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A Review of Urbanization in Kanpur: Issues with River Management and Challenges to Achieving a Viksit Bharat

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Abstract

Kanpur, India's one of the oldest and most industrialized cities, has experienced rapid urbanization over the past decades, resulting in significant environmental and infrastructural challenges. Chief among these is the deteriorating health of the Ganga River, which runs through the city and serves as a critical ecological and cultural lifeline. Foremost among these has been the decaying health of the Ganga River, on whose banks and through which this city flows as a vital cultural and ecological link. This paper reviews the multifaceted impacts of urban expansion on river management in Kanpur, focusing on industrial pollution, inadequate sewage treatment, and unplanned growth. It also discusses how these issues represent significant challenges to realizing the national vision of "Viksit Bharat"—a developed and sustainable India by 2047. Through an examination of policy frameworks, urban governance systems, and environmental statistics, the study determines areas of reform and strategic intervention. This review article argues for an inclusive and composite approach to urban planning that juxtaposes development with ecological integrity so that the trajectory of development of Kanpur aligns with the larger aspirations of a Viksit Bharat.

Keywords: Urbanization, River Management, Ganga River, Viksit Bharat, Kanpur.

1. Introduction

Urbanization is one of the dominant trends of the 21st century, as in developing nations such as India, cities have been growing almost exponentially to be able to serve increasing populations and economic activity (Zhao et al., 2020). Kanpur along the Ganga River in the state of Uttar Pradesh is an exemplary case in point. Previously nicknamed the "Manchester of the East" because it was a vibrant textile and leather industry city, Kanpur today is a bustling urban and industrial center. Unfortunately, this achievement has been steeply paid with an environmental bill. The spontaneous urbanization of the city with poor infrastructure facilities and lax implementation of regulations resulted in the river Ganga severely being polluted (Kumar P., 2019). This poses the risk to the public health as well as its biodiversity and eco-sustainability of the region. Industrial effluents, untreated sewage, and unchecked encroachment along riverbanks have converted parts of the river into highly polluted areas.

These problems not only indicate local planning and governance failures but also underscore larger systemic problems confronting many Indian cities in balancing the trade-offs between growth and

environmental conservation (Simon M. et al., 2022). Set against the national vision of India's Viksit Bharat by 2047—a blueprint for being a developed, inclusive, and sustainable country—Kanpur's travails serve as a crucial case study. The feasibility of this vision rests on the resolution of the intertwined challenges of urbanization, environmental sustainability, and inclusive development (URMP, Kanpur, U.P.). This article will critically assess the urbanization trends of Kanpur, examine the challenges of river management, and discuss how these issues may impede the overall aims of reaching a Viksit Bharat. Through this overview, the research aims to determine primary interventions and policy changes required to balance urbanization with ecological resilience.

2. Study Area

Kanpur, situated in southern Uttar Pradesh on the banks of the Ganga River, is a key urban and industrial hub in northern India. Home to more than 3 million people, it is among the largest and most populous cities in the state. Geographically, the city is situated between latitude 26.4499° N and longitude 80.3319° E, and at an average elevation of approximately 126 meters above sea level. The Ganga River runs along the northern edge of the city and has a key position in the city's history, culture, and economy. The research focus is on the Kanpur Nagar district urban agglomeration, encompassing core urban wards as well as peri-urban areas stretching up to the riverfront. Particular attention is paid to the Jajmau industrial belt, a prime leather tanning hub and one of the major contributors to river pollution. Other significant localities under investigation in this work are Govind Nagar, Kidwai Nagar, Shastri Nagar, and Panki, which symbolize various models of urban development, waste disposal problems, and location close to large drainage canals flowing into the Ganga. The city has numerous natural and artificial drains like Sisamau Nala and Permiya Nala that transmit industrial effluents as well as domestic sewerage into the river. These watercourses are a principal component of research since they impact river health directly.

Furthermore, the study site encompasses municipal and administrative regions liable for urban development, water provision, sewage systems, and ecological monitoring, for example, Kanpur Municipal Corporation (KMC) and the Uttar Pradesh Pollution Control Board (UPPCB). For the purposes of this review, Kanpur is not simply examined as a stand-alone urban phenomenon but as a dynamic interface between industrial production, population pressure, and environmental strain—making it an important case study in terms of grasping the wider implications of urbanization for river systems in India, and the challenge this presents to the national dream of a Viksit Bharat.

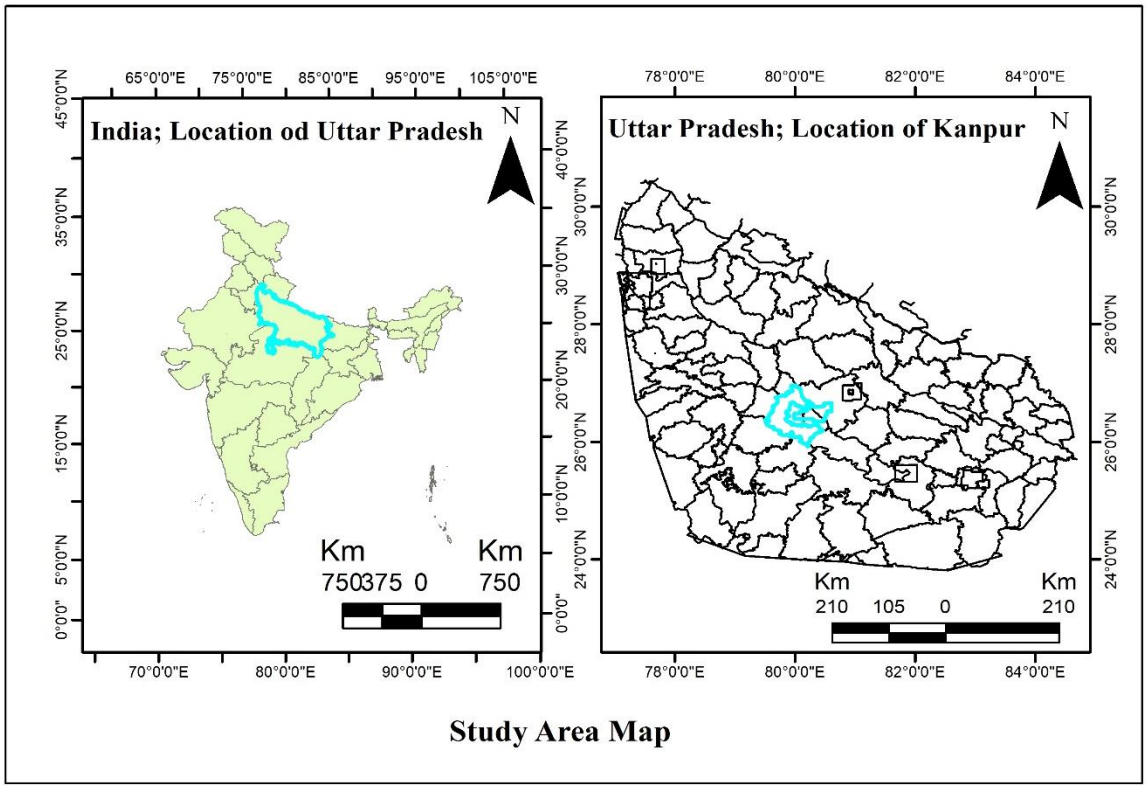

Figure 1: Location of the study area

3. Historical and Current Context of Urbanization in Kanpur

Kanpur's journey of urbanization is deeply rooted in its historical evolution as a center of trade, industry, and colonial administration. During the British colonial era, Kanpur emerged as a major industrial town due to its strategic location on the banks of the Ganga River and its proximity to major trade routes. The British established textile mills, leather tanneries, and military cantonments in the city, which attracted a significant influx of laborers and entrepreneurs. By the late 19th and early 20th centuries, Kanpur had earned the moniker "Manchester of the East," becoming one of the first industrially developed cities in India. The post-independence period saw continued industrial growth, but also the beginning of infrastructural strain. With limited focus on urban planning and environmental management, the city expanded in an unregulated and haphazard manner. The rise in population, driven by rural-to-urban migration, further stressed existing civic amenities. The construction of residential colonies, slums, and informal settlements surged, often without adequate provision for sanitation, waste disposal, or clean water access (Ali S.A., 1970). In recent decades, Kanpur's urbanization has continued to accelerate, with the city now being home to over 3 million people. The industrial base has diversified, but the leather tanning industry remains a dominant economic driver, especially in the Jajmau area (Chaturvedi et al., 2019). Unfortunately, this economic development has not been matched by infrastructural upgrades or environmental safeguards. The riverfront, once a vibrant and sacred space, has become heavily polluted, reflecting the consequences of unchecked urban expansion.

Urban governance in Kanpur faces several challenges, including fragmented institutional responsibilities, weak enforcement of environmental regulations, and limited public participation in planning processes (Kumar P., 2019). Although initiatives like the Smart Cities Mission and Namami Gange Programme have

been introduced to improve urban and environmental conditions, implementation remains inconsistent and plagued by bureaucratic hurdles (NIUA 2021). Thus, the urbanization of Kanpur represents a complex legacy—marked by early industrial prosperity but shadowed by decades of mismanagement, environmental degradation, and socio-economic inequalities. Understanding this historical and current context is essential for formulating effective strategies that can align the city's future development with the national goal of building a Viksit Bharat.

4. Water management in ancient India

The importance of water harvesting and management was recognised early on in India's monsoon-driven rainfall regime. This was evident in the 4,500-year-old Harappan city of Dholavira, located in Gujarat's scorchingly arid Rann of Kachchh. Nearly 20 to 30 percent of its fortified area (48 ha) was devoted to housing a vast network of interconnected reservoirs, some of which were cut in sheer rock. The meticulous collection of rainfall and water redirected from two seasonal streams that bordered the city, whose flows were slowed down by a number of check dams, provided the system with its energy. Located east of the Castle, the city's most heavily guarded enclosure, the largest reservoir was 73 x 29 m in size and, when full, would have held more than 20,000 m3 of water. If the reservoir becomes empty, access to water much later would also be possible through a modest but adequate stepwell dug at the bottom. It was, therefore, never deserted for at least seven centuries.

Water management, water harvesting, reservoirs, and step-wells are the main ancient Indian water management systems. Even 4,500 years ago, the Harappan city of Dholavira, which is now located in Gujarat's oppressively dry Rann of Kachchh, committed nearly 20 to 30 percent of its fortified area (48 ha) to having a vast network of interconnected reservoirs, some of which were carved into sheer rock. This was before monsoon-driven rainfall recognised the significance of having and managing waters. With the help of rainfall and water channelled from two seasonal streams that flanked the city, its entire system was slowed down by a series of check dams. The largest reservoir, which was 73 × 29 m in size and could have stored more than 20,000 m3 of water when full, was located east of the Castle, the city's tallest and most secure perimeter. In the event that the reservoir empties, a modest but sturdy stepwell excavated at the bottom will offer access to water decades later. Thus, for at least seven centuries in a row, this city was not abandoned.

5. Ganga River Management Issues in Kanpur

The sacred Ganga River, which sustains millions of people, experiences acute ecological stress in Kanpur, one of the most industrialized cities along its path (Harijan N., 2003). Despite repeated interventions by the government and civil society, the river is heavily contaminated owing to a multiplicity of problems. Leading among them is industrial pollution, especially from the Jajmau leather tanneries, which frequently discharge untreated or partly treated effluents containing poisonous chemicals into the river. This is supplemented by the dumping of more than 400 million liters per day of mostly untreated domestic sewage, for the city's sewage treatment facilities are still woefully lacking.

Uncontrolled urban growth has caused encroachment along riverbanks, weakened natural buffers, and diminished flood-carrying capacity, while indiscriminate dumping of solid waste—plastics and biomedical waste—adds to the pollution (URMP of Kanpur). Institutional coordination between agencies like the Kanpur Municipal Corporation, Uttar Pradesh Pollution Control Board, and the National Mission for Clean Ganga is still weak, resulting in fragmented and ineffective governance (Kumar P., 2019).

Additionally, aging technology, inadequate maintenance, and electricity shortages restrict the operational capacity of treatment facilities. Public sensitization and community engagement in river conservation efforts are low, and government initiatives such as the Namami Gange and Smart Cities Mission have also been plagued by delays, underfunding, and poor accountability (Ojha, C., et al. 2017). Combating these interconnected challenges with stronger regulation, updated infrastructure, improved governance, and participatory community involvement is essential not just to revitalize the Ganga in Kanpur but also to achieve the national vision of a sustainable and developed India—Viksit Bharat.

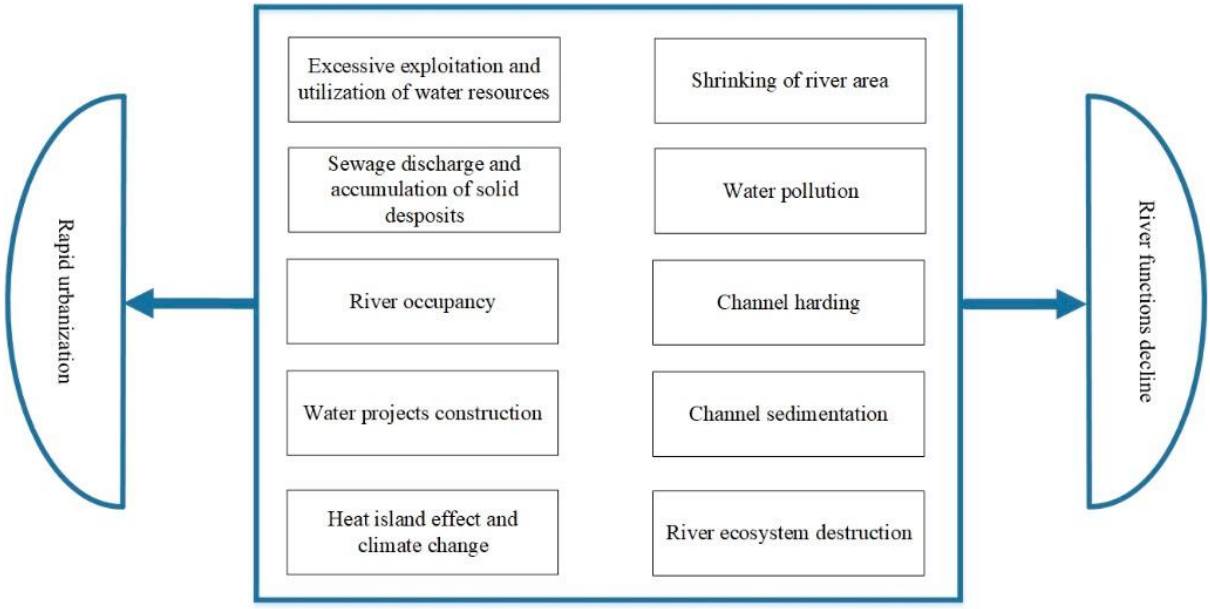

Figure 2: Effect of urbanisation on rivers (Zhao et al., 2020)

6. Challenges towards the "Viksit Bharat"

The vision of Viksit Bharat—a developed, inclusive, and sustainable India by 2047—is critically dependent on good urban and environmental governance, but the persistent Ganga river management problems in Kanpur pose serious challenges to this national vision [Saikia, P. et al., 2024]. The pollution of the river by untreated sewage, industrial effluents, and solid waste has resulted in a public health emergency, with waterborne diseases and pollution-related illnesses impacting local communities, particularly the urban poor. This not only affects productivity but also increases healthcare costs and exacerbates socio-economic inequities. The environmental pollution caused by decreased water quality, aquatic biodiversity loss, and destruction of riparian ecosystems is inconsistent with the strategy of long-term ecological sustainability (Ojha, C. et al., 2017). Economically, the polluted river inhibits agriculture, fisheries, and tourism—the sectors crucial for local livelihood and national development. Kanpur's antiquated sewage system, poor enforcement institutions, and disintegrated governance are symptoms of the larger infrastructural and institutional weaknesses that undermine the creation of future-proof cities (Kumar, P., 2019).

Further, the pollution of the Ganga undermines India's rich spiritual and cultural heritage, undermining public confidence and national pride. The marginalized communities are hit the hardest, exacerbating the gap in social equity and access to basic services. These failures also jeopardize India's pledge to United Nations Sustainable Development Goals, which specifically include targets related to clean water, sanitation, and sustainable urban development and impact the reputation of the nation at the international

level(Simon, M. et al., 2022). Beyond that, achievement of the target of initiatives like Smart Cities Mission gets delayed due to the riverfront being polluting and mishandled and thereby halts integral urbanization. Essentially, the Ganga's degraded condition in Kanpur reflects painful intentions of development which need to be redressed with intentions quickly to enable the integrated and inclusive development visualized under Viksit Bharat.

7. Strategies for Integrated Urban and River Management

Efficient management of the Ganga River in Kanpur needs to be embedded in integrated urban planning that promotes environmental sustainability, public health, as well as socio-economic development. Actioning the interlinked issues of pollution, urban sprawl without planning, poor governance, and ecological depletion needs to be approached through a multi-pronged strategy (Kumar, P., 2019). Major steps involve upgrading and augmenting wastewater facilities by upgrading Sewage Treatment Plants (STPs), installing decentralized treatment plants, and upgrading Common Effluent Treatment Plants (CETPs) in the Jajmau industrial area (Simon, M. et al., 2022). GIS-based pollution source mapping and real-time water quality monitoring can help detect and act against pollution in a timely manner(Zhang et al., 2008). Strengthening of regulatory mechanisms by effective enforcement, imposition of mandatory zero liquid discharge (ZLD) on polluting industries, and taxation incentives based on pollution will ensure compliance (Kumar, P., 2019).

Urban drainage and solid waste infrastructure must be overhauled by converting open drains into green stormwater corridors, making door-to-door waste collection a reality, and developing buffer zones to discourage encroachments and dumping. Green cover-based riverfront redevelopment using green areas, wetlands, and re-afforestation can revive the river's ecological health. Institutional convergence is essential—having a unified organization such as the Kanpur Urban River Management Authority (KURMA) would allow coordinated planning and implementation. Community engagement through awareness generation, grass roots mobilization, and citizen reporting is essential to ensure long-term behavioral change (Simon, M. et al., 2022). Technological solutions like IoT sensors, AI, and drone monitoring, and encouraging start-ups and research institutions, can enhance efficiency and scalability. Financing via Public-Private Partnerships (PPPs), green bonds, and CSR programs will provide long-term sustainability (Zhao et al., 2020). Finally, linking all efforts to national missions such as Namami Gange, Smart Cities, AMRUT, and international Sustainable Development Goals (SDGs) will place local efforts within larger development paradigms. Collectively, these synergistic strategies can make Kanpur a sustainable, resilient city and a model of urban-river symbiosis in the path to Viksit Bharat (Kanpur Master Plan 2041).

Kanpur must adopt a more integrated and future-ready approach to urban planning that emphasizes sustainable development, improved waste management, efficient public transport, and the expansion of green spaces, while strategically incorporating the Ganga and Pandu rivers into the broader vision of the Kanpur Master Plan 2041. Building on the current objectives of the 2021 Master Plan—which include preventing unplanned development, accommodating population growth, decentralizing commercial zones, controlling pollution, and preserving agricultural land—the 2041 vision should integrate advanced guidelines such as mandatory rainwater harvesting for plots over 300 square meters, stricter groundwater usage regulations for industrial and commercial users, and the revival of traditional water bodies like ponds, wells, and rivers. Kanpur already possesses key infrastructural strengths, such as operational STPs and the successful transformation of the Sisamau Nala into a sewage treatment system, and can leverage

support from institutions like IIT Kanpur to address river management challenges (Kanpur Master Plan 2041).

However, persistent industrial pollution, encroachment on riverbanks, and mismatches between wastewater volumes and treatment capacities remain significant weaknesses. Moreover, the city faces flood risks along the Ganga and Pandu rivers, exacerbated by poor waste disposal in vulnerable areas. Yet, opportunities abound: Kanpur's industrial base offers potential for wastewater recycling, its inclusion in the Smart Cities Mission supports synergy with Urban River Management Plans (URMP), and its socially active population can be mobilized to make the riverfront vibrant and community-friendly. By aligning these strengths, addressing key gaps, and embedding river systems at the heart of urban planning, Kanpur can become a model for environmentally sustainable and inclusive urban transformation, fully aligned with the national vision of Viksit Bharat by 2047 (Urban River Management Plan of Kanpur).

8. Conclusion

Urbanization in Kanpur, as it has propelled economic development and construction of infrastructure, has also gone a long way towards environmental degradation in the form of extreme pollution and negligence in managing the Ganga River. Unregulated growth of industrial and residential complexes, together with poor urban planning and laxity in enforcing environmental laws, has undermined both the environmental health of the river and the standard of living in the city. The problems of industrial effluents, untreated sewage, dumping of solid wastes, and institutional fragmentation endanger not only the sustainability of the Ganga but also create serious impediments to the realization of the larger national vision of Viksit Bharat—a developed, inclusive, and environmentally sustainable India. These need to be tackled through a paradigm shift towards integrated urban-river management, including technological innovation, regulatory reform, investment in infrastructure, community engagement, and inter-agency cooperation.

Kanpur's experience is both a warning and a call to action: unless immediate and concerted efforts are made, the aspirations of sustainable development and national transformation will be out of reach. Yet with dedicated governance and systemic transformation, Kanpur can be reformed into an example of ecological rejuvenation and urban resilience that will go a long way toward taking India down the path of a truly developed nation by 2047.

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