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# Geography Of Irrigation and Its Role in Agriculture Development in Vidarbha

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**ABSTRACT**

Irrigation occupies a very important role in agricultural development owing to physiographic and climatic diversity in the Vidarbha region that has recently been mugged by frequent drought, erratic monsoons, and uneven irrigation coverage, all making agricultural productivity and rural livelihoods susceptible to vagaries of nature. The research presents an analysis of the spatial distribution of irrigation infrastructure in Vidarbha and its impacts on cropping patterns, land use, and the economic viability of farming communities. The study identifies disparities in irrigation, evaluates various irrigation types, including canal, well, and micro-irrigation systems, concerning their efficiency, and uses district-level data and spatial mapping. The study suggests the formulation of region-specific irrigation policies coupled with integrated water resource management as a means to achieve fair and sustainable agricultural development. Strengthening irrigation infrastructure plus water use efficiency improvements could change the agrarian discourse to stop further distress and promote better agricultural production in the whole region...

***Keywords:*** *Irrigation Geography, Vidarbha, Agricultural Development, Water Management, Cropping Pattern, Rural Economy*

## 1. INTRODUCTION

Irrigation is one of the more important aspects of sustaining agricultural activities, which carry great importance in the rural economy of India. The 11 districts falling under the purview of the Vidarbha region of Maharashtra are otherwise primarily agrarian and need to depend on the monsoonal rainfall. Such vulnerability has lent itself to agrarian distress and woes such as farmer suicides and rural indebtedness, often aggravated by lack of irrigation coverage and weaker practices of water management.

The irrigation architecture in Vidarbha remains underdeveloped despite having naturally flowing rivers such as the Wardha, Wainganga, Kanhan, and Purna. The hard rock topography, black cotton soils, and erratic rainfall of the area pose special difficulties to traditional canal-based irrigation systems, leading to the sprawl of groundwater exploitation through wells and borewells. Lift irrigation systems and micro-irrigation methods have been adopted, but their coverage is limited. These differences also exist in inter-district irrigation development.

The geographical distribution and management of irrigation resources become very important for boosting agricultural development in the area. An adequate system should allow for the crop besides the monsoon, reduction of monocropping instances, diversification of crops, and sustainable use of water. A poorly planned irrigation system would establish a mono-cropping framework and force a populace to over-depend on crops of high risk, further entrenching poverty levels in the rural sector.

The present research aims to examine the various spatial distributions and types of irrigation systems operating in Vidarbha, study the effect such systems have on agricultural patterns and productivity, and further study how the geographical setting intervenes in determining the presence and effectiveness of irrigation. The study also includes an evaluation of the governmental policies, irrigation projects, and rural development schemes directed at enhancing irrigation access in the region.

### *Objectives of the Research*

- To study the geographical features of the Vidarbha region
- To analyze the existing irrigation infrastructure in Vidarbha
- To examine the impact of irrigation on cropping patterns and agricultural productivity
- To identify inter-district disparities in irrigation access and agricultural outcomes

- To evaluate the role of government schemes and irrigation projects in Vidarbha
- To understand the relationship between irrigation and rural socio-economic development

## 2. LITERATURE REVIEW:

Several scholars have understood the crucial link between irrigation and agricultural development in places like Vidarbha. According to Dhawan's study (1988), irrigation becomes an engine of cropping intensity increase and stabilization of agricultural productivity in semi-arid regions. Building on this, Vaidyanathan drew attention to the institutional challenges and regional imbalances entailed in the development of irrigation while stressing their role in agricultural inequalities. Kale (2010) took this further by documenting the very uneven distribution of irrigation infrastructure in the state, with Vidarbha significantly lagging. Chavan (2012) linked inadequate irrigation to rising farmer distress and suicides among farmers living in Vidarbha. Kulkarni and Shah (2013) raised alarms on unending groundwater extraction and seemed to advocate for much-needed reforms in ensuring fair irrigation. Sathe (2015) examined if irrigation expansion would improve Vidarbha's agrarian situation and concluded to the necessary effect that it must have institutional support. Joshi and Patil (2017) establish that access to irrigation positively affected crop diversification and productivity in parts of Vidarbha. More recently, Bhagat (2019) presented a spatial analysis that revealed stark inter-district disparities in irrigation access coupled with the unlike farm incomes resulting from them. Pawar and Tayade (2021) discovered micro-irrigation as an effective strategy to improve water use efficiency but limited by costs. Finally, Kamble and Kale (2023) used GIS mapping and showed that irrigation development can go a long way in ameliorating backward districts in eastern Maharashtra.

## 3. RESEARCH METHODOLOGY;

This study uses a mixed-method approach to analyze the geographical dimensions of irrigation and its role in agricultural development in the Vidarbha region of Maharashtra. It collects and analyzes secondary and primary data to evaluate the distribution of irrigation infrastructure, its usage, and its impact on cropping patterns and productivity. The research is confined to 11 districts, representing varying levels of irrigation development, agro-climatic zones, and socio-economic conditions.

### *Geography of Irrigation and its Role in Agriculture Development in Vidarbha:*

Vidarbha is a geographical region within Maharashtra, extending to almost 31.6% of the total geographical area of the country. This area incorporates 11 districts, which are grouped into two sub-regions: Western Vidarbha (Amravati division) and Eastern Vidarbha (Nagpur division). A tropical monsoon climate is found with annual rainfall averaging between 800 mm and 1,200 mm. The monsoon plays a critical role in cultivation, with the majority of its districts covered by black cotton soils (Regur).

The irrigation coverage in Vidarbha is very much behind, like Amravati, Yavatmal, and Buldhana, where the percentage is much lower, putting farmers into the clutches of crop failures and distress. The geographical variation is also seen in the irrigational infrastructure where the eastern Vidarbha is blessed with higher rainfall and more surface water projects as compared to the western Vidarbha, which has rain shadow areas with less rainfall and drought frequency. The irrigation coverage usually falls below 15% among these, and many of these districts are now dry or seasonal.

Among the various means of irrigation, irrigation is effective with agriculture development. The productivity of irrigated farms increases almost above average when compared to most rainfed farms. Cotton, soybean, paddy, vegetables, and fruit crops tend to have notably higher productivity. Less than 40% of the suicides in Vidarbha are from irrigated areas. Major irrigation projects for Vidarbha include the Gosikhurd National Irrigation Project (Bhandara-Chandrapur), which is expected to irrigate over 2.5 lakh ha. but has been delayed due to delayed projects because of insufficient funds, inadequate land acquisition, and planning complications.

There are many central and state government schemes to make successful strides towards better irrigation in Vidarbha, such as the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Micro Irrigation Fund (NABARD), Accelerated Irrigation Benefit Programme (AIBP), and Watershed Development Programmes. Unfortunately, the effectiveness of these schemes has been reduced because of bureaucratic delays, corruption, and ignorance of farmers. By 2022, less than 30% of eligible farmers across Vidarbha had access to micro-irrigation subsidies.

The possible strategies to improve irrigation in Vidarbha would be pending project completion, upgrading of systems for micro-irrigation, groundwater recharge through farm ponds and check dams, using technology a strong Water User Association (WUA) for equitable and maintenance purposes.

In a nutshell, the very geography of irrigation in Vidarbha bears the brunt both of natural constraints and human inefficiencies. Improving and expanding irrigation coverage could completely change the agricultural scenario of Vidarbha through a combination of infrastructure investments, technology adoption, and institutional reforms.

An Overview of Vidarbha:

Vidarbha, an agro-climatic region in eastern Maharashtra, is quite famous for its richness in natural resources and agrarian distress. The part of Vidarbha region covers about 97,321 square kilometers and is strategically located between 19°20'N to 21°50'N latitude and 77°30'E to 80°30'E longitude. It falls under a tropical monsoon climate characterized by semi-arid conditions in the western states and sub-humid conditions in the eastern districts. It has received more than 85% of the total rainfall during the Southwest Monsoon (June-September), which explains why assured irrigation is important.

The region is dominated by black cotton soil (regur), which is formed by the weathering of basaltic rock. All these soils are very good for the cultivation of cotton, soybean, tur, gram, and wheat but require timely irrigation to avoid moisture stress and yield loss. More than half, i.e., about 65-70%, of the total active workforce in Vidarbha is directly involved in agriculture as a livelihood, agriculture being the major occupation of the people here. Most of the region is rain-fed with limited coverage area under irrigation.


It includes the land use and cropping in 59.26 lakh hectares (61% of the total area) and 11.3 lakh hectares (only ~19% of the net sown area). Major crops kharif (monsoon crops), cotton (≈15 lakh-ha; yield ≈400-600 kg/ha (rain-fed), up to 1200 kg/ha (irrigated), soybean (~10 lakh ha), tur (pigeon pea) (5 to 6 lakh ha), paddy (mainly eastern Vidarbha), rabi (wheat) (3 lakh ha), chickpea/gram (~2.8 lakh ha), linseed, mustard in pockets) and wheat.

Specific agricultural challenges in the state of Vidarbha are low irrigation cover area (~19%), frequent crop failures and droughts, high dependence on the monsoons, low productivity and income insecurity, and high incidence of farmer suicides. The importance of irrigation in terms of improvement in crop production and agricultural income, crop intensity, and diversification is very important about the adoption of technology and modern inputs, security of food and livelihood, as well as buffering from the uncertainties of the monsoon.

Therefore, about geography, climate, and soil features, Vidarbha provides diverse opportunities and constraints vis-à-vis agriculture. Therefore, an irrigation strategy specific to the region, coupled with its agro-ecological conditions, is needed to propel agrarian development as well as improvements in rural habitation resilience in Vidarbha.***Types of Irrigation in Vidarbha:***

The irrigation infrastructure in Vidarbha is diverse and specific to the region because of factors like the availability of surface water, groundwater potential, topography, and state-level development initiatives. Despite being a rain-fed region, various irrigation systems have been developed to alleviate water shortages and improve productivity in agriculture. The major types of irrigation are canal irrigation, well and tube well irrigation, lift irrigation, and modern techniques like drip and sprinkler irrigation.

So far, canal irrigation is limited by the undulating terrain and absence of major perennial rivers, but some areas of western districts have been connected to a canal system by medium and large irrigation projects. This accounts for about 15-18% of the gross irrigated area in Vidarbha. The challenges are further inefficiency through seepage and aged infrastructure, limited reach to tail-end farmers, and seasonal operation dependent on rainfall and reservoir levels.


The most important and widespread irrigation practices found in Vidarbha are well and tube well irrigation. It can be found mostly in those areas where groundwater is present at a sufficient level and electricity or diesel pumps are available. More than 65-70% of the total irrigated area is covered under groundwater irrigation through more than 5.5 lakh wells and 80,000 tube wells functional in the Vidarbha region. It also has issues such as depletion of groundwater, the high cost involved in the installation and maintenance of wells, and power supply problems in remote areas.

Lift irrigation refers to those places where gravity flow is not possible, lifting water through pumps from rivers, reservoirs, and canals into fields that are set at a high elevation. Most lift irrigations are community-managed or government-supported schemes implemented on small and medium rivers like the Wardha, Penganga, and Wainganga.


The adoption of drip and sprinkler irrigation methods is gradually gaining pace in Vidarbha, as these methods address the problems of water scarcity and improved efficiency in the use of water, especially for horticulture and cash crops. Drip irrigation is compared with traditional methods; 30-50% water savings can be achieved with this technique, whereas sprinkler irrigation minimizes losses of water due to percolation and evaporation.

Thus, combined irrigation modes: groundwater use is predominant in this area, surface water is canalized, and emerging micro-irrigation technologies are being developed. It is urgently needed to expand and upgrade irrigation systems to promote water conservation practices and strengthen community-based water management towards a sustainable agricultural growth path.

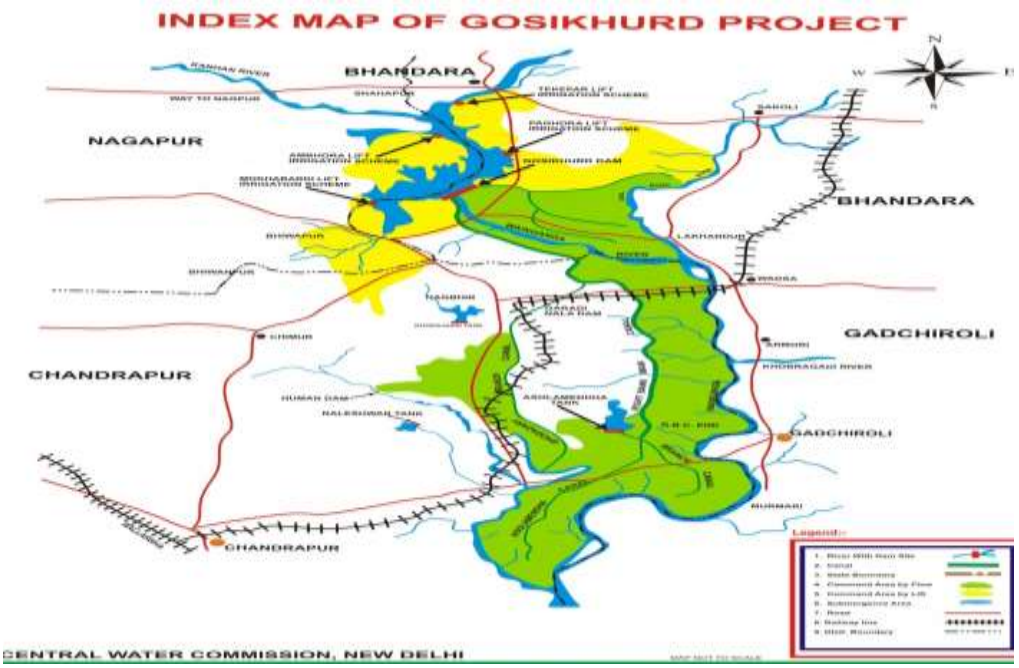
***Geography and Distribution of Irrigation in Vidarbha:***

The Vidarbha irrigation geography presents prima facie wide spatial disparities due to variations in topography, rainfall, river systems, and water structures. The eastern part of Vidarbha, principally the zone stretching from Nagpur to Chandrapur, Gondia, and Bhandara escort-good irrigation infrastructure due to perennial river systems like the Wainganga, Pench, Kanhan, and Bagh. These rivers augment irrigation through the networks of reservoirs and canal systems and help develop surface irrigation in this very region.

The district-wise variation in irrigation coverage presents severe contrasts. The Nagpur district, the largest in area, suffers chronic water scarcity, with irrigation coverage of only about 10%, leading to frequent crop failures and agrarian distress. Gadchiroli district, despite very good rainfall, is severely lacking in irrigation infrastructure, with less than 10% of its

cultivated land irrigated, mainly due to the presence of hills and absence of water harvesting systems.

**Limited surface water infrastructure in**




western and central Vidarbha forces many of the districts to depend heavily on groundwater irrigation, especially through dugwells and borewells. Consequently, this has led to a drop in the water table, borewell failure, and dry wells in peak summer months. In Yavatmal district, for example, more than 70% of irrigated land depends on borewell irrigation, with a rapid depletion of aquifers and breakdown of pumps, particularly in the drought years.

Geography in irrigation diffuse over Vidarbha unearths a dual reality: the eastern districts have better access to surface water resources, while districts in the western-central region suffer utmost vulnerability due to low rainfall, inadequate canal systems, and over-dependence on groundwater. Hence, it is imperative to strengthen surface water irrigation and micro-irrigation, as well as implement watershed management in under-irrigated areas, promoting sustainable and equitable growth of agriculture in Vidarbha.

***Impact of Irrigation on Agricultural Development in Vidarbha:***

One of the most important factors in the agricultural development of the Vidarbha area, where rainfall patterns are erratic, dry spells occur intermittently, and droughts visit every few years, is irrigation. By improving productivity, diversifying crops, saving the farmers from vicissitudes, raising rural incomes, and controlling food security, irrigation acts as a safeguard. Farmers from irrigated regions like Nagpur, Bhandara, and Amravati are now increasingly taking to high-value commercial and horticultural crops such as oranges, pomegranates, vegetables, and flowers. This change in crop pattern acts as a natural risk cover against market volatility and weather shocks, thereby increasing farm incomes by as much as 40-60% compared to traditional monocropping.

Assured irrigation raises the crop productivity astronomically, especially for cash crops such as cotton and soybean, the main crops in Vidarbha. The irrigation potential of a district directly correlates to its yield per hectare, evidenced by districts with better irrigation infrastructure consistently realizing higher yield per hectare. Irrigated farms produce 25-40% more yield than rainfed farms due to timely sowing, use of fertilizers, and protection against mid-season dry spells.

Irrigation indeed serves in bettering agricultural distress, which has been historical in Vidarbha, primarily on account of rainfed dependency and crop failures. Districts with fairly widespread irrigation, like Nagpur, Bhandara, and Gondia, report lower instances of farmer suicides contrasted with Yavatmal, Akola, and Amravati, whose irrigation facilities remain low. Above all, irrigation helps reduce crop failure, guarantees debt-free farming with assured income, and enables government compensation during drought only when records of irrigation are available.

Irrigation opens multiple cropping patterns, leading in turn to the year-round activities of agriculture, thus creating employment opportunities and stabilizing rural incomes. Farmers under irrigation cultivate 2 to 3 crops per year and support 1.5 to 2 times greater man-days of labor per hectare per year, contributing to household income from irrigated agriculture.

Thus, the effect on rural livelihoods entails providing work to farm laborers during the off-season, curbing rural-to-urban migration, and promoting agro-based entrepreneurship.

***Government Policies and Irrigation Projects in Vidarbha:***

Government intervention thus ensured the development of irrigation infrastructures within Vidarbha, wherein extensive irrigation projects, policy schemes, and promotion of micro-irrigation intervention on the part of both central and state governments were encouraged to control issues regarding water scarcity and productivity enhancement. Major projects include the Gosikhurd National Irrigation Project, Upper Wardha Dam, and Purna Irrigation Project. But these projects have had disadvantages such as ill maintenance, siltation, and an inequitable distribution.

Apart from developing major irrigation infrastructure, the government also addresses sustainable water management through some centrally sponsored schemes like Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). PMKSY has been useful in promoting drip and sprinkler irrigation and watershed development in the rainfed areas such as Yavatmal and Washim. So far, PMKSY has brought about 70,000 hectares under micro-irrigation and provided 55 percent subsidy for general category farmers and up to 60-70 percent for SC/ST/small farmers.

But there are several structural and institutional challenges that hinder full utilization of potential irrigation in Vidarbha. Among them are the most important: delays and cost overruns, underutilization of irrigation potential, poor maintenance of canals and storage structures, lack of trained staff for regular repair and monitoring, social-political constraints, and lack of awareness and poor outreach in tribal areas.

However, as important as any government intervention, projects in creating such irrigation schemes and programs have formed a solid basis for agricultural development in Vidarbha. To maximize these benefits, implementation delays must be checked, equitable water distribution promoted, and modern techniques integrated, for example, with GIS-based water planning, solar-powered pumps, and farmer water-user associations. Institutional capacity and accountability at the grassroots level are also necessary for sustainable inclusive irrigation development within the region.

***Challenges and Limitations of Irrigation in Vidarbha:***

The fact that irrigation continued to pose a number of challenges for the optimal exploitation of water resources by the farmers has made a clinging social-economic vulnerability to the farmers. Some of the main policy constraints include irregular access to irrigation facilities, underground depletion, an uncertain and variable climate, and poor methodologies in water use.

Uneven access to irrigation facilities affects almost seventy-five percent of the farming people in Vidarbha; most of the areas under the command of canals are upper stream areas, and land fragmentation makes it almost impossible to design and share irrigation infrastructures. There are small area farmers and marginal farmers, among which only 28 percent have access to irrigation that gives assurance, and there is a further gap in crop productivity and returns. Another issue is the depletion of groundwater, with an average of more than 65 percent of irrigation depending on groundwater sources.

Climatic uncertainty and variability add to the other stresses in Vidarbha. The region is classified as semi-arid to sub-humid, making it highly vulnerable to both rainfall variability and climate change impacts. More than 85% of annual rainfall is captured during the monsoon, which is increasingly erratic compared to previous years, thereby greatly affecting irrigation and cropping patterns. Poor monsoons will directly lower the storage in reservoirs and directly affect dam-dependent irrigation projects, such as Gosikhurd and Upper Wardha.

Flooding irrigation, from the traditional irrigation practices, still continues to be practiced in most parts of Vidarbha, wasting much of this water through percolation, evaporation, and runoff. There is only 35-40% water use efficiency for canal systems, while drip irrigation has a water use efficiency of roughly 80-90% since less than 12% of the total area irrigated uses micro-irrigation systems, despite subsidy programs.

A multi-faceted approach is required to overcome these constraints, including groundwater regulation, equitable canal distribution, promotion of water-saving technologies, and climate-resilient planning. Future irrigation and agricultural policies for the region would include a very significant goal of inclusive access to the benefits for small and marginal farmers.

## 4. CONCLUSION:

The geography of irrigation in Vidarbha has a large role to play in the cropping pattern, productivity, and socio-economic well-being of the population. However, notwithstanding investment in projects like the Gosikhurd and Upper Wardha Dams, irrigation coverage is uneven and inaccessible to marginal and small farmers. The erratic behavior of monsoons and the depletion of groundwater resources have caused severe environmental concerns and the degradation of land. Efficient irrigation management, particularly in the eastern districts of Bhandara and Nagpur, would result in more cropping diversity, higher yields, and better acceptance of high-value and horticultural crops. Challenges such as inequitable distribution of canal water, poor maintenance of infrastructure, groundwater depletion, and inefficient use of water remain unchecked. Equitable and sustainable agricultural development, therefore, requires urgent intervention to finish pending irrigation

projects, encourage micro-irrigation technologies, release groundwater regulations, and foster participatory irrigation management. Strengthening the irrigation paradigm through inclusiveness, efficiency, and climate resilience will aid in this agrarian transformation of the region toward the betterment of millions of farmers.

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