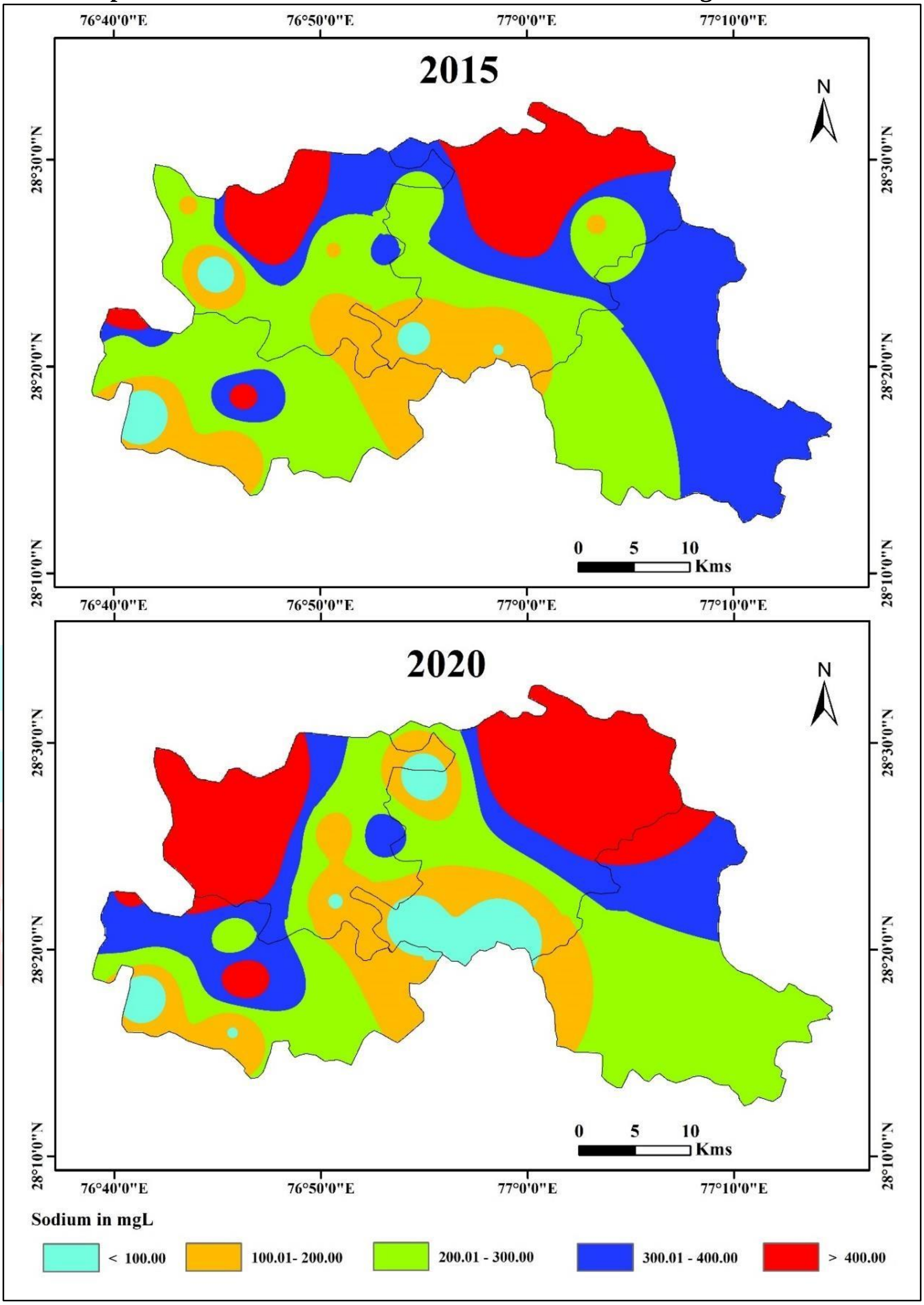
The map 10 shows the sodium concentration in groundwater in Gurugram District, India, from 2015 to 2020. The map is divided into different color-coded zones to represent different sodium levels. The legend at the bottom of the map shows the sodium ranges in milligrams per liter (mg/L). The overall sodium in groundwater in Gurugram District has increased over the past 5 years. In 2015, the average sodium level was between 100 and 200 mg/L. However, by 2020, the average sodium level had increased to between 200 and 300 mg/L. This represents an increase of 50 to 100 mg/L over the past 5 years.

The increase in sodium has been uneven across the district. The highest sodium levels are now found in the northern and western parts of the district, where the sodium level is greater than 300 mg/L. The lowest sodium levels are found in the southern and eastern parts of the district, where the sodium level is less than 100 mg/L. The increase in sodium has accelerated in recent years. For example, between 2015 and 2017, the average sodium level increased by 50 mg/L. However, between 2017 and 2020, the average sodium level increased by 100 mg/L.

The map 10 also shows that the increase in sodium has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry. The map also shows that the increase in sodium has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem. The increase in sodium in groundwater quality in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water. In addition to the above, it is important to note that sodium is also an essential nutrient for human health. However, too much sodium can be harmful.

The increase in sodium in groundwater in Gurugram District has a number of implications for the local population and environment. High sodium levels in drinking water can cause a number of health problems, such as high blood pressure, heart disease, and stroke. Sodium is corrosive and can damage plumbing fixtures and appliances. High sodium levels in soil can reduce the productivity of agricultural crops. There are a number of things that can be done to address the increase in sodium in groundwater quality in Gurugram District.

**Map 10: Sodium Concentration in Groundwater in Gurugram District**




**Sources:**ataljal.hid.gov.in and prepared by Research Scholar

**Sulphate Concentration in Groundwater from 2015 to 2020**

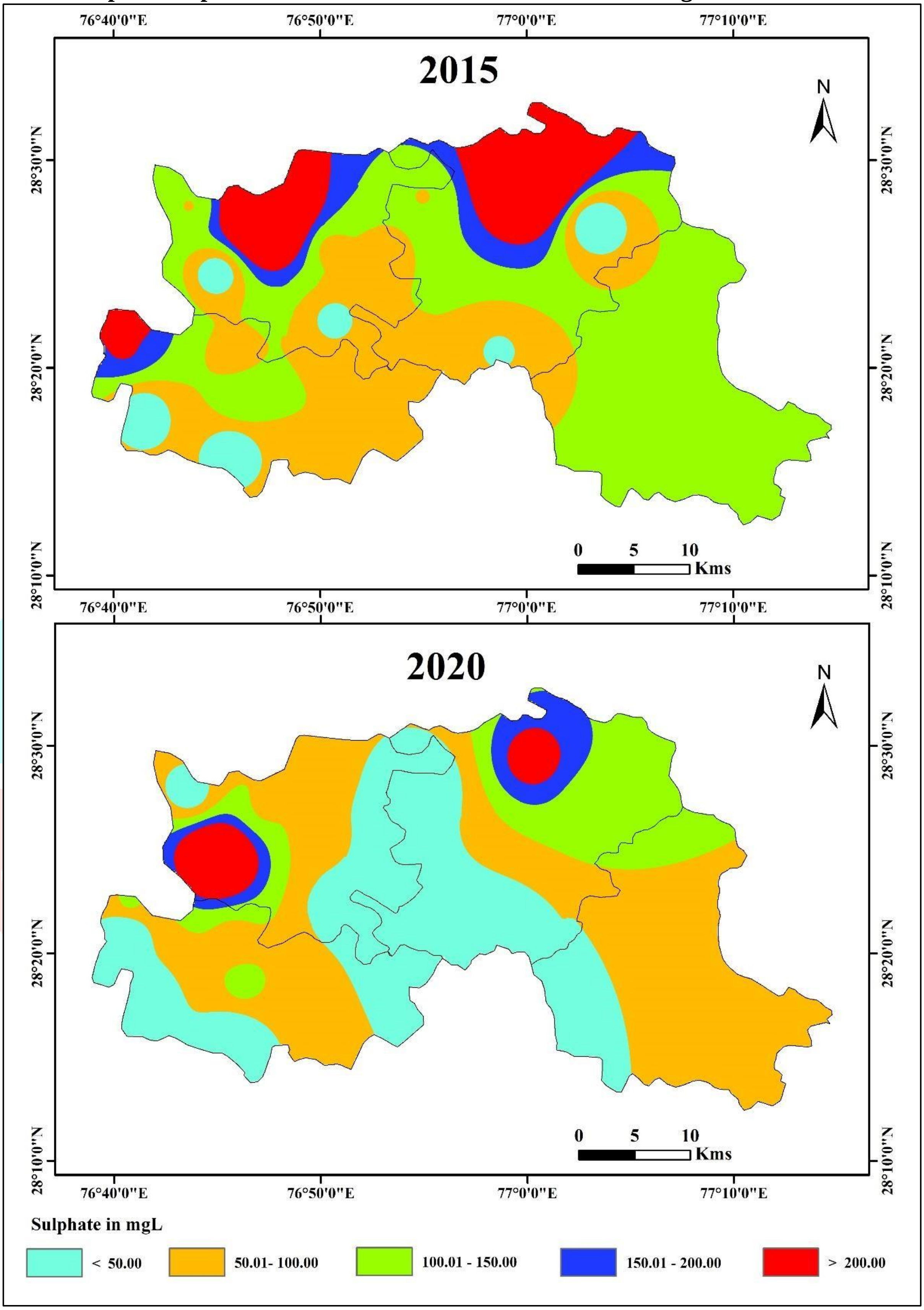
The map 11 shows the sulphate concentration in groundwater in Gurugram District, from 2015 to 2020. The map is divided into different color-coded zones to represent different sulphate levels. The legend at the bottom of the map shows the sulphate ranges in milligrams per liter (mg/L). The overall sulphate in groundwater in Gurugram District has increased over the past 5 years. In 2015, the average sulphate level was between 100 and 200 mg/L. However, by 2020, the average sulphate level had increased to between 200 and 300 mg/L. This represents an increase of 50 to 100 mg/L over the past 5 years.

The increase in sulphate has been uneven across the district. The highest sulphate levels are now found in the northern and western parts of the district, where the sulphate level is greater than 300 mg/L. The lowest sulphate levels are found in the southern and eastern parts of the district, where the sulphate level is less than 100 mg/L.The increase in sulphate has accelerated in recent years. For example, between 2015 and 2017, the average sulphate level increased by 50 mg/L. However, between 2017 and 2020, the average sulphate level increased by 100 mg/L.

The map 11 also shows that the increase in sulphate has been more pronounced in the northern and western parts of Gurugram District. This is likely due to a number of factors, such as the higher population density in these areas and the greater demand for water from agriculture and industry.The map also shows that the increase in sulphate has been more pronounced in recent years. This is a worrying trend, and it suggests that urgent action needs to be taken to address the problem.The increase in sulphate in groundwater in Gurugram District is a serious problem. However, there are a number of things that can be done to address this problem. By taking action now, we can ensure that future generations have access to clean and safe water.

The increase in sulphate in groundwater in Gurugram District has a number of implications for the local population and environment. High sulphate levels in drinking water can cause a number of health problems, such as diarrhea, dehydration, and respiratory problems. Sulphate is corrosive and can damage plumbing fixtures and appliances. High sulphate levels in soil can reduce the productivity of agricultural crops.There are a number of things that can be done to address the increase in sulphate in groundwater quality in Gurugram District.

**Map 11: Sulphate Concentration in Groundwater in Gurugram District**




**Sources:** ataljal.hid.gov.in and prepared by Research Scholar

## Conclusion

The groundwater quality in Gurugram District has shown a concerning trend in terms of total hardness over the five-year period from 2015 to 2020. The total hardness, measured in milligrams per liter (mg/L), has increased significantly. In 2015, the average total hardness was between 100 and 200 mg/L, but by 2020, it had risen to between 200 and 300 mg/L, marking an increase of 50 to 100 mg/L during this period. The highest total hardness levels are now found in the northern and western parts of the district, exceeding 300 mg/L, while the southern and eastern areas have lower levels, less than 100 mg/L. Furthermore, the increase in total hardness accelerated notably in the later years, with a 100 mg/L increase between 2017 and 2020.

The rapid increase in total hardness, especially in the northern and western regions, calls for immediate attention and intervention to address this concerning issue.In contrast to total hardness, the bicarbonate levels in the groundwater of Gurugram District have decreased between 2015 and 2020. Initially, the average bicarbonate levels ranged between 200 and 300 mg/L, but by 2020, they had dropped to between 100 and 200 mg/L, marking a decrease of 50 to 100 mg/L. The northern and western regions of the district currently exhibit lower bicarbonate levels, less than 100 mg/L, while the southern and eastern areas have higher levels, surpassing 300 mg/L.

The levels of calcium in groundwater in Gurugram District have increased during the fiveyear period from 2015 to 2020. Initially, the average calcium levels were between 50 and 100 mg/L, but by 2020, they had risen to between 100 and 150 mg/L, marking an increase of 50 to 100 mg/L. The northern and western parts of the district currently exhibit the highest calcium levels, exceeding 150 mg/L, while the southern and eastern areas have lower levels, less than 50 mg/L. This increase in calcium levels has accelerated, with a 100 mg/L increase between 2017 and 2020. As with total hardness, the increase in calcium is more pronounced in the northern and western regions, possibly due to higher population density and industrial and agricultural water demand. Urgent action is required to tackle this issue and ensure clean and safe water for future generations.

The levels of carbonate in groundwater in Gurugram District have decreased from 2015 to 2020. Initially, the average carbonate levels ranged between 50 and 100 mg/L, but by 2020, they had dropped to between 25 and 50 mg/L, marking a decrease of 25 to 50 mg/L. The northern and western regions of the district currently exhibit the lowest carbonate levels, less than 25 mg/L, while the southern and eastern areas have higher levels, surpassing 50 mg/L. The decrease in carbonate has accelerated, with a 50 mg/L decrease between 2017 and 2020, primarily in the northern and western parts of the district. This decrease is likely due to increased water demand and climate change, leading to more extreme weather events impacting groundwater quality. Addressing this issue is vital for maintaining water quality and ensuring the availability of clean and safe water for the future.

The groundwater quality in Gurugram District, Haryana, from 2015 to 2020 has shown significant variations in the concentrations of various key components. The chloride levels in groundwater quality in Gurugram District have increased over the past five years.In 2015, the average chloride level ranged from 100 to 200 mg/L, but by 2020, it had increased to 200-300 mg/L, indicating a 50 to 100 mg/L increase.This increase has been more pronounced in the northern and western parts of the district.The acceleration of chloride increase is a concerning trend with implications for public health, water infrastructure, and agriculture.

In 2015, the average EC ranged from 1000 to 2000 µS/cm, whereas in 2020, it increased to 2000-3000 µS/cm, representing an increase of 500 to 1000 µS/cm.Similar to chloride, the northern and western parts of Gurugram District have experienced more significant increases.Urgent action is needed to address this rising EC trend, as it has implications for water quality and agriculture.The concentration of magnesium in groundwater quality has decreased over the past five years.In 2015, the average magnesium level ranged from 50 to 100 mg/L, but by 2020, it decreased to 25-50 mg/L, signifying a decrease of 25 to 50 mg/L.The decrease is more pronounced in the northern and western parts of the district.This trend has implications for agricultural productivity and human health. Nitrate levels have increased from 2015 to 2020.In 2015, the average nitrate level ranged from 25 to 50 mg/L, whereas in 2020, it increased to 50-100 mg/L, marking a 25 to 50 mg/L increase.The northern and western parts of Gurugram District have experienced more significant increases, likely due to factors like agricultural practices and population density.High nitrate levels in drinking water can pose health risks, especially for infants.Potassium levels in groundwater have decreased over the past five years. In 2015, the average potassium level ranged from 50 to 100 mg/L, but by 2020, it decreased to 25-50 mg/L, representing a decrease of 25 to 50 mg/L.The decrease is more pronounced in the northern and western parts of the district.This has implications for agricultural productivity and human health.Sodium levels in groundwater quality have increased over the same period.In 2015, the average sodium level ranged from 100 to 200 mg/L, but by 2020, it increased to 200-300 mg/L, indicating a 50 to 100 mg/L increase.The northern and western parts of Gurugram District have seen more significant increases, likely due to population density and water demand.High sodium levels in drinking water can have health and infrastructure implications.The concentration of sulphate in groundwater quality has increased over the past five years.In 2015, the average sulphate level ranged from 100 to 200 mg/L, but by 2020, it increased to 200-300 mg/L, signifying an increase of 50 to 100 mg/L.

The increase is more pronounced in the northern and western parts of the district.High sulphate levels can lead to health issues and water infrastructure damage.These trends in groundwater quality have significant implications for both public health and agricultural productivity in Gurugram District.

Urgent actions are needed to address these changes and ensure access to clean and safe water for future generations. Measures may include improved water management practices, efficient agricultural methods, and addressing factors contributing to the changes in water quality.Gurugram District in Haryana has experienced significant changes in groundwater quality between 2015 and 2020, with notable increases in total hardness and calcium levels and decreases in bicarbonate and carbonate levels. These changes pose challenges for water quality and sustainability and call for immediate and comprehensive measures to address the issues and ensure a clean and safe water supply for the district's growing population and economy.

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