Water and Industrial Development in Uttar Pradesh

Industrial Water Demand, District-Level Risk, and the Investment Opportunity in Treatment and Reuse

2026
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Preface and Scope

This paper examines the relationship between water resources and industrial development in Uttar Pradesh. It argues that water availability has become a determinant of industrial location and competitiveness in the state, assesses that constraint at the district level, and identifies the resulting opportunities in water treatment and reuse.

The analysis draws on official hydrogeological and pollution-control data, national programme documentation, and published market estimates, supplemented by the firm's own framework analysis. Where the firm has constructed composite indicators — notably the district-level Water-Risk Index — the basis is described and the indicative character of the result is stated. The paper is intended for institutional readers concerned with industrial policy, investment promotion, and infrastructure. It does not constitute engineering, investment, or policy advice.

A note on method. The district and cluster assessments combine published data with the firm's judgement. They are analytical tools for comparison and prioritisation, not measurements, and they are not a substitute for site-level hydrogeological and engineering survey. They should be weighed accordingly.

Contents

1. Summary

1.1 Uttar Pradesh is pursuing industrial expansion in sectors that are, for the most part, water-intensive. At the same time, the state's water resources are under increasing pressure. This paper assesses the resulting tension and its implications for industrial policy and investment.

1.2 At the state level, ground water extraction stands at approximately 71 per cent of the annually replenishable resource, placing Uttar Pradesh in the semi-critical category.[1] This aggregate, however, conceals substantial variation. Nine districts are classified as over-exploited, with extraction exceeding replenishment, and two regions — the western Ganga–Yamuna Doab and Bundelkhand — face acute and structurally different forms of stress.

1.3 The principal findings are three. First, water risk in the state is local, and industrial decisions taken on the basis of state averages will misjudge it. Second, several of the state's most water-intensive industrial clusters are located in its highest-risk districts, creating a concentrated set of pressure points. Third, the combination of rising demand, tightening regulation, and a growing treatment market constitutes a defined and largely unrealised investment opportunity in shared treatment infrastructure and reuse.

1.4 The paper proceeds from the general constraint (Sections 2 and 3) to its district-level assessment (Section 4), the overlay of industrial clusters (Section 5), the regulatory and market context (Sections 6 and 7), the investment opportunities (Section 8), and the firm's analytical framework (Section 9).

2. Water as an Industrial Constraint

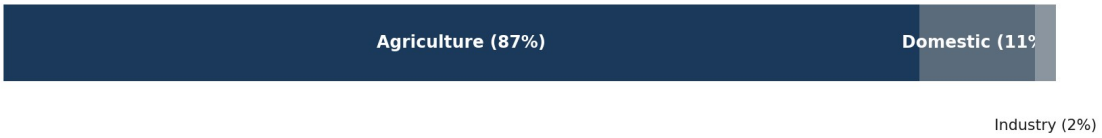
2.1 Industrial location in India has historically been determined by access to land, labour, and transport. Water has been treated as a utility — generally available and administratively straightforward. In water-stressed regions this assumption no longer holds, and Uttar Pradesh contains some of the most stressed industrial geographies in northern India.

2.2 The competition for water is structural. Agriculture accounts for approximately 87 per cent of ground water use nationally, domestic consumption for some 11 per cent, and industry for around 2 per cent.[2] Industry's small share is the point: as industrial demand grows, it must be met from a resource already heavily committed to agriculture and to a rapidly urbanising population. Figure 1 shows the national allocation.

[1] Central Ground Water Board (CGWB), Dynamic Ground Water Resources of India; National Compilation on Dynamic Ground Water Resources, 2024 assessment.

[2] CGWB block-level categorisation for Uttar Pradesh; 2017 assessment and subsequent updates. Block categories follow the standard over-exploited / critical / semi-critical / safe classification.

Figure 1. Ground water use in India, by sector



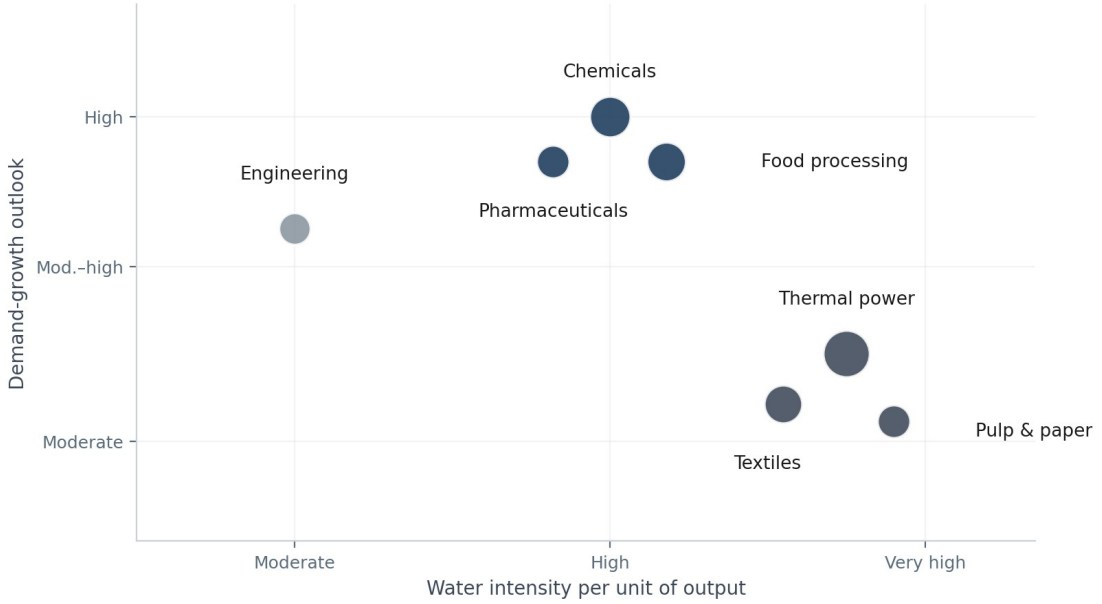
Source: Central Ground Water Board; national assessments.

2.3 Regulation has tightened in consequence. Guidelines now restrict new industrial extraction in over-exploited zones, require authorisation for industrial ground water use, and encourage the substitution of treated waste water for fresh water. Pollution-control directions impose zero-liquid-discharge obligations on specified water-intensive industrial categories.[3] For water-intensive industry, water availability has thus become a determinant not only of operating cost but of whether operation is permitted at all.

3. Industrial Water Demand

3.1 Industrial water demand in the state is concentrated in a limited number of sectors. Figure 2 sets out the firm's assessment of water intensity and demand growth across the principal industrial sectors.

Figure 2. Industrial sectors by water intensity and demand-growth outlook



Source: Prologue Research assessment. Positions are qualitative and indicative.

3.2 Three sectors combine high intensity with strong growth: chemicals, food processing, and pharmaceuticals. A further group — thermal power, textiles, and

[3] CGWB guidelines on ground water extraction; Central Pollution Control Board (CPCB) directions on zero liquid discharge for specified industrial categories.

paper — grows more slowly but consumes disproportionately per unit of output. The demand pressure on water resources will be greatest where these sectors expand, and that expansion is not evenly distributed across the state.

4. District-Level Water Risk

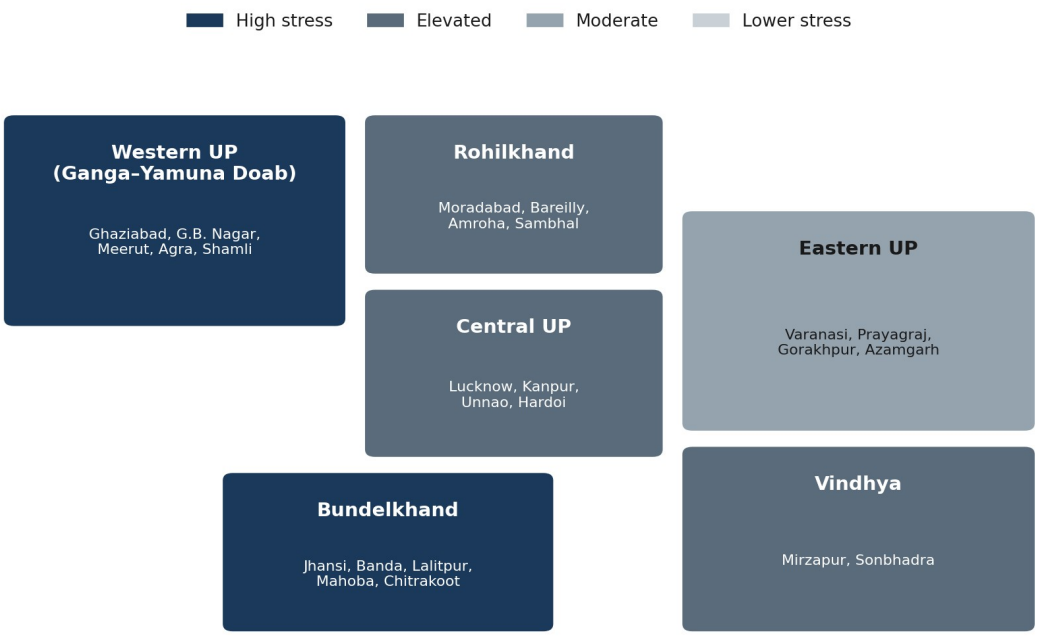
4.1 The central analytical contribution of this paper is to assess water risk at the district level rather than the state level. The state aggregate of 71 per cent extraction spans districts drawing well in excess of their annual replenishment and others comfortably within it. For an industrial decision, the relevant figure is the district one.

4.2 The 2017 assessment classified nine districts as over-exploited: Agra, Amroha, Firozabad, Gautam Buddha Nagar, Ghaziabad, Hapur, Hathras, Sambhal, and Shamli, with Ghaziabad extracting in the order of 128 per cent of replenishment. Across the state, 113 blocks in 43 districts are over-exploited and a further 59 are critical.[4]

4.3 Two regions are distinct. The western Ganga–Yamuna Doab combines intensive irrigated agriculture with dense industrialisation, and contains the most depleted aquifers in the state. Bundelkhand, by contrast, suffers from hard-rock terrain in which the great majority of rainfall runs off rather than recharging aquifers — a structural scarcity independent of industrial draw. Eastern Uttar Pradesh, in the Ganga basin, is comparatively better placed. Figure 3 summarises the regional pattern.

Figure 3. Ground water stress in Uttar Pradesh, by region

4 Indian water-treatment and zero-liquid-discharge market estimates are developed by Prologue Research with reference to public and industry sources; market estimates and projections vary across sources.



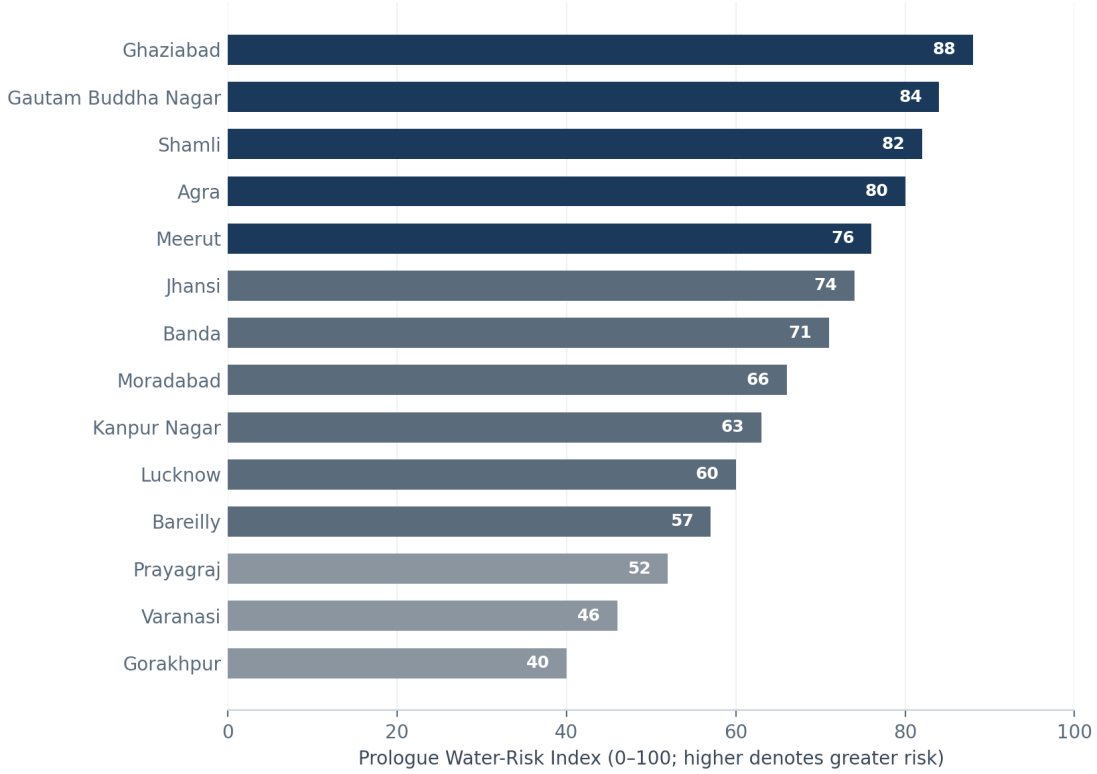
Source: Prologue Research, synthesising CGWB block classifications and aquifer assessments. Schematic; not to geographic scale.

The Water-Risk Index

4.4 To render district risk comparable, the firm has constructed a Water-Risk Index scoring districts from 0 to 100, with higher values denoting greater industrial water risk.[5] The index synthesises ground water extraction stage and block category, aquifer characteristics, the concentration of urban and industrial demand, and regulatory status. It is intended as a first-order screen for site selection and prioritisation. Figure 4 presents the index for selected districts.

Figure 4. Prologue Water-Risk Index, selected districts

[5] National Mission for Clean Ganga (Namami Gange) programme documentation, sewage-treatment capacity commitments.



Source: Prologue Research composite index. Indicative.

4.5 The western industrial districts — Ghaziabad, Gautam Buddha Nagar, Shamli, Agra, and Meerut — occupy the upper range of the index, alongside the Bundelkhand centres of Jhansi and Banda. Kanpur and Lucknow fall in the middle range; the eastern districts of Varanasi, Prayagraj, and Gorakhpur in the lower. The practical implication is that a water-intensive facility proposed in a high-index district requires a materially different water strategy from one in a low-index district, and may face regulatory constraints on extraction that the latter does not.

Table 1. Water-Risk Index bands and their implications

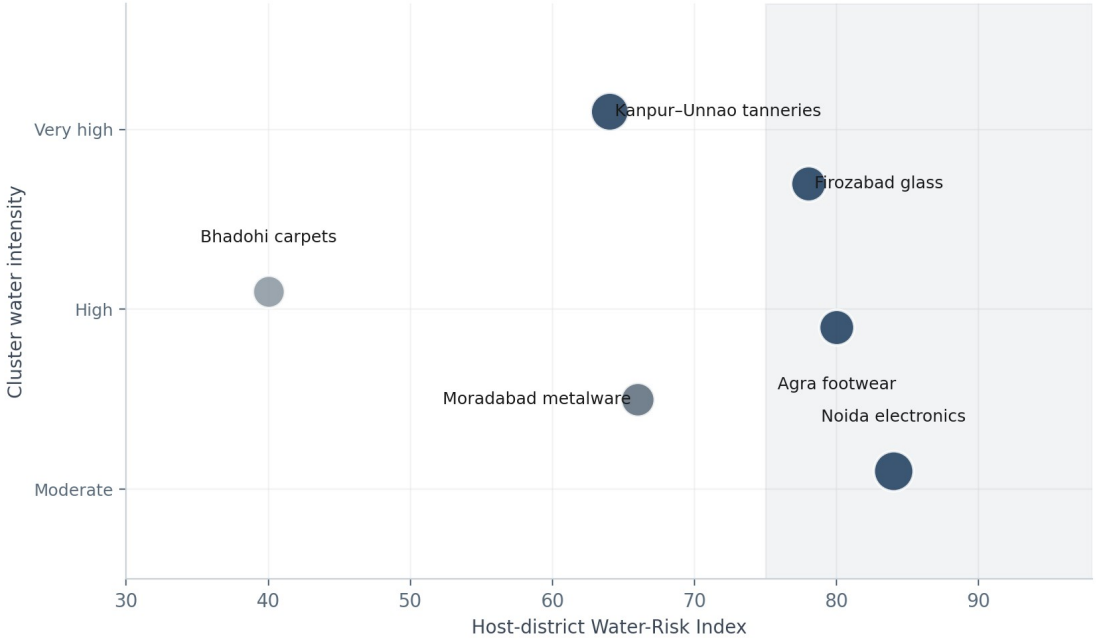
Band	Districts (illustrative)	Implication for water-intensive industry
High (≥75)	Ghaziabad, G.B. Nagar, Shamli, Agra, Meerut	New extraction constrained; reuse and external supply essential
Moderate (55–74)	Jhansi, Banda, Moradabad, Kanpur, Lucknow	Viable with strong reuse and efficiency; close monitoring
Lower (<55)	Prayagraj, Varanasi, Gorakhpur	Comparatively favourable; good practice still required

Source: Prologue Research. Indicative.

5. Industrial Clusters and Water Demand

5.1 Water risk becomes an industrial problem where water-intensive production is located in high-risk districts. Uttar Pradesh's industry is organised in specialised clusters — leather and tanning at Kanpur and Unnao, electronics at Noida, metalware at Moradabad, glass at Firozabad, footwear at Agra, carpets at Bhadohi. Figure 5 plots the principal clusters by water intensity against the risk of their host districts.

Figure 5. Industrial clusters by water intensity and host-district risk



Source: Prologue Research assessment. Indicative.

5.2 The tanning clusters of Kanpur and Unnao are the clearest case: leather processing is both water-intensive and effluent-heavy, located along the Ganga under close regulatory scrutiny. The glass industry at Firozabad and the footwear cluster at Agra combine high intensity with high district risk. Noida's electronics cluster is less water-intensive per unit but sits in one of the most over-exploited districts in the state. The carpet cluster at Bhadohi, in lower-risk eastern Uttar Pradesh, is comparatively well placed.

6. Treatment, Reuse, and Regulation

6.1 The industrial response to water stress consolidates around three practices: reuse and recycling, effluent treatment, and zero liquid discharge. Each is moving from regulatory obligation toward established practice, and the regulatory framework increasingly requires them.

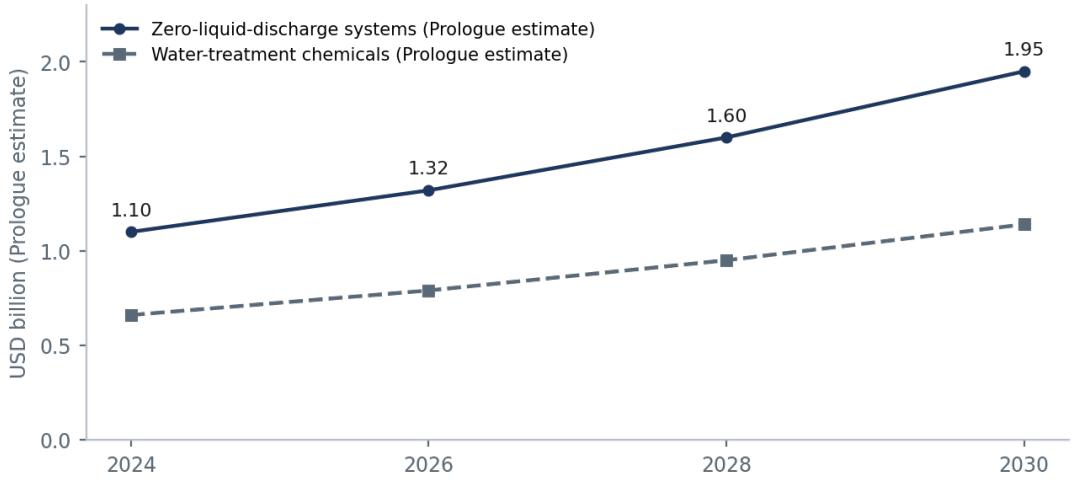
6.2 Investment in treatment infrastructure is supported by public programmes. The National Mission for Clean Ganga has committed substantial funding to sewage-treatment capacity, of direct relevance to a state through which the Ganga and its tributaries run.[6] The market for zero-liquid-discharge systems, mandated for specified industrial categories, has expanded accordingly.

7. The Market for Water Solutions

7.1 The market serving industrial water management comprises treatment

7.1 The market serving industrial water management comprises treatment chemicals, filtration, and advanced treatment. Prologue Research estimates the Indian water-treatment chemicals market at approximately USD 0.7 billion in 2025, growing at over 9 per cent annually; the market for zero-liquid-discharge systems is estimated at around USD 1.1 billion in 2024 and is projected to approach some USD 1.95 billion by 2030. These are Prologue Research estimates, developed from public and industry data and the firm's own analysis, and are indicative. Figure 6 shows the two trajectories.

Figure 6. India water-treatment markets, actual and projected (USD billion)



Note: Prologue Research estimates and projection. Figures for 2026 onward are projections and are indicative.

7.2 Northern India, including Uttar Pradesh, is the largest regional market within the country. For suppliers of treatment chemicals in particular, demand is recurring and technically differentiated, with correspondingly durable customer relationships.

8. Investment Opportunities

8.1 The convergence of district-level water risk, water-intensive clusters, tightening regulation, and a growing treatment market defines a set of investment opportunities. The most significant is shared treatment infrastructure.

[6] Prologue Research composite index. The construction is described in the accompanying note; scores are indicative and not a substitute for site-level hydrogeological survey.

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8.2 Common effluent treatment plants address a structural problem: many of the state's water-intensive clusters are composed of small and medium enterprises that cannot individually justify advanced treatment. Shared infrastructure distributes the capital cost, raises treatment standards across the cluster, and converts a fragmented compliance liability into a financeable utility. The opportunity is most acute, on the analysis of Sections 4 and 5, in the Kanpur–Unnao tannery belt, at Firozabad, and at Agra.

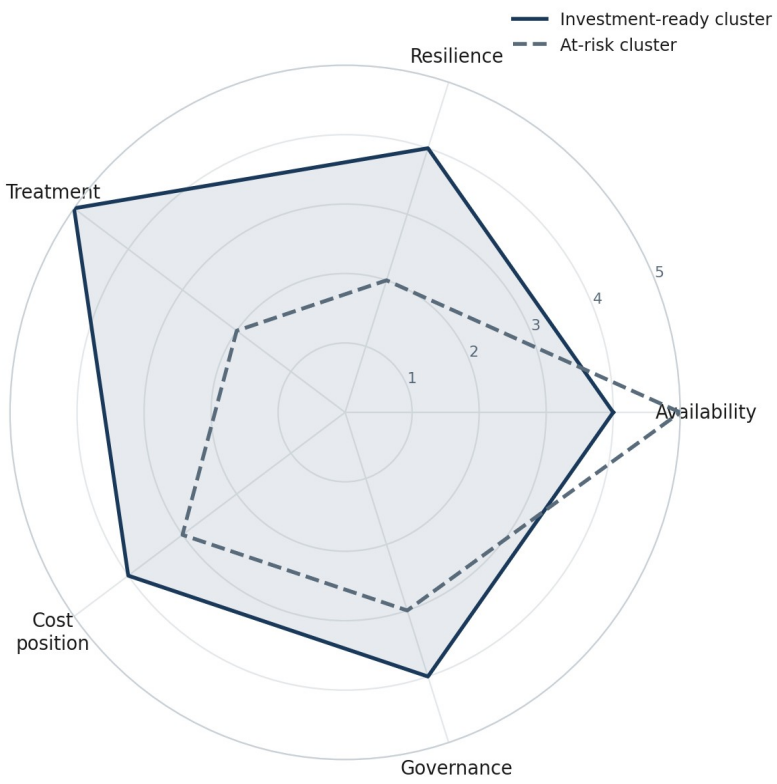
- Common effluent treatment plants for enterprise-dense clusters — the highest-leverage intervention, strongly aligned with regulatory direction.
- Zero-liquid-discharge systems for textile and chemical units subject to discharge mandates.
- Treated-sewage reuse, structuring municipal waste water as industrial supply.
- Decentralised treatment serving specific clusters or industrial parks.
- Water audit and advisory services, as water becomes a board-level concern.

8.3 These are, in the main, infrastructure-grade opportunities with a public-good dimension, and they are well suited to arrangements combining public and private capital.

9. An Analytical Framework

9.1 The district and cluster assessments in this paper rest on a common framework, which the firm applies to evaluate the water position of a facility, a cluster, or a district across five dimensions: availability, resilience, treatment, cost position, and governance. Figure 7 illustrates its application to two contrasting clusters.

Figure 7. The five-dimension water-competitiveness framework, illustrative application



Source: Prologue Research framework. Illustrative.

9.2 The value of the framework is comparative. A district strong on availability but weak on treatment is a candidate for shared-infrastructure investment; a cluster strong on treatment but located in a high-risk district remains exposed on availability. The Water-Risk Index of Section 4 is, in effect, the availability and governance dimensions rendered quantitative and mapped across the state.

10. Concluding Observations

10.1 Water has become a determinant of industrial competitiveness in Uttar Pradesh, and it operates locally. Industrial policy and investment decisions that treat the state as uniform will misjudge both the constraint and the opportunity.

10.2 The constraint is most acute in the western industrial districts and in Bundelkhand, and it bears most heavily on the water-intensive clusters located there. The opportunity — in shared treatment, reuse, and the supply of treatment technology — is correspondingly concentrated, and is supported by regulation and public programmes. On present trends, the pressure on industrial water will intensify; the question for policy and for investors is whether to anticipate that pressure or to respond to it once it binds.

Sources

Central Ground Water Board — dynamic ground water resource assessments and block categorisation. Central Pollution Control Board — zero-liquid-discharge directions. National Central Ground Water Board · dynamic ground water resource assessments and block categorisation. Central Pollution Control Board · zero-liquid-discharge directions. National Mission for Clean Ganga (Namami Gange) · programme documentation. UPSIDA and UPEIDA · industrial cluster information. Water-treatment and zero-liquid-discharge market figures are Prologue Research estimates developed with reference to public and industry sources.

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