

STUDY OF BISULPUR DAM-A LIFE LINE OF TONK (RAJASTHAN)

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Abstract

The Rajasthani Bisalpur Dam, built on the Banas River, provides a lifeline for the drought-prone Tonk district and surrounding territories. Water security, agricultural support, improved access to drinking water in both urban and rural areas, and regional socioeconomic growth are some of the many important aspects of the Bisalpur Dam that this research aims to analyze. The dam has stabilized agricultural production and improved the livelihoods of local inhabitants by providing a consistent source of irrigation and drinking water, significantly reducing Tonk's susceptibility to recurring droughts. The research also emphasizes the dam's strategic relevance in Rajasthan's water management system by highlighting its role in delivering drinking water to big cities like Tonk, Jaipur, and Ajmer. To provide a well-rounded picture, we also looked at the environmental effects, including how river ecology changed, groundwater recharge, and issues associated to displacement. This study assesses the pros and cons of the Bisalpur Dam using secondary data culled from official documents, hydrological statistics, and other research. While the dam has improved water availability and resilience in the region, the results show that sustainable management approaches are needed to solve environmental problems and make sure the advantages last. In sum, the Bisalpur Dam is a crucial piece of infrastructure that has had and will have far-reaching effects on the Tonk district's economy, society, and ecology, earning it the title of "lifeline" for the area.

Keywords: Bisalpur, Dam-A life line, Tonk, Rajasthan

Introduction

For a long time, water shortage has been a major problem in Rajasthan, especially in the semi-arid and dry parts of the state. Regional planners and developers have prioritized sustainable water management in response to climate change, increased population density, more frequent and severe droughts, and high evapotranspiration rates. To alleviate water stress and guarantee socioeconomic stability, massive multifunctional river valley projects have been instrumental in this regard. Particularly for the Tonk area, the Bisalpur Dam—built on the Banas River—serves as an essential water supply for domestic use, agricultural irrigation, and regional progress in general. Agricultural and domestic water demands in Tonk district, which is situated in the eastern section of Rajasthan, have historically been met by groundwater and monsoon rains. But falling water levels, crop failures, and repeated droughts are the results of over-extraction of groundwater and unpredictable rainfall patterns. Rural communities and city water systems were both hit hard by the region's severe water shortage before the Bisalpur Dam was built. Tonk went from being a water-deficient region to one with relatively reliable surface water supply with the commissioning of the Bisalpur Dam, marking a turning point in its hydrological and

developmental history. With its many functions, the Bisalpur Dam can meet a wide range of water demands. Its principal goals are the provision of potable water, the facilitation of irrigation, and the reduction of floods; other goals include the recharging of groundwater and the maintenance of ecological balance in the surrounding area. The dam's lasting impact goes much beyond its original site; it is now the primary source of potable water for Tonk and other large cities like Jaipur, Ajmer, and the neighboring villages. The dam has reduced reliance on tanker supplies and deep tube wells by making potable water available all year round, especially for Tonk area. The Bisalpur Dam has greatly aided Tonk district's agricultural sector, which is the economic backbone of the area. From rain-fed subsistence farming to more stable and varied cropping patterns, farmers have been able to make the transition thanks to the dam-supported irrigation system. As a result, farming communities have seen higher incomes, better food security, and more agricultural output. Consequently, the dam has grown inextricably associated with the improvement of rural areas' economic conditions and social standing. The Bisalpur Dam has affected Tonk's social and natural landscapes in addition to its practical and economic impacts. Public health has improved, fewer people have to leave their homes during droughts, and overall quality of life has gone up because to the increased availability of water. Submergence of land, displacement of towns, and modifications in riverine ecosystems are only a few of the environmental and social difficulties brought about by the dam. To get a full picture of the dam's effects, you need to know these factors. This research aims to analyze the Bisalpur Dam, which is vital to Tonk district, in terms of its impact on water security, agricultural growth, and socio-economic change. The research intends to emphasize the need of sustainable water resource management in guaranteeing long-term resilience for Tonk and similar semi-arid regions of India by analyzing the project's advantages and disadvantages.

Literature Review

Academics have continued to focus on India's massive dams and river valley projects for several purposes, especially in light of recent discussions about water shortages, regional development, and social and environmental change. Research on the effects of surface water projects on livelihood security and sustainable development has mostly focused on Rajasthan because of the state's status as one of the most water-stressed in India. Despite its initial focus as a drinking water project, the Bisalpur Dam has since found its way into more policy- and academia-oriented conversations on water governance and resilience in the region.

Previous research on Rajasthan's water resource management has focused on the state's frequent droughts and the problems with systems that rely on groundwater. Researchers like Sharma (2006) and Narain et al. (2012) point out that massive surface water reservoirs have to be built in eastern Rajasthan because of ecological stress and falling water tables caused by unsustainable groundwater exploitation. Research like these laid the groundwork for the idea that major dams like Bisalpur Dam were necessary to stabilize water supplies in arid and semi-arid regions.

Iyer (2007) and Singh (2010) are only two of many Indian studies that highlight the need of multifunctional dams for expanding agriculture, supplying water to cities, and controlling flooding. Despite the fact that big dams have been divisive over relocation and environmental issues, these studies show that they are essential for ensuring water security in regions prone to drought. Within this larger context, the Bisalpur Dam is frequently referenced in official papers and studies as an exemplar

of effective inter-basin and regional water supply augmentation, especially for cities such as Jaipur and Ajmer.

The worsening water shortage in Rajasthan's urban centers has been the focus of research by a number of academics. Projects like Bisalpur were crucial because to the enormous strain that Jaipur's fast urbanization and population expansion put on the city's conventional water sources (Kumari and Singh 2014). Their research shows that the Bisalpur Dam was a planned reaction to urban water scarcity; it guarantees a steady supply for the future by connecting to a vast network of pipelines. Even while they mostly deal with metropolitan areas, they do make a passing reference to the effects on neighboring regions like Tonk.

Researchers have examined the effects of surface water projects on agriculture in eastern Rajasthan. For example, Meena and Rathore (2015) show how irrigation practices and crop patterns changed when reservoir- and canal-based irrigation systems were implemented. Their results imply that greater agricultural intensity and less susceptibility to monsoon failure are outcomes of guaranteed water availability. Studying Bisalpur's indirect effects on agricultural and groundwater recharge in Tonk district is important, even though the dam isn't really designed for irrigation.

Another important area of research on big dams is their social and environmental impacts. Displacement, livelihood loss, and the necessity for efficient rehabilitation plans in regions of India impacted by dams are addressed in works by Cernea (1997) and Fernandes (2008). Although the number of displaced people in Rajasthan may be lesser than in other megaprojects, Jodha (2011) notes that the social and cultural effects on rural areas are still significant. To fully evaluate the Bisalpur Dam, taking into account the difficulties endured by the impacted villages in Tonk district, it is necessary to look at it from these angles, in addition to its economic advantages.

Central Water Commission (CWC) and Rajasthan Water Resources Department reports are only two examples of recent policy-oriented research and government evaluations that highlight sustainability and integrated water resource management. There is a growing consensus in these papers that we must strike a balance between competing demands for potable water, ecological flow, and local water supplies. The Bisalpur Dam's long-term management is greatly affected by the claims made by scholars such as Molle and Mollinga (2018), who state that effective water use and participatory governance are just as important as infrastructure when it comes to future water security.

Large dams in Rajasthan have important hydrological, economic, and social implications, and the current research sheds light on these aspects. But research looking at the Bisalpur Dam as a lifeline for Tonk district at the district level is scarce. Urban water supply or the water issue in Rajasthan as a whole have been the primary foci of most studies. To fill this knowledge vacuum, this study analyzes Bisalpur Dam's impact on water security, livelihoods, and development in Tonk from a local perspective while also taking into account these larger viewpoints.

Dependence of Runoff

Since runoff is directly proportional to rainfall, it is extremely vulnerable to fluctuations in precipitation. However, both climate change and human activities affect the quantity of precipitation that becomes runoff. Alterations to wind speed, humidity, and temperature describe the continuation of climate change. However, evaporation levels are significantly affected by temperature. Over the last several decades, runoff from China's main rivers has been steadily declining. It has become increasingly difficult for water managers to prepare for future demands due to climate-induced reductions in runoff, which have been increasing in size throughout the past few decades. A lack of water is the primary issue impeding local economic growth and environmental improvement in the arid climatic zone through which the Kuyehe River runs in China. The reported discharge at the Wenjiachuan station of the Kuyehe River watershed decreased by 1.34 mm/year between 1980 and 2008, according to a research conducted in China's Kuyehe River. Climate change and human activities are the primary causes of this decrease in runoff. The majority of the 68% decrease in runoff that happened in 1980 was caused by human activities. The following are examples of other factors that influenced runoff: - Variability in the natural world was being overshadowed by human activities. Phase 2 (1998–2002) saw a rise from 58.6% of overall runoff reduction to 74.9% of human-induced runoff reduction, mostly as a result of large-scale changes in watershed features and a quick increase in water usage. From 1980 to 2008, the runoff reduction in the Kuyehe River catchment was primarily caused by human activity. This is reasonable because, on average, climate change accounted for 32.2% of the total runoff reduction and human activity 67.8%.

Land Use Characteristics

Global interest in understanding how human-caused changes to land use impact hydrological processes in catchments is at an all-time high. Nevertheless, despite extensive study and studies spanning decades, very little is known about it. Curiously, the runoff process at the outflow is the system-wide reaction of the whole basin to the input, precipitation. Consequently, if there is a change in the surface area underneath the basin, there will be an equal and opposite change in the system's response. This feature has led many research to center on the idea that changes in output (such as runoff) might represent changes in the forms of land use and land cover. Extreme shifts in the Huaihe River's runoff have occurred in recent decades as a result of changes in land use and land cover. Traditionally, the paired catchment method has been used to measure the impact of changes in land use and land cover on runoff response. However, this method is often limited to small headwater basins where a control can be set up. The newly applied method in the 1,640 km² Dapoling watershed of the upper Huaihe river basin was assessed using the Xinanjiang model. According to the study's findings, the Xinanjiang model is capable of accurately simulating daily runoff and highlighting changes in land use and land cover. The study found that between 1976 and 2005, there was a nearly 25% decrease in runoff due to changes in land use, which suggests that the current pattern of land use consumes more water and enhances evaporation to a greater extent.

Research Methodology

In order to investigate the significance of the Bisalpur Dam as the vital resource for the Tonk district in Rajasthan, the current study makes use of a research approach that is both descriptive and analytical. This technique is designed to evaluate the hydrological, socio-economic, and developmental implications of the dam by including both qualitative and quantitative methodologies. The

methodology is intended to examine these aspects. Due to the nature of the study, the major focus is on secondary data analysis, with a limited number of original observations being used to support the analysis where it is applicable.

Nature of the Study

Both exploratory and evaluative aspects of the research are included in this study. The purpose of this study is to get an understanding of the relevance of the Bisalpur Dam in terms of addressing the issue of water shortage, raising agricultural output, and improving the quality of life in the Tonk area. In addition to this, the research analyzes additional concerns that are linked with it, including as environmental repercussions, problems associated with relocation, and sustainability.

Sources of Data

A significant portion of the research is based on secondary material that was gathered from reliable and legitimate sources. The Rajasthan Water Resources Department, the Public Health Engineering Department (PHED), the Central Water Commission (CWC), the Census of India, and the District Statistical Handbooks of Tonk are some of the official publications and reports that fall under this category. There has also been a comprehensive study of scholarly publications, including but not limited to academic journals, books, research papers, theses, and policy documents that pertain to the management of water resources, big dams, and regional development in Rajasthan. For the purpose of capturing recent events, supplementary material has been gathered from many sources, including media, government websites, and reports from planning commissions.

Study Area

The Tonk district, which is situated in the eastern part of Rajasthan, serves as the focal point of the research project. Particular attention is paid to particular regions that are impacted by the Bisalpur Dam and the Banas River basin. In order to evaluate the differences in water access, agricultural utilization, and socio-economic consequences, the research takes into account various parts of the district, including both rural and urban areas.

Tools and Techniques of Analysis

In order to determine patterns in water availability, irrigation coverage, and agricultural production before to and during the commissioning of the Bisalpur Dam, the data that was obtained was examined using straightforward statistical procedures such as percentages, averages, and comparative analysis. Whenever it is deemed appropriate, tables and graphs are included in order to improve both clarity and interpretation. On the basis of the current literature and reports, qualitative analysis has been utilized to evaluate the consequences of potential policies, issues regarding the environment, and social repercussions.

Time Frame of the Study

In order to conduct an analysis of the long-term changes that have occurred in water supply and regional development, the research spans the time period beginning with the commissioning of the Bisalpur Dam and continuing up to the present day. Data from before and after the construction of the dam have

been compared wherever they are accessible in order to emphasize the transformative effect of the project.

Results and Discussion

After conducting a review of secondary data pertaining to the Bisalpur Dam, it has been determined that the dam has made a significant contribution to the socio-economic development, agriculture, and water security in the Tonk district. Following the presentation of the data in a thematic manner using Tables 1–5, interpretations are provided in order to provide a clear explanation of the observed patterns and implications.

Table 1: Storage Capacity and Water Availability of Bisalpur Dam

Particulars	Details
River	Banas
Gross Storage Capacity	~1,095 MCM
Live Storage Capacity	~800 MCM
Year of Commissioning	1999
Main Beneficiary Areas	Tonk, Jaipur, Ajmer

It is demonstrated in Table 1 that the Bisalpur Dam possesses a large storage and live capacity, which enables it to provide water throughout the entire year, even during years with poor rainfall. The reliance of the Tonk district on the unpredictable monsoon rains and groundwater extraction has been greatly decreased as a result of this capability. As a result of the dam's huge live storage capacity, which guarantees a continuous supply of drinking water and serves as a buffer during times of drought, the dam is considered to be a vital infrastructure for the region.

Table 2: Drinking Water Supply Before and After Bisalpur Dam

Indicator	Pre-Bisalpur Period	Post-Bisalpur Period
Primary Water Source	Groundwater & Tanks	Surface water (Bisalpur)
Frequency of Water Supply	Irregular	Regular
Tanker Dependency	High	Low
Urban Coverage (%)	Limited	Extensive

After the Bisalpur Dam was put into operation, the records show that there has been a significant increase in the amount of drinking water that is available. In the past, the Tonk district experienced acute shortages of drinking water, particularly during the winter and summer months. As a result of the implementation of regular piped water delivery after Bisalpur, the reliance on tankers has decreased, and public health and living conditions have improved. The significance of the dam's role in assuring the availability of drinkable water is shown by this.

Table 3: Impact on Agricultural Irrigation in Tonk District

Parameter	Before Dam	After Dam
Irrigated Area (ha)	Low	Moderately Increased
Cropping Intensity (%)	~110	~135
Dependence on Rainfall	High	Reduced

Crop Diversity	Limited	Improved
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Table 3 illustrates the indirect benefits that the Bisalpur Dam gives to agriculture, despite the fact that its primary purpose is to provide drinking water. Both the increased agricultural intensity and the decreased susceptibility of farmers to the failure of the monsoon have been brought about by the improved groundwater recharge and restricted canal irrigation. There has been an improvement in agricultural stability in the Tonk district, as shown by the trend toward varied cropping patterns.

Table 4: Socio-Economic Changes Linked to Water Availability

Indicator	Pre-Dam Condition	Post-Dam Condition
Seasonal Migration	High	Reduced
Employment Stability	Low	Improved
Health & Sanitation	Poor	Improved
Rural Livelihood Security	Vulnerable	More Stable

An increase in the amount of water that is available as a result of the Bisalpur Dam has resulted in a favorable socioeconomic impact. The decrease in seasonal migration is a reflection of the better prospects for self-sufficiency within the region. A greater availability of potable water has led to improvements in sanitation and health conditions, particularly in rural regions, which has contributed to the general development of the human population.

Table 5: Environmental and Social Impacts of Bisalpur Dam

Aspect	Observed Impact
Groundwater Recharge	Positive
Flood Control	Moderate Benefit
Displacement of Villages	Yes
River Ecology	Altered Flow Regime
Rehabilitation Challenges	Partial

In spite of the fact that the Bisalpur Dam has resulted in major environmental advantages, such as the recharging of groundwater and the reduction of floods, it has also resulted in social and ecological issues, as shown in Table 5. Both the relocation of settlements and the alteration of the ecological balance of rivers highlight the importance of implementing appropriate rehabilitation strategies and sustainable dam management. The effects of these repercussions highlight the need of striking a balance between the advantages of development and environmental and social issues.

The results make it abundantly evident that the Bisalpur Dam has converted the Tonk district, which was formerly a territory with a limited supply of water, into a region with a relatively secure supply of water. The most noteworthy accomplishment is the contribution it has made to the provision of drinking water, which is followed by the indirect advantages it has brought to agriculture and the socio-economic system. On the other hand, environmental changes and problems associated with relocation continue to be major concerns. The findings highlight the significance of coordinated and sustainable water resource management in order to guarantee that the long-term advantages of the Bisalpur Dam would continue to promote the development of the Tonk region while simultaneously limiting any detrimental consequences.

Discussion

This research proves without a reasonable doubt that the Bisalpur Dam was a game-changing infrastructure project that altered the face of Tonk district's water security and growth. In order to assess the dam's lifeline function, new problems and sustainability issues are considered, and the results are integrated with insights from the current literature.

Drinking water security is one of the most important benefits of the Bisalpur Dam. The findings point to a dramatic change away from relying on unstable groundwater and conventional water supplies and toward a more reliable system that relies on surface water. Bisalpur is now indispensable for supplying water to the expanding urban and peri-urban areas of eastern Rajasthan, a finding that is in line with previous research by Kumar and Singh (2014). Tonk district's public health indicators have improved, water-related disputes have decreased, and reliance on tankers for water delivery has decreased. This highlights the strategic value of the dam as a social asset that satisfies fundamental human needs in addition to its physical construction.

Though indirect, the Bisalpur Dam's effects on agriculture are significant. Increased agricultural intensity and variety, along with reduced irrigation assistance, imply improved water availability through groundwater recharge, even though the dam was not originally intended for large-scale irrigation. Meena and Rathore (2015) contend that surface water projects in semi-arid locations frequently produce ancillary agricultural advantages beyond their intended uses, and this conclusion is in line with their arguments. Farmers in Tonk, especially those on the margins and with smaller plots of land, have more stable incomes now that they are less reliant on the unpredictable monsoon rains.

From a societal and economic point of view, the study shows that more readily available water has been crucial in decreasing seasonal migration and increasing job security. The local economy has benefited from the availability of clean water since it has allowed for the continuation of farming, cattle raising, and small-scale rural businesses. Jodha (2011) and other larger development studies have found a correlation between water security and resilience in rural areas and reduced vulnerability in areas prone to drought; these findings are consistent with those findings. Health and sanitation improvements provide more evidence of how water infrastructure affects human development.

But we can't wrap up this conversation about the Bisalpur Dam without talking about the socioeconomic and environmental implications. There are worries about the long-term ecological viability due to changes in local habitats and the natural flow of the Banas River. The problems with rehabilitation and the uprooting of entire communities are similar to those raised by Cernea (1997) and Fernandes (2008) in their criticisms of massive dam projects in India. Despite the fact that Bisalpur's displacement is on a lower scale than mega dams, it nonetheless has a substantial impact on the populations impacted and needs ongoing governmental attention. As the conversation progresses, another pressing concern becomes clear: the growing urban demand, especially in Jaipur and Ajmer, is putting a strain on the Bisalpur Dam. Tonk district residents' demands may take a back seat to those of larger cities as their water demands increase. To prevent unfair results, experts like Molle and Mollinga (2018) stress the need of effective water governance, demand management, and democratic decision-making in addition to infrastructure-led solutions. The Bisalpur Dam has become an essential lifeline for Tonk district, and the discussion as a whole shows that it has mostly achieved its goals. Concurrently, the study stresses

that equitable distribution of water resources, ecological consciousness, and inclusive leadership are crucial to sustainability in the long run. For the Bisalpur Dam's advantages to be shared fairly and maintained for generations to come, it is crucial to strengthen rehabilitation efforts, encourage efficient water use, and include local stakeholders in water management operations.

Conclusion

This research finds that the Bisalpur Dam has saved Tonk district in Rajasthan from chronic water constraint and supported regional growth. The dam changed the hydrological, socio-economic, and developmental characteristics of the region in an arid and semi-arid state. The Bisalpur Dam's main benefit is stable and sustainable drinking water. The switch from groundwater and traditional sources to a dependable surface water infrastructure has enhanced water security for Tonk district's rural and urban residents. This has improved public health, sanitation, and quality of life while reducing seasonal water problems. The dam has provided indirect but significant agricultural advantages despite its drinking water design. boosted groundwater recharge and additional irrigation have boosted farming intensity, reduced monsoon reliance, and fostered crop diversity. These developments have improved rural lives and farming communities' economic stability. Socially, secured water has decreased seasonal migration, stabilized employment, and supported livestock raising and small businesses. Thus, the dam has helped Tonk district's rural resilience and inclusive development. The research acknowledges that the Bisalpur Dam has caused environmental and socioeconomic problems. Village displacement, rehabilitation concerns, and Banas River biological changes require thoughtful and sustainable management. Additionally, rising urban demand from Jaipur and Ajmer threatens fair water allocation and sustainability. The Bisalpur Dam has improved water security and development in Tonk district, but its effectiveness depends on integrated water resource management, ecological protection, and democratic governance. Enhancing rehabilitation, water allocation, and water efficiency are crucial to the project's long-term success. With such efforts, the Bisalpur Dam will continue to power Tonk district's water security and socioeconomic growth for generations.

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