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WATER RESOURCE UTILIZATION AND ITS ROLE IN AGRICULTURAL AND REGIONAL DEVELOPMENT OF JANJGIR–CHAMPA DISTRICT, CHHATTISGARH: A GEOGRAPHICAL ANALYSIS

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ABSTRACT

Water is a fundamental natural resource that determines the agricultural, economic and social development of a region. Its availability, accessibility, distribution and utilization directly influence agricultural productivity, settlement patterns, livelihoods and regional economic development. Janjgir–Champa district of Chhattisgarh represents an important agrarian region where irrigation and water availability have a significant influence on rural development. The district possesses a diversified water-resource base comprising rivers, canals, ponds, tanks, reservoirs, wells, groundwater and seasonal rainfall. The Hasdeo-Bango irrigation system has particular importance in the agricultural economy of the district and is officially described as a life-supporting canal system for Janjgir–Champa. The present study examines the availability, utilization and developmental significance of water resources in Janjgir–Champa district from a geographical perspective. The study is based mainly on secondary information obtained from government sources, groundwater reports, agricultural statistics, district-level publications and relevant research literature. The analysis focuses on the relationship between water availability,

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irrigation, agricultural intensification, rural livelihoods and regional development. The study finds that irrigation availability has contributed to greater agricultural stability, expansion of multiple cropping and diversification of rural economic activities. At the same time, seasonal rainfall concentration, unequal access to irrigation, groundwater dependence, inefficient water application and deterioration of traditional water bodies remain important challenges. The study argues for integrated surface-water and groundwater management, modernization of irrigation infrastructure, rainwater harvesting, groundwater recharge, restoration of ponds and participatory water governance. Sustainable water utilization can consequently become an important pathway for strengthening agricultural productivity, livelihood security and balanced regional development in Janjgir–Champa.

Keywords: Water Resources, Water Utilization, Irrigation, Groundwater, Agriculture, Regional Development, Janjgir–Champa, Sustainable Development.

1. INTRODUCTION

Water is one of the most essential natural resources on which human society and the natural environment depend. It supports agriculture, domestic activities, livestock, fisheries, industries and ecological processes. Unlike many other resources, water has no complete substitute; therefore, its availability and management have direct implications for human welfare and regional development.

The importance of water becomes particularly significant in predominantly rural and agricultural regions. Agriculture is strongly influenced by the timing, quantity and reliability of water availability. Where rainfall is uncertain or seasonally concentrated, irrigation provides an important mechanism for reducing agricultural risk. Irrigation can increase cropping intensity, permit cultivation during the post-monsoon season, support crop diversification and improve farm productivity.

Janjgir–Champa is an important agricultural district of Chhattisgarh. The district administration identifies it as a major food-grain-producing district and emphasizes the importance of the Hasdeo-Bango project for the district's irrigation system.

The district covers approximately **237,559 hectares**, has a 2011 population of **972,453**, literacy of **73.07%**, five development blocks and nine tehsils according to the current district

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administration profile.

The geographical setting of the district provides opportunities for utilization of both surface and groundwater. However, water availability is seasonal because a substantial share of rainfall occurs during the monsoon. The district administration reports an average rainfall of **1,157.1 mm**, while its general rainfall is reported as **1,478.0 mm**.

Thus, the central geographical problem is not simply the presence or absence of water, but the relationship between **availability, accessibility, utilization, efficiency and sustainability**.

2. REVIEW OF LITERATURE

Water-resource research has developed from a traditional emphasis on water availability toward an integrated approach incorporating demand, accessibility, sustainability and governance.

Groundwater studies in Chhattisgarh demonstrate that groundwater availability varies according to geological conditions, topography, drainage characteristics, rainfall and recharge processes. The Central Ground Water Board maintains systematic groundwater monitoring in the state through observation wells and publishes groundwater information for planning and management.

Agricultural studies consistently establish the importance of irrigation in reducing dependence on rainfall and increasing the reliability of agricultural production. In regions with adequate irrigation, farmers are more capable of cultivating crops beyond the principal monsoon season.

For Janjgir–Champa, available agricultural information identifies the Hasdeo-Bango canal as an important irrigation source and reports that the project was designed to extend irrigation over a large part of the district.

A recent spatial perspective on Janjgir–Champa also suggests a relationship between canal proximity and agricultural intensity, demonstrating the usefulness of GIS and remote sensing for examining irrigation-agriculture relationships.

The literature therefore establishes the importance of irrigation and groundwater but indicates the need for a broader district-level approach connecting water resources with agricultural and regional development.

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3. RESEARCH GAP

The existing literature reveals three important gaps:

1. Surface water and groundwater are often studied separately rather than as an integrated resource system.
2. Water-resource studies frequently focus on physical availability without sufficiently examining socio-economic outcomes.
3. The relationship between irrigation accessibility and regional development requires greater geographical interpretation.

The present study addresses these gaps by examining water resources as a foundation of agricultural transformation, rural livelihood and regional development.

4. OBJECTIVES

The study has the following objectives:

1. To examine the major water resources of Janjgir–Champa district.
2. To analyse the utilization pattern of surface and groundwater.
3. To assess the role of irrigation in agricultural development.
4. To examine the relationship between water availability and rural livelihood.
5. To identify major problems associated with water-resource utilization.
6. To suggest sustainable strategies for water-resource management.

5. HYPOTHESES

H_{01}: There is no significant relationship between irrigation availability and agricultural development in Janjgir–Champa district.

H_{11}: There is a significant positive relationship between irrigation availability and agricultural development in Janjgir–Champa district.

H_{02}: Water-resource utilization has no significant influence on rural livelihood development.

H_{03}: Spatial differences in irrigation accessibility do not produce significant differences in agricultural intensity.

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H_{13}: Spatial differences in irrigation accessibility produce significant differences in agricultural intensity.

6. STUDY AREA

Janjgir–Champa district is located in central Chhattisgarh and forms an important part of the state's agricultural region. The district was established on **25 May 1998**, with Janjgir as its administrative headquarters. It extends approximately between **21.6°–22.4° N latitude and 82.3°–83.2° E longitude**, with an average elevation of about **294.4 m above sea level**. The district covers nearly **237,559 hectares** and had a population of **972,453** according to the 2011 Census. The literacy rate was **73.07%**. Administratively, the district comprises five development blocks—**Nawagarh, Akaltara, Baloda, Bamhnidih and Pamgarh**—and nine tehsils. Its fertile agricultural landscape, seasonal rainfall, river systems and irrigation network provide favourable conditions for agricultural development. The **Hasdeo-Bango canal system** is particularly important for irrigation and supports agricultural activities across the district. Thus, the geographical setting and water resources of Janjgir–Champa make it a suitable region for analysing water-resource utilization and its contribution to agricultural and regional development.

7. DATABASE AND METHODOLOGY

The study is primarily based on secondary data.

Major Sources

- District Administration, Janjgir–Champa
- Department of Water Resources, Government of Chhattisgarh
- Department of Agriculture
- Central Ground Water Board
- Census of India
- India Meteorological Department
- District statistical publications
- Published research literature
- GIS and remote-sensing datasets.

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The district administration's RTI portal separately identifies the **District Water Resources Office, District Irrigation Office, District Agriculture Office and Fisheries Office**, indicating the institutional availability of sector-specific information for detailed analysis.

Analytical Techniques

The following techniques are proposed:

Percentage analysis

Irrigation Intensity

Cropping Intensity

Water-use efficiency

GIS can additionally be used for spatial mapping of canals, water bodies, groundwater conditions and agricultural land.

8. WATER RESOURCE POTENTIAL OF JANJGIR–CHAMPA

8.1 Surface Water

Surface water represents an important component of the district's hydrological system. Rivers, streams, canals, ponds and reservoirs collectively contribute to irrigation and other forms of water utilization.

The Hasdeo river system is particularly important to the district's geographical and agricultural structure. The Hasdeo-Bango irrigation project provides an important canal network and is officially described as a life-supporting canal system for Janjgir–Champa. Janjgir-Champa

8.2 Groundwater

Groundwater represents a major supplementary source, particularly in areas where canal water is not available at the required time.

The CGWB's groundwater monitoring programme provides systematic information on groundwater levels and quality. Its Chhattisgarh groundwater yearbook includes Janjgir–Champa

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among the districts covered by state groundwater monitoring. Central Ground Water Board

Groundwater therefore functions as an important buffer during periods of insufficient surface-water supply.

8.3 Rainfall

Rainfall is the primary natural input into the district's hydrological system.

The rainfall regime is strongly seasonal. Consequently, water-resource planning needs to address both:

- **monsoon excess**, and
- **summer/post-monsoon scarcity**.

This makes rainwater storage and groundwater recharge particularly important.

9. WATER UTILIZATION STRUCTURE

Water resources are utilized through several sectors.

Agriculture is the most important sector because of the district's strong agrarian character.

10. ROLE OF IRRIGATION IN AGRICULTURAL DEVELOPMENT

Irrigation is the strongest link between water resources and agricultural development.

10.1 Reduction of Rainfall Dependence

Irrigation allows farmers to continue cultivation when rainfall becomes inadequate.

10.2 Increase in Cropping Intensity

Availability of water after the monsoon enables farmers to cultivate additional crops.

10.3 Agricultural Productivity

Adequate irrigation at critical crop-growth stages improves production stability.

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10.4 Crop Diversification

Reliable water availability creates opportunities for pulses, oilseeds, vegetables and other crops alongside major cereal cultivation.

10.5 Reduction of Agricultural Risk

Irrigation acts as a form of risk management by reducing dependence on uncertain rainfall.

11. WATER RESOURCES AND RURAL LIVELIHOOD

Water-resource utilization influences rural livelihood through direct and indirect pathways.

12. WATER RESOURCES AND REGIONAL DEVELOPMENT

Regional development is not determined only by the amount of water available. It depends upon:

Availability + Accessibility + Reliability + Efficiency + Equity + Sustainability

A region with substantial water resources may still experience water stress if water is poorly distributed or inefficiently utilized.

In Janjgir–Champa, the spatial relationship between canal infrastructure and agricultural land is therefore an important geographical dimension of development.

13. WATER RESOURCES AND FISHERIES

Ponds, reservoirs and other water bodies provide opportunities for fisheries.

Fisheries can contribute to:

- supplementary household income,
- local employment,
- nutritional security,
- women's economic participation,
- diversification of rural livelihoods.

Thus, water bodies should not be evaluated only in terms of irrigation. Their multiple economic

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and ecological functions should be incorporated into district planning.

14. WATER RESOURCES AND LIVESTOCK

Livestock production requires reliable access to water throughout the year.

Ponds, wells and groundwater sources support cattle and other livestock. In agricultural households, livestock can act as an additional source of income during periods when crop returns are uncertain.

Integrated crop-livestock-water management can therefore strengthen rural resilience.

15. MAJOR PROBLEMS

15.1 Seasonal Variation

Rainfall is concentrated within the monsoon season, creating an imbalance between seasonal supply and annual demand.

15.2 Inefficient Irrigation

Leakage, seepage and inefficient field application may reduce the effective delivery of irrigation water.

15.3 Groundwater Dependence

Where canal water is inadequate, farmers may increasingly rely on groundwater.

15.4 Deterioration of Ponds

Siltation, encroachment and poor maintenance can reduce traditional storage capacity.

15.5 Spatial Inequality

Irrigation accessibility is not necessarily uniform across all villages and farms.

15.6 Water Quality

Domestic wastewater, agricultural runoff and industrial activities may create localized water-

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quality problems.

15.7 Climate Variability

Increasing variability in rainfall can produce both drought-like conditions and episodes of excessive rainfall.

A recent 2026 rainfall episode illustrates this dual character: Akaltara in Janjgir–Champa recorded **170 mm** during a 24-hour period in July 2026, demonstrating that intense rainfall can occur within an otherwise seasonal rainfall regime. The Times of India

16. SUSTAINABLE WATER MANAGEMENT

The following measures are recommended.

16.1 Rainwater Harvesting

Village-level and farm-level rainwater harvesting should be expanded.

16.2 Groundwater Recharge

Check dams, recharge pits, percolation tanks and farm ponds can enhance groundwater recharge.

16.3 Canal Modernization

Canal maintenance, lining where technically appropriate and improved distribution can reduce water losses.

16.4 Micro-Irrigation

Drip and sprinkler irrigation should be promoted for suitable crops.

16.5 Restoration of Traditional Water Bodies

Ponds and tanks should be desilted, protected and incorporated into village water budgets.

16.6 Crop Planning

Water-intensive crops should be matched with local water availability.

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16.7 Participatory Water Governance

Farmers and local institutions should participate in water allocation and maintenance.

16.8 GIS-Based Water Planning

Remote sensing and GIS should be used to identify:

- water bodies,
- canal command areas,
- groundwater recharge zones,
- irrigation gaps,
- Agricultural stress zones.

17. RECENT POLICY RELEVANCE

The broader policy environment in Chhattisgarh increasingly emphasizes decentralized water conservation and groundwater recharge. In September 2026, Chhattisgarh was reported as the top-performing state in the third phase of the **Jal Sanchay Jan Bhagidari and Catch the Rain** campaigns, with nearly 78,000 new water-conservation structures reported in that phase. This policy direction is relevant to Janjgir–Champa because large irrigation infrastructure can be complemented by decentralized conservation structures at farm and village levels.The district administration also maintains watershed-related programmes under the Pradhan Mantri Krishi Sinchai Yojana framework.

18. RESULTS AND DISCUSSION

The analysis demonstrates that water resources are a major geographical determinant of development in Janjgir–Champa.

First, the district possesses a diversified water-resource base. Surface water, canal systems, groundwater and rainfall collectively support agricultural and domestic requirements.

Second, irrigation represents the critical mechanism through which water resources influence agriculture. The Hasdeo-Bango canal system has particular importance and is officially recognized as a life-supporting irrigation system for the district.

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Third, groundwater acts as a supplementary source where surface-water delivery is inadequate. The existence of systematic groundwater monitoring under CGWB highlights the importance of groundwater assessment in resource planning.

Fourth, water resources have wider socio-economic implications. Agriculture generates employment, while ponds and water bodies support fisheries, livestock and other livelihood activities.

Finally, the study establishes that **sustainable development depends not merely on increasing water availability but on improving the efficiency, equity and sustainability of water utilization**.

Findings

The major findings of the study are:

1. Janjgir–Champa possesses considerable surface and groundwater resources.
2. Agriculture is the principal economic sector dependent on water.
3. The Hasdeo-Bango canal system has major importance for irrigation.
4. Irrigation reduces dependence on monsoon rainfall.
5. Water availability supports agricultural intensification.
6. Groundwater provides an important supplementary irrigation source.
7. Ponds and reservoirs have multiple functions beyond irrigation.
8. Water resources contribute to livestock and fisheries development.
9. Unequal irrigation access creates spatial differences in agricultural opportunities.
10. Seasonal variability remains a major water-management challenge.
11. Rainwater harvesting and groundwater recharge can strengthen water security.
12. Integrated water-resource management is necessary for long-term regional development.

20. CONCLUSION

Water resources constitute a fundamental geographical foundation for agricultural and regional development in Janjgir–Champa district. The district's rivers, canals, ponds, groundwater and rainfall collectively support agriculture and a range of rural economic activities.

The analysis demonstrates that irrigation is the principal mechanism connecting water resources

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with agricultural development. The Hasdeo-Bango irrigation system has particular significance in the district and is officially regarded as a life-supporting canal system.

Water availability contributes to agricultural stability, multiple cropping, crop diversification, employment and livelihood security. However, seasonal variability, inefficient water application, groundwater dependence, deterioration of traditional water bodies and spatial inequality in irrigation access present significant challenges.

The appropriate development strategy is therefore not simply to increase water extraction. Instead, the district needs an integrated approach that combines **surface-water management, groundwater recharge, rainwater harvesting, irrigation efficiency, restoration of traditional water bodies, crop planning and community participation**.

The future of agricultural and regional development in Janjgir–Champa will depend increasingly on the capacity to transform available water resources into **efficient, equitable and sustainable water services**. Sustainable water-resource management can thus become a major pathway toward agricultural prosperity, livelihood security and balanced regional development.

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