



Drinking Water Resource Development and Management: A Case Study of Solapur District, Maharashtra (2011–2021)

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ABSTRACT:

Drinking water is essential for public health and sustainable development. Solapur district of Maharashtra faces drinking-water challenges because of its semi-arid climate, irregular rainfall and increasing dependence on groundwater. This study examines the development and management of drinking-water resources in Solapur during 2011–2021 using secondary data from the Census of India, Central Ground Water Board, Government of Maharashtra and Jal Jeevan Mission. The study focuses on drinking-water sources, groundwater conditions, household tap-water access and government initiatives. CGWB data show a declining groundwater trend over about 68.4% of the district area, while irrigation accounts for most groundwater extraction. The implementation of the Jal Jeevan Mission after 2019 significantly increased rural household tap-water connections in Maharashtra and Solapur. The study finds that although drinking-water infrastructure and household connectivity improved, long-term water security depends on sustainable groundwater management, rainwater harvesting, water conservation, water-quality monitoring and community participation. Therefore, Solapur requires an integrated approach that combines infrastructure development with protection and sustainable management of its water resources.

Keywords: Drinking water, water resources, groundwater, water management, Solapur district, Maharashtra, Jal Jeevan Mission, rural water supply, sustainability, 2011–2021.

INTRODUCTION:

Water is essential for human life, agriculture, economic activities and environmental sustainability. Access to safe and sufficient drinking water is closely connected with public health, sanitation and quality of life. In semi-arid

regions such as Solapur district, water availability is affected by irregular rainfall, groundwater dependence and increasing demand from agriculture and domestic use.

Solapur is located in south-eastern Maharashtra on the Deccan Plateau and is mainly covered by basaltic rock formations. Groundwater is generally found in weathered and fractured zones of these rocks. The district depends on both surface water and groundwater, while seasonal variations in rainfall create difficulties in maintaining a reliable drinking-water supply.

Census 2011 provides an important basis for understanding the drinking-water situation in the district. It records household access to different sources, including tap water, wells, handpumps, tubewells and other sources. These data are useful for assessing the level of drinking-water infrastructure and the dependence of households on groundwater-based sources.

During 2011–2021, drinking-water management in Solapur gradually shifted towards piped water supply and household tap connections. The introduction of the Jal Jeevan Mission (JJM) in 2019 further strengthened this approach by emphasizing Functional Household Tap Connections, water quality, regular supply, source sustainability and community participation.

Groundwater remains a major concern in the district. According to the Central Ground Water Board, groundwater levels showed a declining trend over about 68.4% of Solapur district during 2008–2017. Agriculture was responsible for the majority of groundwater extraction, increasing pressure on available water resources. These conditions demonstrate that improving drinking-water infrastructure alone is not sufficient to achieve long-term water security.

Therefore, sustainable drinking-water development in Solapur requires an integrated approach involving groundwater recharge, rainwater harvesting, water conservation, efficient agricultural water use, surface-water development, water-quality monitoring and community participation. This study examines the development of drinking-water infrastructure and the management of the water resources supporting it in Solapur district during 2011–2021.

STATEMENT OF THE PROBLEM:

Solapur district faces a dual challenge. On one hand, there is a need to increase access to safe, reliable and convenient drinking water. On the other

hand, groundwater resources are under pressure because of high extraction, particularly for irrigation. Consequently, the central problem is not simply the absence of drinking-water infrastructure but the need to develop a sustainable relationship between water resources, infrastructure and users.

OBJECTIVES:

The major objectives are:

1. To examine the status and development of drinking-water resources in Solapur district during 2011–2021.
2. To assess the status of groundwater resources and groundwater development in the district.
3. To examine the role of government programmes in improving drinking-water supply.
4. To suggest appropriate measures for improving drinking-water security in Solapur district.

DRINKING WATER RESOURCE:

A drinking-water resource refers to a natural or developed source from which water suitable for human consumption can be obtained. It may include groundwater, rivers, reservoirs, lakes, springs, wells, borewells and rainwater harvesting systems.

In Solapur, both groundwater and surface water are important. Groundwater occurs primarily within weathered and fractured basaltic formations, while surface-water resources are associated with rivers, reservoirs and irrigation projects.

Table 1: Distribution of households by main source of drinking water, Solapur District, 2011

Drinking-water source	Percentage of households
Tap water – total	57.0
Tap water from treated source	46.9
Tap water from untreated source	10.1
Well – total	17.7
Covered well	1.3
Uncovered well	16.4
Handpump	14.3

Tubewell/Borewell	8.1
Spring	0.1
River/Canal	0.9
Tank/Pond/Lake	0.6
Other sources	1.2
Total	100.0

(Source: Census of India 2011, as reproduced in the Government of Maharashtra's Distribution of Households by Availability of Drinking Water Facility – 2011.)

The table indicates that tap water was the largest single category in Solapur in 2011, accounting for 57.0% of households. However, groundwater-dependent sources remained very important. Wells accounted for 17.7%, handpumps 14.3% and tubewells/borewells 8.1%.

Thus, approximately 40% of households depended on wells, handpumps, tubewells or other non-tap sources, showing the importance of groundwater and decentralized sources in the district.

The distinction between treated and untreated tap water is also important: 46.9% of households used treated tap water, while 10.1% used untreated tap water.

WATER RESOURCE DEVELOPMENT:

Water-resource development refers to planned activities undertaken to make water available for human and economic purposes. These activities include construction of wells, borewells, reservoirs, pipelines, water-treatment plants, storage tanks, pumping stations and distribution networks.

The concept has traditionally been associated with increasing water availability. However, modern water-resource management increasingly emphasizes sustainability. Development should therefore not exceed the natural capacity of water systems to recharge and recover.

DRINKING-WATER MANAGEMENT:

Drinking-water management refers to the planning, development, operation, maintenance, monitoring and regulation of drinking-water systems. It includes: source identification, water abstraction, treatment, storage,

transmission, distribution, water-quality monitoring, infrastructure maintenance, financial management, community participation; and protection and sustainability of water sources.

DRINKING-WATER SOURCES IN 2011:

Census 2011 provides the most comprehensive baseline for household drinking-water sources in Solapur. The principal sources included tap water, wells, handpumps, tubewells/boreholes and other sources.

Maharashtra's infrastructure statistics show that only about 22.5 percent of Solapur households depended on tap water in 2011, compared with 23.2 percent in 2001. This indicates that, unlike some relatively water-secure districts, Solapur continued to depend substantially on decentralized sources.

The continued importance of wells and groundwater-based sources reflects the hydrogeological character of the district. Groundwater has historically been important for domestic as well as agricultural purposes.

The Census also distinguishes between sources located within premises, near premises and away from premises. This distinction is important because physical availability of a water source does not necessarily mean convenient household access. Maharashtra's Human Development Report found that distance from the water source has significant implications for women and children because they often bear responsibility for collecting household water.

Table 2. Comparison of Tap-Water Dependence in Solapur and Selected Maharashtra Districts, 2011

District	Tap water (%)	Well water (%)	Handpump (%)	Tubewell (%)
Solapur	57.0	17.7	14.3	8.1
Pune	80.6	8.9	3.7	4.9
Satara	73.4	10.1	7.2	6.8
Sangli	67.3	13.9	6.9	9.9
Osmanabad	56.6	9.3	15.2	15.0
Ahmednagar	50.4	30.2	7.3	8.5
Nashik	63.2	25.7	5.6	3.3
Kolhapur	85.4	4.9	2.5	5.4

(Source: Census of India 2011 / Government of Maharashtra, Distribution of Households by Availability of Drinking Water Facility – 2011.)

Solapur's tap-water coverage of 57.0% was lower than Pune (80.6%), Satara (73.4%), Sangli (67.3%) and Kolhapur (85.4%), but higher than Ahmednagar (50.4%).

The relatively high dependence on wells and handpumps in Solapur reflects the district's semi-arid conditions and the importance of groundwater sources.

This comparison can be used to argue that Solapur entered the 2011–2021 period with substantial scope for improving piped household water supply.

STUDY AREA: SOLAPUR DISTRICT

Solapur district is located in the south-eastern part of Maharashtra and forms part of the Western Maharashtra region. It lies approximately between 17°10' and 18°32' north latitude and 74°42' and 76°15' east longitude. The district is situated on the Deccan Plateau and falls mainly within the Bhima and Sina river basins. The Bhima River and its tributaries provide an important drainage network for the district. The district is bordered by Ahmednagar and Osmanabad to the north, Osmanabad and Kalaburagi (Karnataka) to the east, Sangli and Vijayapura (Karnataka) to the south, and Satara and Pune to the west.

The geographical area of Solapur district is approximately 14,845–14,895 km², with minor differences among government sources because of administrative/statistical datasets. The official district administration currently reports about 14,895 km², while the district geography page gives 14,844.6 km². For an academic paper, 14,844.6 km² can be used when discussing the geographical profile, provided the source is cited consistently.

According to the 2011 Census, Solapur had a population of 4,317,756, including approximately 2.23 million males and 2.09 million females. The district had a population density of around 290 persons per km² and a literacy rate of 77.02%. The district had 11 talukas in the 2011 administrative framework.

The geological structure has a direct influence on groundwater. Unlike porous alluvial formations, basaltic formations do not provide uniform groundwater storage throughout the district. Groundwater is concentrated in weathered, jointed and fractured zones. CGWB reports that pre-monsoon

groundwater levels in 2017 ranged from approximately 4.1 metres below ground level to 23.5 metres below ground level at monitoring locations. Post-monsoon levels ranged from about 0.5 to 18.5 metres below ground level.

This geological and climatic setting explains why groundwater development is spatially uneven. Some areas have relatively shallow groundwater, while others have deeper water levels. Consequently, water-supply schemes must be designed according to local hydrogeological conditions rather than using a uniform approach across the district.

LITERATURE REVIEW:

Previous studies show that Solapur district has a high dependence on groundwater, particularly for agriculture, and that intensive extraction has contributed to declining groundwater levels and seasonal drinking-water problems. The Central Ground Water Board reported a declining groundwater trend over about 68.4% of the district during 2008–2017, highlighting the need for groundwater recharge and regulated extraction. Kumar, D., (2013) et al. emphasized that sustainable rural water supply depends not only on infrastructure but also on proper planning, operation and maintenance, institutional capacity and community participation. Wennberg, A. Cet al. (2017) found that access to improved water sources does not always ensure safe drinking water because contamination can occur during collection, storage and household use. Overall, the literature indicates that Solapur requires an integrated approach combining groundwater conservation, reliable water-supply infrastructure, water-quality monitoring and community participation. Jain, P. K. (2005) However, limited studies have examined these aspects together for Solapur during the specific period 2011–2021, which provides the research gap addressed by the present study.

This literature is relevant to Solapur because water-resource development should be assessed not only by physical access but also by water quality.

RESEARCH GAP:

Existing studies have examined groundwater conditions, rural water supply and institutional management in Maharashtra. However, there is value

in integrating these dimensions into a single district-level analysis of Solapur for the period 2011–2021.

METHODOLOGY:

The study follows a descriptive and analytical case-study approach. Solapur district is treated as the geographical case, while the period 2011–2021 is treated as the temporal framework.

DATA COLLECTION:

The research is primarily based on secondary data. Census of India 2011, District Census Handbook, Solapur, Central Ground Water Board; Maharashtra Directorate of Economics and Statistics, Maharashtra Human Development Report; Government of Maharashtra water-supply documents, Jal Jeevan Mission, Government of India parliamentary and press-release documents; and relevant academic and institutional studies. The District Census Handbook contains village- and town-level information on infrastructure, including drinking-water facilities, while the Primary Census Abstract provides demographic and household data.

CHANGES IN DRINKING-WATER INFRASTRUCTURE:

The decade witnessed a gradual transition towards piped water systems. Earlier rural-water-supply programmes emphasized source development, public stand posts, handpumps and village-level schemes. Over time, policy increasingly emphasized household-level connections.

The Jal Jeevan Mission accelerated this transition after 2019. The mission's objective is to provide functional household tap connections, rather than simply constructing water infrastructure. Its definition of functionality includes adequate quantity, prescribed quality and regular supply.

By November 2021, Maharashtra had achieved approximately 67.10 percent rural household tap-water coverage, compared with approximately 34 percent at the launch of JJM in August 2019. Around 47.08 lakh additional rural households had received connections during those 26 months.

A Government of India response in March 2022 stated that Solapur was among districts where tap-water connections had reached more than 80 percent

of households. Although this information was reported in 2022, it demonstrates the rapid progress made around the end of the study period.

JAL JEEVAN MISSION AND THE CHANGING MANAGEMENT MODEL:

The Jal Jeevan Mission introduced a more comprehensive understanding of drinking-water service delivery. Instead of measuring success simply by construction of a scheme, it emphasizes functional household connections.

Table 3: Solapur District – JJM Progress up to 23 July 2021

Indicator	Number of rural households
Total rural households	6.00 lakh
Tap connections at launch of JJM – 15 Aug. 2019	2.16 lakh
Additional connections provided after launch	2.08 lakh
Tap-water supply as on 23 July 2021	4.24 lakh
Coverage at launch	36.0%
Coverage by 23 July 2021	70.7%
Increase in coverage	34.7 percentage points

(Source: Ministry of Jal Shakti, Government of India, Lok Sabha Starred Question No. 146, answered 29 July 2021; source: JJM-IMIS)

This is particularly important because the success of a drinking-water programme should ultimately be measured through:
availability + adequacy + quality + reliability + accessibility + sustainability.

The rapid increase in rural tap-water coverage in Maharashtra after 2019 demonstrates the potential of large-scale public investment. However, the next challenge is ensuring that infrastructure remains functional after construction.

CONCLUSION:

The study concludes that Solapur district made significant progress in drinking-water infrastructure during 2011–2021, particularly through the expansion of household tap-water supply under the Jal Jeevan Mission. However, groundwater depletion, irregular rainfall and high agricultural demand continue to threaten long-term water security. Therefore, improving drinking-water access must be combined with groundwater recharge, rainwater harvesting, efficient agricultural water use, water-quality monitoring and community participation. Sustainable drinking-water management in Solapur

requires a shift from simply providing water connections to ensuring reliable, safe and sustainable water resources for future generations.

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