Analysis of Policies on Urbanization and Urban Sprawl in Maharashtra and its Impact on Environment: With Specific Reference to Underground Water

Sapna Bansal[1] and Smita Pandey[2]

[1] Symbiosis Law School, Symbiosis International (Deemed University), Pune, India
[2] Jharkhand Rai University, Ranchi, India
bansalsapna78@gmail.com

Abstract. The policies regarding urbanization and urban sprawl significantly impact the environment, mainly underground water resources. The impact of urbanization and urban sprawl on underground water is multifaceted. Increased impervious surfaces, altered hydrology due to construction, and contamination from pollutants like chemicals, sewage, and runoff from urban areas can degrade groundwater quality and reduce recharge rates.

Policies aiming to mitigate these impacts need to address land-use planning, wastewater treatment, sustainable urban design, green infrastructure, and coordinated efforts among various stakeholders. Balancing urban development with the preservation and long-term administration of underground water resources is vital for ensuring water security and environmental sustainability in rapidly growing urban areas.

In 2013, The Maharashtra Ground Water Legislation was implemented. With a decade of its implementation, the article is aimed at understanding the logic of enactment of this legislation, the provisions thereof, the procedures announced for the performance of the Act, the public awareness about the Act, and the current status of implementation in different parts of Maharashtra, predominantly urban areas and the extent of its mitigating efforts on sustainable usage of underground water.

Keywords: Underground water, Urbanization, Legislation, Sustainable, Urban Design, Environment.

1 Introduction

Groundwater depletion is a problem which is intensifying with time irrespective of place i.e., high plains, central & western India and other aquifers throughout the world. The quality and quantity of groundwater are deteriorating and depleting resulting in the global issue of water shortage. Throughout the world, groundwater management has been attempted, albeit with varying degrees of success, to mitigate pollution and depletion. Several organizations are working on the depletion issue. One such organization is the Consultative Group on International Agricultural Research ("CGIAR"). In agriculture, forestry, fisheries, policy, and the environment, it seeks to

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"achieve sustainable food security and reduce poverty in developing countries through scientific research and research-related activities."

India's groundwater use has been sharply rising during the past few years., and it has become essential to the food and drinking water security of the nation. Consequently, the world's largest groundwater user is now India. (Data collected from 1970).

Groundwater contribution for irrigation (out of 80% of Net irrigated land): 60%
Groundwater contribution for drinking: 80%

The population increase has impacted all walks of life along with all the natural resources. The impact is visibly portrayed in extraction quantity (around 30 million groundwater extraction structures) and quality of groundwater. The dynamic availability of resources has been extracted and exploited beyond capacity leading to various problems like contaminated water quality. As a rough estimate, 60% of districts in India are facing quality or quantity availability of groundwater or both.

Since groundwater is becoming a more significant water supply for most uses, its regulation is necessary, generally and following the unique requirements of various users. It serves as the main water supply for domestic needs and commercial and subsistence irrigation and is becoming a more significant source of water for industrial use.

2 Problem Statement

In areas with abundant resources, conventional practices develop, but conflicts arise when population growth and resource scarcity occur. Access and usage norms must be changed, often involving legal entities overseeing the resource. In India, groundwater in subterranean aquifers is a shared resource, with landowners having an unrestricted right to access it. This legal position has been in place since around 1970 due to a lack of knowledge on water flow in aquifer systems. However, there is a strong case for changing groundwater legislation in water-scarce regions where groundwater supplies drinking water for human and livestock populations. Maharashtra has changed the groundwater legislation to address this issue and has made efforts to implement it. This paper aims to understand the Act's implementation experience.

3 Objectives

- To analyse the Maharashtra Groundwater (Development and Management) Act, 2009 (implemented on 3rd December 2013)
- To analyze how the Maharashtra Groundwater Legislation has affected urban population growth and development during the past ten years.
- To provide recommendations for amendments to laws on sustainable use of groundwater for urban sprawl and urbanization.

4 Research Questions

1. What are the primary features of the Maharashtra Groundwater (Development and Management) Act, 2009, which took effect on December 3, 2013?
2. In the ten years following its enactment, how has the Maharashtra Groundwater Legislation impacted urban development and population growth?
3. What legislative amendments are recommended to address the sustainable use of groundwater for sprawl and development?

4.1 Maharashtra and Topography

Maharashtra has comparatively more rainfall than other states in the entire country. However, if immediate action is not taken to work on the amount of groundwater depleted and the issue of poor-quality quantity related to groundwater, Maharashtra may soon find itself amid a chronic water crisis.

4.2 Maharashtra Underground Water Usage in a Nutshell

Number of Villages: 40,785
Number of hamlets: 45,528
Percent of rural population dependent on Agriculture: 82%
Percent of rural population dependent on groundwater for drinking water: 80%

Table: Irrigation Usage

Irrigation	Land	Percentage
Agricultural land	28.75 lakh hectares	71%
Flow or canal irrigation	11.83 lakh hectares	29%

Table: Usage of Groundwater

Usage	Percentage
Agriculture	85%
Industries	10%
Home Use	5%

Table: Composition of Rocks

Hard rock, or Deccan trap basalt	82%
Metamorphic and granite rocks	10%
Sedimentary rocks	5%
alluvial rocks (retains water)	4%

Furthermore, an examination of the rainfall pattern reveals significant regional and annual variability in addition to its non-uniformity.

- Konkan sub-division (coastal districts and Western Ghats): more than 6000 mm of rainfall is received
- Plains: 2500 mm is received
- Range of Rainfall: 500mm to 6000mm

On the other hand, rainfall diminishes toward the eastern slopes and plateau regions where it is less than 500 mm.

After that, the rainfall once more rises to about 1500 mm in the east or towards Marathwada and Vidarbha. As a result, the Madhya Maharashtra subdivision receives the least amount of rainfall in the state and is nearly perpetually affected by droughts and water scarcity. In the state, up to 99% of the talukas are permanently impacted by drought.

There are multiple constraints on the availability, recharging, and storage of groundwater in the state due to fluctuations in rainfall, terrain, and geology of the area. A strange phenomenon of over-extraction of groundwater is observed around certain areas which can be demarcated as rich sources of groundwater. They generally opt for cash crops like oranges, bananas sugarcane and grapes which are known for their high usage of water in their growth and processing. This is especially strange in the situation when there is a limitation and restriction of the supply of groundwater in specific parts of the state.

5 Maharashtra and Groundwater

Maharashtra's rural population and urban areas rely heavily on groundwater for drinking and irrigation, with over 50% of the state's water supply coming from this source. However, due to limited resources and frequent droughts, the number of wells has increased four times in four decades without any legal restrictions on groundwater withdrawal.

The imbalance in water supply, resulting from increased draft or withdrawal but constant recharge, has led to overexploitation, water quality issues, and overdoing in Marathwada, where farmers drill borewells in desperation.

The Maharashtra Water and Irrigation Commission has proposed registering borewells, tube wells, and wells and estimating groundwater and surface water on a watershed/sub-basin basis. The state has 33.93 BCM of rechargeable fresh groundwater resources and 32.15 BCM of net groundwater availability. Every year, 24.27 lakh groundwater is extracted using conceptual structures for home, industrial, and agricultural uses. 76 of the 1531 watersheds are overfished, 4 are critically endangered, and 100 are in a semi-critical state. There are four low-quality watersheds and four safe ones. The commission aims to address the situation and ensure the availability of water for all purposes.

5.2 Maharashtra Groundwater (Development and Management) Act, 2009

The Maharashtra Groundwater (Regulation for Drinking Water Purposes) Act 1993 regulates overexploited watersheds and prohibits the construction of new wells. Nevertheless, it has shortcomings, including restricting irrigation water withdrawal, permitting highly water-demanding crops in overfished basins, and excavating deep borewells. The state government amended the Act and passed the Maharashtra

Groundwater (Development and Management) Bill 2009 in response to the findings of the Chitale Committee.

5.2 The main provisions of the Act in this section are;

Section 3 mandates at least a 500-meter distance between public drinking water sources and new wells, based on rainfall, soil porosity, and population reliant on the source. This requirement is liberal for new well erection at the request of State or PRI authorities.
Section 4 instructs the Technical Agency to inform the district Collector about potential water shortages based on rainfall and groundwater levels, with subsequent sections implemented in affected areas.
Section 5 regulates the extraction of groundwater for non-drinking uses where there is a stated shortage, including existing wells used for irrigation. Section 6 advises the GSDA to declare overexploited watersheds and ban the construction of new wells. Section 8 allows the Collector to forbid farmers from using existing wells to extract water for non-drinking purposes. Sections 9-11 empower the Collector to gather technical information to determine whether to shut down an existing well if it is obstructing a source of drinking water. Section 11 allows for actions to prevent contravention of the Act, such as closing wells, removing pumps, or disconnecting power supplies. Section 12 offers compensation for permanent well closures if they negatively affect drinking water. Other sections detail procedural details, appeals, good faith protection, penalties, and punishments. 6 months of simple imprisonment is the punishment for violating the law. This Act supersedes other laws, as per Section 18.

6 Features of the Act

This Act's main objective is safeguarding public drinking water sources and enabling a sustainable and sufficient groundwater supply with the required quality for various user categories. It does this by implementing supply and demand management strategies. A few of the Act's key characteristics are-

7 Groundwater management will be the state's responsibility

In the early years of the 2000s, the Hon'ble High Court of Kerala pointed out the position of all-natural resources especially groundwater in the case of Coco Cola case, which took place in Plachimada, Kerala. The court concluded that groundwater ought to be regarded as a national asset since it is a natural resource. This national asset needs to be managed and maintained by the state as its custodian. The national asset needs to be treated as the property of the public and used for the benefit of the entire society and not for the benefit of some private owners. Maharashtra Water Resources Regulatory Authority (MWRRA) is a regulatory authority to be overlooked by the state. The regulatory authority will function from the ground up ie. From local

governance (gram sabha and panchayats to State Groundwater Authority). District Level Authority and Watershed Water Resources Committee (WWRC) will function at the watershed level.

8 Laws to avoid overusing the groundwater resources

By requiring the registration of wells and borewells, restricting the excavation of deep borewells for non-drinking reasons, and designating over-exploited or water quality-affected areas as notified areas, the legislation seeks to prevent the overexploitation of groundwater resources. It also proposes prohibitions on new well construction, extraction of groundwater from existing wells, withdrawal from deep wells, and groundwater sales in designated regions.
Pay attention to source and resource management by increasing supply and reducing demand.

The Act focuses on water management, combining surface and groundwater resources, and focuses on watersheds as basic areas. It acknowledges aquifers as the foundation for understanding groundwater exploitation. The Act also addresses groundwater withdrawal for irrigation calling for the state water plan to include an integrated watershed development plan. It motivates farmers to lower their demand for groundwater and look into alternatives like rainwater collecting and personal-level preservation systems. The Act places a strong emphasis on maximizing resource availability for long-term use and taking resource accessibility into account when planning for water.

Planning for crops, groundwater use, and water accounting are the primary objectives.
The Act emphasizes accounting for water, allowing farmers to balance demand and supply by deciding between drinking water and irrigation water needs. Farmers can regulate irrigation water by looking into alternate sources. WWRC prepares and maintains water accounts in notified areas, while Gram Panchayat handles non-notified areas. The Act promotes locally suitable cropping patterns and establishes infrastructure for water-efficient crops. It also bans water-intensive crops based on WWRC, GSDA, and watershed or aquifer-wise groundwater use plans. If a farmer asks to cultivate crops that require a lot of water, like sugarcane, WWRC might approve as long as the farmer uses less groundwater and pays for water conservation measures.

9 Focus on decentralization and community participation

The act emphasizes decentralization and community participation, with the watershed area being the lowest unit for development. Management plans for all watersheds involve community participation from the beginning, with the State Groundwater Authority involving the Director GSDA, one groundwater user, and a woman to provide information. If necessary, the area is declared notified and formed by the Watershed Water Resources Committee (WWRC) to promote and regulate

groundwater development and management. The act reaches the village-level Panchayat, creating Integrated Watershed Development and Management plans for both notified and non-notified areas.

As per Section 9, in notified areas, the State Authority shall instruct the Panchayat, GSDA, and District Watershed Management Committee to develop an Integrated Watershed Development and Management Plan for artificial groundwater recharge. Community involvement is also encouraged, even in non-notified areas. Panchayats, Samitis, and local urban bodies will participate in watershed management, ensuring safe watershed status through groundwater recharge, water budgeting, and a groundwater use plan. The Watershed Water Resources Committee will ensure equity, protecting small and marginal farmers' rights and implementing restrictions for groundwater surveys and withdrawals.

Pay attention to maintaining the quality of water and the polluter pays principle.
The Act also addresses sanitation and water quality, explicitly addressing industries and groundwater contamination. It mandates local bodies to prevent pollution in both notified and non-notified areas. The polluter pay principle is also implemented. Recharge areas are notified, making open defecation an offence and preventing groundwater faecal contamination.

10 Linkages with the aquifer mapping programme

The Act's linkages to the aquifer mapping effort are among its additional important components. It conforms to the Land Revenue Code.

10.1 Urbanization, Urban Sprawl and Groundwater Usage

By 2050, the urban population is projected to almost double to 6 billion and about 90% of this growth will take place in low-income countries. In the next 30 years, it is expected that there will be 2 billion more people living in urban slums. unprecedented challenges for water management. India's rapid industrialization and urbanization are causing limited supply, falling water tables, and water quality issues. Topography, climate, soils, and rock formation influence groundwater in Maharashtra. The Western Ghats' rain shadow covers one-third of the state, which is semi-arid. This region experiences annual rainfall between 500 and 750mm, which runs off due to rock formation and gradients. The state is almost four-fifths covered by the Deccan trap formation. Poor underground water storage and uncertainty in subsoil aquifer capacity are prevalent. The Vidarbha region has better rainfall and surface water availability, with longer flow life streams and more tanks in Bhandara and Gadchiroli districts. Traditional sources of drinking water include dug wells in shallow aquifer zones.

The use of dug wells for irrigation has been prevalent in Maharashtra since the post-independence era, particularly in alluvial belts and rivers. With the rise of commercial crops like sugar cane and improved electrification, the use of groundwater for farming expanded quickly. In 1972, AFPRO, a non-governmental

organization with Swiss Development Aid, introduced modern drilling technology to address drinking water scarcity. This led to the construction of deep bore wells in water-scarce regions.

The rise of high-speed drilling rigs, particularly down-the-hole hammer rigs, has led to excessive exploitation of groundwater sources, as stated by CGWB functionaries, resulting in excessive groundwater use that has negative consequences on the sources. This has had catastrophic effects on the groundwater supply, which is necessary to support most of the rural population's subsistence demands. The absurdity is that people who can afford to invest comparatively considerable sums of money in groundwater development or who can obtain loans from cooperatives or banks are the ones who have the most significant advantage when it comes to access to groundwater.

11 Conclusion

Maharashtra heavily relies on groundwater for domestic, commercial, and subsistence irrigation and is increasingly a significant source of industrial use. The current legal system needs to work on meeting these demands due to its outdated conception of groundwater, concerns about groundwater before drinking water use, and fragmented perspective based on private property ownership. Groundwater plays a crucial role in water use, but its depletion has been exacerbated by the introduction of mechanized pumping decades ago. This has led to the exploitation of groundwater resources to avoid short-term crises, which could be more sustainable. The current legal regime fails to address these issues, as it fails to protect aquifers beyond individual landowners' interests. The disconnection between groundwater and surface water allocation principles hinders an integrated view of water management. Authorities have acknowledged the necessity of a new groundwater legislation paradigm and implemented a policy in 2019.

In the second decade of the twenty-first century, groundwater cannot be regulated like an individual's resource. Its public nature requires a clear recognition of its public nature, separating land ownership from control over groundwater. This is necessary for social dimension and comprehensive protection. Groundwater should be conceived as a public trust, and groundwater law reform along with social reforms is necessary. However, there are still barriers in the way of a legal system that is both environmentally sound and socially just.

12 Recommendations

Understanding the Resource: This means recognizing the fact that underground water is a common pool resource that occurs in aquifers. Further, the storage and transmission characteristics of aquifers and underground water quality are important qualities in understanding the resource and that aquifers are dynamic in both space and time. The recharge and discharge of aquifers as a pattern needs to be understood as well.

Managing Demand: Balancing various types of demands that determine including water extraction from the aquifer, including mechanisms of access, pumping system, distribution of water, its application, and disposal in various fields like agriculture, industry and sanitation.

The active role of local governance: The management and disposal of underground water need to be monitored at the micro level which includes local governance eg panchayat and municipal corporations.

Planning Supply: The governance of groundwater apart from being monitored, requires policies, procedures, goals, and accounting, enabling stakeholders participation and holding responsibility and accountability.

Alternative Opportunities: Groundwater governance should also include specific management goals by developing alternative niches in livelihood, energy used and opportunities offered under adaptation and coping strategies that focus on events such as droughts, floods, economic drivers and climate change and variability.

Community Participation: The goal of the government of India's promotion of Participatory Irrigation Management (PIM) in numerous irrigation schemes is to ensure sustainability in irrigation development and management by enhancing crop productivity, reducing water conflicts, and improving irrigation operation and maintenance through the creation of Water Users' Associations (WUAs). To facilitate the transition of management to WUAs, several Indian states have enacted their legislation. The state of Maharashtra has a long history of including the community in irrigation management. Following 1985, the Maharashtra government made a conscious effort to show great interest in the establishment of cooperative societies and associations for water consumers. The organizations themselves are in charge of running and maintaining the distribution system.

To encourage the creation of WUAs, the Maharashtra government passed a special act in 2005 called the Maharashtra Management of Irrigation System by the Farmers Act, 2005. The best historical examples of participatory and sustainable irrigation management systems include the Phad (Block) System, the Waghad Irrigation Project, and the Malgujari Tank System. Sixty-seven per cent of the population participated in planning, 57.7 per cent in execution, and 75.1% in maintenance. It demonstrates that during the design and implementation stages of the watershed programme in the six affected districts of the Vidarbha area of Maharashtra, the level of public participation in the NSHWDP was modest, whereas, during the maintenance phase, there was a significant degree of public participation. Knowing allows people to act.

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