

## The Depleting Blue Water Cycle: An In-depth Examination of Bengaluru's Water Scarcity 2024

Paper Id : 18832 Submission Date : 13/04/2024 Acceptance Date : 20/04/2024 Publication Date : 25/04/2024

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DOI:10.5281/zenodo.11064074

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### Abstract

The water scarcity crisis in Bengaluru, Karnataka's capital, stands as a stark reflection of the challenges posed by climate change. Once renowned for its abundant lakes and verdant landscapes, the city now confronts a severe water shortage jeopardizing its very existence. This depletion of the blue water cycle epitomizes broader issues of drinking water access and management amid rapid urbanization and environmental neglect. As Bengaluru grapples with complex water supply dynamics, the urgency to address this crisis intensifies. This examination delves into the origins and ramifications of Bangalore's water scarcity, juxtaposing its predicament with global water management approaches. By spotlighting innovative solutions and sustainable practices, the article seeks to chart a forward-looking perspective and devise a comprehensive strategy to mitigate the burgeoning crisis. It not only underscores the precarious state of Bengaluru's water resources but also advocates for measures to safeguard and ensure water availability for future generations. Karnataka Chief Minister Siddaramaiah highlighted on Monday, April 18, 2024, that Bengaluru is experiencing a deficit of 500 million litres of water daily, approximately a fifth of the city's total daily demand. He also mentioned ongoing efforts to secure additional water supplies for the city. However, the water shortage extends beyond Bengaluru and encompasses the entire state of Karnataka, as well as neighbouring areas in Telangana and Maharashtra. This scarcity is largely attributed to below-average rainfall over the past year and the characteristics of underground aquifers in the region.

**Keywords** Bengaluru, Water Crises, Day Zero, Karnataka, Scarcity, Bluewater Cycle.

### Introduction

In 2024, Bengaluru, Karnataka's bustling capital, finds itself at the epicentre of a dire water crisis, emblematic of broader challenges stemming from climate change and rapid urbanization. Once celebrated for its lush landscapes and abundant lakes, the city now grapples with a pressing scarcity of water, threatening its very sustainability. With a deficit of 500 million litres of water daily, roughly a fifth of its total demand, Bengaluru's predicament epitomizes the complexities of managing water resources in an increasingly urbanized environment [1]. This crisis extends beyond mere drinking water scarcity, reflecting deeper systemic issues in water management exacerbated by environmental neglect. Against the backdrop of dwindling rainfall and the depletion of underground aquifers, the urgency to address Bengaluru's water woes has never been more pronounced. As the city navigates the intricacies of water supply and crisis mitigation, innovative solutions and sustainable practices emerge as imperative pathways towards securing a resilient future for Bengaluru's water resources and its inhabitants.

Karnataka Chief Minister Siddaramaiah highlighted on Monday, April 18, 2024, that Bengaluru is experiencing a deficit of 500 million litres of water daily, approximately a fifth of the city's total daily demand [2]. He also mentioned ongoing efforts to secure additional water supplies for the city. However, the water shortage extends beyond Bengaluru and encompasses the entire state of Karnataka, as well as neighbouring areas in Telangana and Maharashtra. This scarcity is largely attributed to below-average rainfall over the past year and the characteristics of underground aquifers in the region.

**Objective of study** The objective of this paper is to examine the causes of depleting Blue Water Cycle and Bengaluru's water scarcity problem.

**Review of  
Literature  
Main Text**

This is the review article so reviews have been discussed through out the paper.

During this water crisis of 2024, residents of Bengaluru grappled with a myriad of challenges that severely impacted their daily lives. With a shortage of 500 million litres of water daily, roughly a fifth of the city's total demand, accessing sufficient water for basic needs became increasingly arduous. Many households faced erratic water supply schedules, often enduring prolonged periods without access to running water. This scarcity placed significant strain on families, forcing them to prioritize essential tasks such as cooking and sanitation. Additionally, businesses, industries, and agricultural activities suffered disruptions due to inadequate water supply, leading to economic losses and livelihood uncertainties. The situation exacerbated existing inequalities, disproportionately affecting marginalized communities who lacked resources to mitigate the crisis's impacts. Moreover, concerns about water quality and sanitation heightened, raising fears of waterborne diseases and health hazards. In essence, the water crisis in Bengaluru in 2024 underscored the urgent need for comprehensive measures to address water scarcity and ensure equitable access to this vital resource for all residents.

Water, essential for life on Earth, remains a critical global challenge despite covering the majority of the planet's surface. The worldwide water crisis, marked by scarcity, pollution, and inadequate sanitation, poses significant threats to human health, economic progress, and environmental well-being. Millions of people worldwide face water shortages as resources dwindle, yet the issue of water scarcity receives insufficient attention globally. The United Nations Water Development Report 2018 reveals that approximately 3.6 billion people inhabit areas with dangerously low or rapidly declining water levels, endangering nearly half of the world's population with imminent water deficiencies.

In India, the challenge of clean drinking water availability persists, compounded by rapid population growth. By 2030, the demand-supply gap is expected to widen significantly, exacerbating the situation. According to a 2019 NITI Aayog report, nearly half of India's population, or over 600 million people, experience severe water stress. Moreover, a significant portion of rural households lack access to safe, piped water, leading to reliance on unsafe sources with associated health risks. Disturbing statistics from the World Bank further underscore India's water crisis: 163 million Indians lack access to safe drinking water, while 210 million lack improved sanitation. Unsafe water is linked to 21% of communicable diseases, contributing to the tragic deaths of 500 children under five years old daily due to diarrhoea. Pollution from industrial waste, sewage, and agricultural runoff further contaminates water bodies, rendering water unsuitable for consumption.

**Causes of Water Crises in Bengaluru:**

The water crisis in Bengaluru stems from a combination of interrelated factors. Rapid urbanization and population growth have strained the city's water resources, as the demand has outpaced supply due to the influx of people seeking better opportunities. Another critical factor is the unsustainable extraction of groundwater. In the absence of adequate water supply infrastructure, many residents have turned to drilling borewells, depleting the city's aquifers and aggravating the water scarcity.

Climate change has also significantly impacted Bengaluru's water situation. Altered rainfall patterns and rising temperatures have led to reduced precipitation and increased evaporation, resulting in the drying up of reservoirs and lakes [3]. The once predictable monsoon season, a vital water source, has become increasingly erratic, worsening the crisis. Overall, Bengaluru's water crisis is the product of urbanization, unsustainable groundwater usage, and the adverse effects of climate change, highlighting the need for comprehensive solutions to ensure water security for the city's residents.

**Impact of Water Crisis on the residents of the city:**

The water crisis in Bengaluru has had profound and multifaceted effects on the city and its residents. Agriculture, vital to the region's economy, is faltering as farmers grapple with irrigation challenges. The diminishing water supply has resulted in decreased agricultural output, placing immense financial strain on farmers and jeopardizing local food security. Industries, too, are feeling the pinch of water scarcity. With limited access to water, businesses are compelled to scale back operations, hampering production and hindering economic progress. Many industries are now actively seeking alternative water sources and implementing water-saving measures to mitigate the crisis's impact. Furthermore, the scarcity of safe drinking water has precipitated a public health emergency. Sanitation standards have deteriorated in the face of water shortages, leading to the proliferation of waterborne illnesses and other health concerns. Vulnerable

demographics, including children and the elderly, are especially vulnerable to the adverse effects of inadequate access to clean water.

### **Addressing the Crises: Initiatives Taken By Karnataka Government to Address the Water Crises:**

To effectively confront the global water crisis, a holistic approach is imperative. This entails implementing measures to conserve water and enhance efficiency through the adoption of water-saving technologies and the promotion of sustainable practices. Investment in water infrastructure, including the development of robust water supply systems, wastewater treatment facilities, and efficient irrigation networks, is paramount to ensuring universal access to clean water and sanitation services. Furthermore, policy reform is essential, necessitating the enactment and enforcement of regulations aimed at protecting water resources, fostering sustainable water management practices, and addressing water pollution. Equally crucial is the engagement of communities and stakeholders in water management and decision-making processes, which fosters ownership, encourages the adoption of sustainable behaviours, and enhances resilience to water-related challenges [4]. This comprehensive and integrated approach is the key to effectively addressing the multifaceted nature of the global water crisis.

In response to the pressing water crisis, the Bengaluru government has launched various initiatives to tackle the issue head-on. Among these efforts, a prominent focus lies on promoting rainwater harvesting. By encouraging households and buildings to capture and store rainwater, this initiative aims to diminish reliance on external water sources while aiding in replenishing groundwater levels. Moreover, the government has introduced programs to incentivize water recycling and reuse. Through the establishment of wastewater treatment plants, efforts are underway to treat and repurpose wastewater for non-potable purposes like irrigation and industrial use. This strategy not only alleviates pressure on freshwater sources but also fosters a more sustainable water cycle. Additionally, substantial investments have been directed towards infrastructure development aimed at enhancing water distribution and management. Projects encompassing the construction of new reservoirs and pipelines seek to optimize water supply efficiency while curbing losses attributed to leakages. These proactive measures underscore the government's commitment to addressing Bengaluru's water crisis through a comprehensive approach encompassing conservation, recycling, and infrastructure enhancement.

### **Economic Consequences on Bengaluru:**

The economic repercussions of the water crisis in Bengaluru reverberate across various sectors, profoundly impacting businesses, industries, agriculture, and the overall economy of the region. As the city grapples with acute water scarcity, several economic consequences come to the forefront, highlighting the urgent need for sustainable water management strategies. First and foremost, the industrial sector bears a significant brunt of the water crisis. Bengaluru, often referred to as the Silicon Valley of India, hosts numerous IT and manufacturing industries vital to the city's economic landscape [5]. These industries require substantial water resources for their operations, including cooling systems, manufacturing processes, and employee facilities. With dwindling water supplies, businesses face disruptions, reduced productivity, and increased operational costs. Many industries are forced to invest in alternative water sources or implement water-saving technologies to mitigate the impact of the crisis on their operations. Moreover, agriculture, an essential component of Karnataka's economy, faces severe challenges due to water scarcity. The outskirts of Bengaluru are dotted with agricultural lands that rely on irrigation for crop cultivation. However, diminishing water availability hampers agricultural productivity, leading to crop failures, reduced yields, and financial losses for farmers [6]. Many farmers are compelled to abandon traditional crops and switch to less water-intensive alternatives, further altering the agricultural landscape and affecting livelihoods.

Furthermore, the real estate sector in Bengaluru experiences a slowdown as water scarcity dampens construction activities and infrastructure development. Water is a critical resource in construction, used for mixing concrete, dust suppression, and site operations. With limited water availability, construction projects face delays, increased costs, and logistical challenges. Additionally, prospective homebuyers and investors may hesitate to engage in property transactions in areas grappling with water scarcity, leading to a decline in real estate demand and property values. The hospitality and tourism industry, another significant contributor to Bengaluru's economy, also suffers from the water crisis. Hotels, restaurants, and recreational facilities rely on water for guest amenities, food preparation, and sanitation. Water shortages disrupt hospitality services, affecting customer satisfaction, business revenues, and the overall tourism experience [7]. Moreover, the perception of water scarcity in Bengaluru may deter potential tourists,

impacting the city's reputation as a desirable travel destination and leading to decreased tourism revenues.

Furthermore, small and medium-sized enterprises (SMEs) and local businesses bear the brunt of the water crisis, struggling to sustain operations amidst water shortages and rising costs. Many small businesses, such as car washes, laundromats, and small-scale manufacturing units, heavily depend on water for their daily activities. With limited access to water, these enterprises face operational challenges, reduced revenues, and even closure, exacerbating unemployment and economic hardship in the region. The economic consequences of the water crisis in Bengaluru are profound and multifaceted, impacting various sectors and stakeholders [8], [9]. Urgent measures are needed to address water scarcity through sustainable water management practices, infrastructure investments, and community engagement. By safeguarding water resources and promoting efficient water use, Bengaluru can mitigate the economic impact of the crisis and ensure long-term economic resilience and prosperity for its residents and businesses.

#### **Effect on the Health of the Residents of Bengaluru:**

The health consequences of the water crisis in Bengaluru are significant and multifaceted, affecting individuals across various demographics and socioeconomic strata. One of the primary health risks associated with water scarcity is the increased likelihood of waterborne diseases. As access to clean and safe water becomes limited, residents may resort to using contaminated water sources, leading to the spread of waterborne illnesses such as cholera, typhoid, and dysentery. Contaminated water can also harbour pathogens and pollutants, posing risks to both drinking water and sanitation, and increasing the incidence of gastrointestinal infections and other water-related diseases.

Furthermore, inadequate access to water for sanitation purposes can exacerbate hygiene-related health issues. Without sufficient water for hand-washing, personal hygiene practices may suffer, increasing the risk of infections and diseases. Additionally, limited access to water for bathing and cleaning can lead to skin infections and exacerbate existing skin conditions. The health impacts of the water crisis extend beyond infectious diseases to include mental health concerns. Prolonged water scarcity and the stress of coping with limited water resources can contribute to anxiety, depression, and other mental health disorders among residents. Moreover, the economic strain resulting from the water crisis, such as increased healthcare costs and reduced productivity, can further exacerbate mental health challenges [10].

Vulnerable populations, such as children, the elderly, and individuals with pre-existing health conditions, are particularly susceptible to the health effects of water scarcity. Children, in particular, may face developmental issues and growth stunting due to inadequate access to clean water and proper nutrition. Overall, the health consequences of the water crisis in Bengaluru underscore the urgent need for comprehensive and sustainable solutions to ensure access to clean and safe water for all residents. Efforts to address water scarcity must prioritize public health considerations to mitigate the adverse impacts on individuals and communities.

#### **Impact on Drinking Water and Agricultural Water Supply:**

In Karnataka, a substantial 80% of freshwater allocation is directed towards agriculture, primarily for water-intensive crops like paddy and sugarcane, leading to the depletion of water resources and hindering availability for other essential purposes. Agricultural practices contribute to significant water wastage, with around 60% lost, and only half of this recycled. Bangalore, managed by the Bangalore Water Supply and Sewerage Board (BWSSB), faces challenges in meeting its water demand, supplying only 1470 Million Liters per Day (MLD) against a demand of 2100 MLD [11]. In areas densely populated with IT professionals, reliance on borewells and tanker water exacerbates water scarcity, driving up the cost of water tankers as owners exploit the situation. Government interventions include price and distribution regulations, and repurposing Nandini milk supply tankers for water delivery. Beyond households, water scarcity disrupts schools and businesses, impacting educational activities and economic stability, particularly in rural areas where scarcity is more acute. Suggestions for curbing water wastage include implementing water-saving measures like recycling wastewater from RO systems and reducing shower frequency.

#### **Indian cities that could face a Day Zero shortly:**

Water scarcity poses a significant challenge across various cities in India, with forecasts suggesting an exacerbation of the situation in the foreseeable future. This issue

transcends Bangalore's borders; it's a pervasive crisis looming over India's urban areas. Several major cities are on the brink of confronting severe water shortages, posing formidable challenges for both residents and policymakers alike. Day Zero, a term popularized by the water crisis in Cape Town, South Africa, refers to the hypothetical day when a city or region runs out of water entirely. While India has not yet reached this critical juncture on a national scale, several cities are teetering on the brink of severe water scarcity, raising concerns about the possibility of Day Zero scenarios in the future. Rapid urbanization, population growth, climate change, and unsustainable water management practices have exacerbated water stress across the country [12]. Cities like Chennai, Bengaluru, and Delhi have already experienced acute water shortages, with residents facing disruptions in water supply and grappling with the impacts on daily life and economic activities [13]. Unless significant measures are taken to address water scarcity through conservation, infrastructure improvements, and sustainable practices, the spectre of Day Zero looms ominously over India's urban landscape, necessitating urgent action to avert such a crisis.

1. Mumbai: Mumbai faces a looming water crisis due to increasing demand, erratic rainfall, and dwindling water sources. Rapid urbanization exacerbates the situation, along with inadequate infrastructure and inefficient water management. The Brihanmumbai Municipal Corporation (BMC) frequently imposes water cuts as the seven lakes supplying water to the city struggle to meet demand [14].

2. Jaipur: Jaipur's burgeoning population and industrialization have outstripped the available water supply. Once reliant on the Ramgarh Dam, now depleted, the city shifted entirely to groundwater, leading to aquifer depletion and worsening water scarcity.

3. Bathinda: Water scarcity plagues Bathinda due to agricultural overexploitation and declining groundwater reserves. Heavy reliance on groundwater for irrigation, coupled with inefficient usage, has depleted aquifers significantly.

4. Lucknow: Lucknow faces impending water scarcity driven by excessive groundwater extraction, equivalent to one-third of the Bhakra Nangal dam's capacity annually. A drying Gomti River, erratic rainfall, and urbanization exacerbate the strain on water resources, threatening the city's sustainability.

5. Chennai: Despite Chennai's substantial annual rainfall, the city confronted a severe water crisis in 2019, becoming one of the first major cities worldwide to exhaust its water supply. Susceptibility to extreme weather events, rapid urbanization, and industrialization heighten Chennai's vulnerability to water scarcity.

6. Delhi: Delhi grapples with acute water scarcity each summer, worsened by Yamuna River contamination and groundwater depletion. Sixty per cent of water supplied by the Delhi Jal Board is sourced from the polluted Yamuna, emphasizing the urgent need to reverse groundwater depletion and improve water quality [15].

#### **Innovative solutions and sustainable practices:**

Innovative solutions and sustainable practices offer promising avenues to address the water crisis in Bengaluru. Technological innovations such as Watermen's Air-to-Water technology, which extracts moisture from the air, present novel approaches to combat water scarcity [16]. Additionally, AI-powered tools like Aqua Wise play a crucial role in optimizing water distribution, detecting leaks, and predicting water demand patterns, thereby enhancing the resilience of water infrastructure [17]. Decentralized wastewater treatment methods also offer a sustainable solution by treating wastewater locally and promoting reuse in sectors like construction and landscaping. Moreover, policy initiatives focusing on decentralized city development and community-driven campaigns like the 'Million Wells for Bengaluru' initiative are essential for improved water management and distribution. Practical measures at the household level, including installing water-saving devices and promoting rainwater harvesting, further contribute to water conservation efforts [18]. By leveraging these innovative solutions and engaging in sustainable practices, Bengaluru can effectively address its water challenges and ensure a more resilient and water-secure future for its residents.

#### **Conclusion**

##### **Conclusion and call to action for sustainable management in Bengaluru:**

The water crisis in Bengaluru demands immediate attention and concerted action from all stakeholders. Its origins are multifaceted, spanning from rapid urbanization to the effects of climate change. Nevertheless, Bengaluru is actively pursuing solutions through government interventions, grassroots initiatives, technological innovations, and individual

commitments to water conservation. To effectively address the crisis, a collaborative effort is imperative. This entails active participation from government entities, industries, communities, and individuals alike. By embracing water-efficient practices, enhancing infrastructure, and fostering awareness, Bengaluru can chart a path towards a future where water scarcity is no longer a looming threat. Let us unite in our endeavour to create a sustainable Bengaluru, where every drop of water is treasured and safeguarded for future generations [19].

In summary, Bengaluru's water crisis is a complex challenge with widespread implications. Urbanization, unsustainable groundwater usage, and climate change exacerbate its severity. Yet, with coordinated governmental actions, community-driven initiatives, technological breakthroughs, and personal commitments, there exists optimism for a sustainable tomorrow. Through prudent water management, infrastructure investments, and heightened awareness, Bengaluru can surmount its water woes, ensuring a resilient and flourishing city for posterity.

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