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Trend analysis of groundwater level of Raipur district: A survey of rice growers

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Abstract
Groundwater is essentially water stored beneath the Earth's surface in the tiny spaces within rocks, soil, and gravel. It's a crucial natural resource that supplies a significant portion of the world's freshwater needs. Groundwater is replenished naturally through a process called *infiltration*. Rainwater seeps into the ground, gradually filling up the spaces in the underground layers. Groundwater is a vital component of the Earth's water supply, and its significance can be seen in several areas. Groundwater's significance cannot be overstated, and its conservation and management are crucial for ensuring a sustainable future. The present survey was conducted in Raipur district of Chhattisgarh during the year 2024, were 2 blocks namely (Dharsiwa and Tilda) selected purposively. A total of 120 respondents participated in this study, 60 respondents from each of the blocks. The finding of the study revealed that, the trend line shows the groundwater level (in feet below ground level) over several time periods. In initial Period (2001 - 2006) groundwater level is at 108 feet below ground level. In 2007 – 2011, the level drops slightly to 109.23 feet below ground level. In 2012 – 2016 a more significant decline was seen, 112.49 feet below ground level. In 2017 – 2021 the ground level falls further to 119.66 feet below ground level. In current situation (2022 – 2023), the groundwater level reaches 128.87 feet below ground level. The rate of decline appears to increase over time. The initial drop from 2001 to 2006 is relatively small, but the subsequent periods show increasingly larger declines. In the most recent period (2022 - 2023), it shows the largest decline, suggesting that the situation is worsening.

Keywords: Trend analysis, ground water level, rice, Raipur, Chhattisgarh, water, agricultural, I.G.K.V., natural resources

Introduction
The groundwater behaviour in the Indian sub-continent is highly complicated due to the occurrence of diversified geological formations with considerable lithological and chronological variations. The ground water potential of the State as per latest assessment is 13.68 BCM, and Net Ground Water Availability for future irrigation development is 10.67 BCM. The medium tube wells are constructed in alluvial areas down to an average depth 40-50 m. Groundwater, frequently underestimated, is a crucial lifeline for our planet. (Ground Water Status Chhattisgarh, Water Resources Department 2020). It is the water that infiltrates the earth, filling the gaps in rocks and soil. This concealed reservoir supports life by offering an essential source of water for agriculture, industry, and everyday use. Boosting groundwater levels involves implementing various strategies to restore aquifers and promote sustainable water use. Creating recharge pits, trenches, or basins facilitates the infiltration of rainwater into the soil, enhancing groundwater replenishment. Harvesting and storing rainwater from rooftops and other surfaces for direct use or to seep into the ground can elevate groundwater levels. Planting trees and reforesting areas improves water infiltration and reduces runoff, aiding in groundwater recovery. Utilizing efficient irrigation techniques, such as drip or sprinkler systems, minimizes water loss and encourages more groundwater absorption. Raising awareness about the significance of groundwater and promoting community involvement in conservation efforts can foster more sustainable practices and improved management. In this prospect, the following survey was conducted "Trend analysis of Groundwater level of Raipur district". (2023 Water Resources Department, Chhattisgarh).

Materials and Methods

The present study was conducted in Raipur district of Chhattisgarh. Raipur district consist of 4 blocks (Arang, Abhanpur, Dharsiwa and Tilda). Out of these 4 blocks, 2 blocks namely Dharsiwa and Tilda were selected purposively. Groundwater trend analysis is a crucial tool for understanding the long-term behaviour of groundwater resources. Data for this study was collected through a pre structured interview process the sample size includes 120 rice grower farmers from the 2 blocks (Dharsiwa and Tilda) in Raipur district of Chhattisgarh. Selected based on their Ground Water irrigation availability. The interview questionnaire focused on various aspect such as irrigation availability, cropping pattern, Ground water utilization pattern, cropping intensity etc. It involves examining historical data on groundwater levels, often collected over several decades, to identify patterns and changes. This information is essential for effective water resource management, planning, and policymaking. The trend line shows the water availability (measured in feet below ground level) over the time, spanning the years 2001 to 2023. The data is presented in five-year intervals. The trend line is a blue line that visually connects the data points, suggesting an overall trend in water availability.

Results

The trend line shows a clear upward slope, indicating that water availability has been generally decreasing over the examined period. While the trend is upward, there are fluctuations between data points, signifying periods of varying water availability within the five-year intervals. This suggests a declining water table. The trend line shows the groundwater level (in feet below ground level) over several time periods. In initial period (2001 - 2006) groundwater level is at 108 feet below ground level. In 2007 – 2011, the level drops slightly to 109.23 feet below ground level. In 2012 – 2016 a more significant decline was seen i.e. 112.49 feet below ground level. In 2017 – 2021 the ground level falls further to 119.66 feet below ground level. In current situation (2022 – 2023), the groundwater level reaches 128.87 feet below ground level. Consistent decline in the groundwater levels show a consistent downward trend over the years, indicating continuous depletion of groundwater resources. The rate of decline appears to increase over time. The initial drop from 2001 to 2006 is relatively small, but the subsequent periods show increasingly larger declines. In the most recent period (2022 - 2023), it shows the largest decline, suggesting that the situation is worsening. The increasing rate of groundwater depletion likely reflects higher water demand, possibly due to agricultural, industrial, and domestic uses, sustainability concerns the consistent decline in groundwater levels raises serious concerns about the long-term sustainability of water resources. If the trend continues, it could lead to severe water shortages, impacting agriculture, drinking water supplies, and ecosystems.

Perception of the respondents towards availability of ground water, A very high percentage (95.83%) of respondents believe that flood irrigation is a primary source of groundwater. 91.70 percent of respondents agree that groundwater availability is changing. Over 90.83 percent of respondents agree that decreased rainfall due to climate change is contributing to the lowering of the groundwater table. 88.33 percent of the respondents are agreed with avoiding runoff rain water helps to recharge ground water. 85.33 percent of the respondents believe that water conservation practices are waste of time, labour, and money. A significant number (84%) of respondents agreed that canal water supply is inadequate for crop needs and a significant number (84.00%) of respondents agree that canal water supply is inadequate for crop needs. 80.83 percent of respondents want that scientists should develop more efficient irrigation system. There is a strong demand for technological solutions to address water scarcity with 79.16 percent of respondents were agreed with the ground water table going down. A high percentage i.e. 75.00 percent of respondents agreed that there is increasing reliance on groundwater and farmers are heavily dependent on groundwater for irrigation. A significant proportion i.e. 74.16 percent of respondents believe in the effectiveness of water conservation awareness programs. Farmers recognizes the importance of education and awareness in addressing groundwater issues.

Conclusion

Consistent decline in the groundwater levels show a consistent downward trend over the years, indicating continuous depletion of groundwater resources. The increasing rate of groundwater depletion likely reflects higher water demand, possibly due to agricultural, industrial, and domestic uses, sustainability concerns the consistent decline in groundwater levels, raises serious concerns about the long-term sustainability of water resources. If the trend continues, it could lead to severe water shortages, impacting agriculture, drinking water supplies, and ecosystems. Groundwater is a limited and priceless resource that requires our careful management and protection. By embracing sustainable practices and making thoughtful decisions, we can preserve its availability for future generations. We must acknowledge groundwater for the crucial role it plays and take active measures to protect this essential part of our planet’s ecosystem.

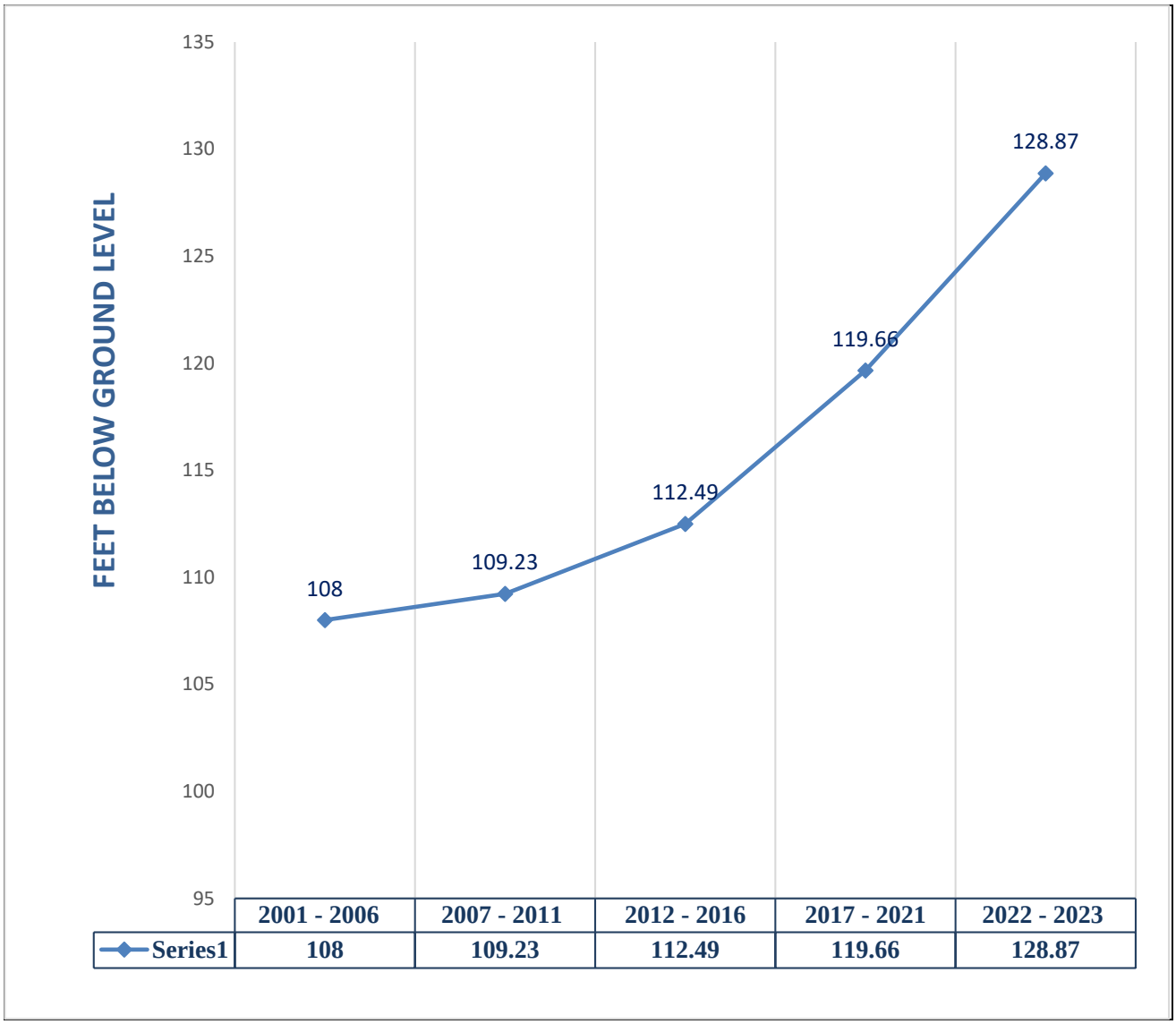


Fig 1: Trend of Declining Water Availability (Feet Below Ground Level) Over Time (2001 – 2023)

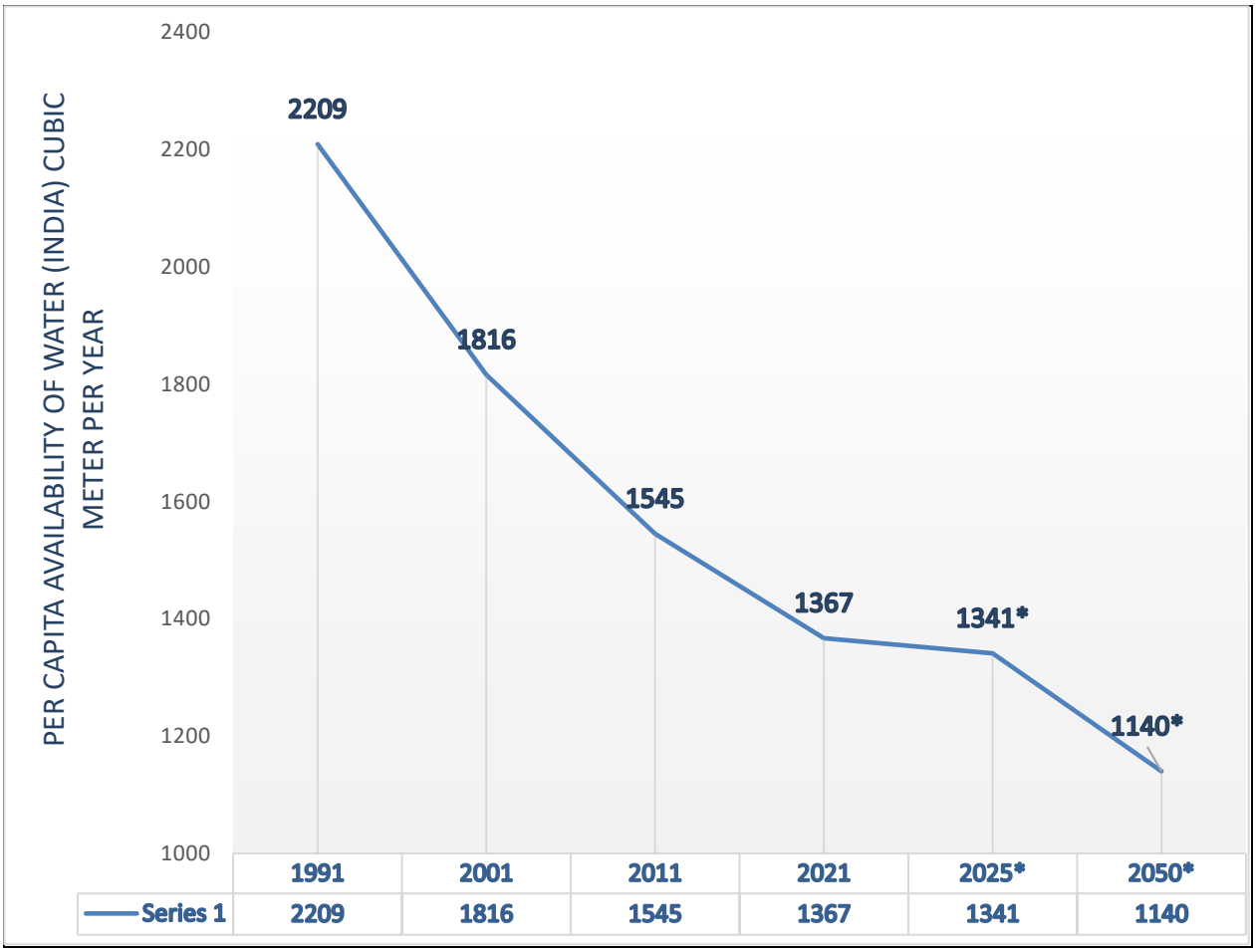
Per Capita Availability of Water

The average annual water availability of any region or country is largely dependent upon hydro meteorological and geological factors. As per the "Reassessment of water availability in basins using space inputs" report, the total water availability of India received through precipitation is about 3,880 billion Cubic Meter (BCM). Due to geological and other factors, the utilizable water availability is limited to 1,139 BCM per annum comprising 690 BCM of surface water and 449 BCM of replenishable ground water. Out of this, the water potential utilized is around 691 BCM, comprising 450 BCM of surface water and 241 BCM of groundwater. Total requirement of the country for different uses for high demand scenario for the years 2025 and 2050 has been assessed as 843 BCM and 1,180 BCM, respectively. (Department of Water Resources, River Development & Ganga Rejuvenation) Water availability per person is depend on population of the country. Per capita water availability in the country is reducing progressively. The average annual per capita water availability in the years 2011 and 2025 was assessed as 1,545 cubic meters and 1,341 cubic meters respectively which may further reduce due to increase in population. Annual per capita water availability of less than 1,700 cubic meters is considered as water stressed condition, whereas annual per-capita water availability below 1,000 cubic meters is considered as a water scarcity condition. (Department of Water Resources, River Development & Ganga Rejuvenation)

Table 2: Trend of Declining Water Availability (Feet below Ground Level) Over Time (2001 – 2023)

Year	Per Capita Availability of Water (m^3/ year)
1991	2209
2001	1816
2011	1545
2021	1367
2025*	1341*
2050*	1140*

The table provides data on the per capita availability of water in India from 1991 to 2050, measured in cubic meters per year. This metric indicates the average amount of water available for each person in the country during a given year.



Source: Department of Water Resources, Ministry of Jal Shakti

Fig 2: Per capita availability of water (India) cubic meter per year

Overall, there has been a significant decline in per capita water availability in India over the past few decades. This trend is indicative of increasing water scarcity and the growing strain on water resources. The highest per capita availability was recorded in 1991, at 2209 cubic meters per year. The trend of decline continued from 2001 to 2021, with notable drops between 1991 and 2001, and between 2011 and 2021. The trendline includes projections for 2025 and 2050, indicating a further decrease in per capita availability. These projections suggest that water scarcity will likely become more severe in the coming decade. India's population has grown significantly over the past few decades, leading to increased demand for water resources, changes in rainfall patterns and increased water pollution due to climate change are further exacerbating water scarcity. The declining per capita availability of water in India has serious implications for various sectors, including agriculture, industry, and domestic use. Addressing water scarcity will require sustainable water management practices, such as rainwater harvesting, efficient irrigation systems, and reducing water wastage.

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