



The Need For Pipe Distribution Networks In Sindhudurg District, Maharashtra: A Sustainable Solution For Irrigation Challenges

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Abstract: This study looks into the growing need for Pipe Distribution Networks (PDNs) in Maharashtra's Sindhudurg district—a region known for its coastal setting, rugged terrain, and high annual rainfall, averaging around 3,287 mm and reaching up to 4,242.5 mm in places like Sawantwadi. Despite receiving substantial rainfall, the district still experiences seasonal water shortages, mainly due to inefficiencies in traditional irrigation systems like open canals. These systems often lose large amounts of water through seepage and evaporation and struggle to function effectively in hilly or uneven landscapes. While projects such as the Dhamapur Dam and the Sarambala Medium Irrigation Scheme have contributed to local irrigation efforts, they frequently fall short in delivering water equitably and efficiently across the region. This paper evaluates the feasibility of introducing PDNs by analyzing Sindhudurg's geography, climate, and agricultural practices using field observations, stakeholder feedback, and official records. The findings suggest that PDNs could significantly enhance water use efficiency, encourage the adoption of micro-irrigation, and promote sustainable farming methods—offering a practical and replicable model for other similarly challenged regions in India.

Index Terms - Pipe Distribution Network (PDN), Annual Rainfall, Culturable Command Area, etc.

I. INTRODUCTION

Agriculture continues to be the cornerstone of rural livelihoods in India, making the need for efficient irrigation systems vital to ensuring food security, economic resilience, and sustainable rural development. In states like Maharashtra, traditional irrigation methods—particularly gravity-fed open canal systems—have been widely used for decades. However, these systems face a range of limitations, especially in areas with uneven terrain and variable rainfall. Water losses through seepage and evaporation, challenges with land acquisition, and poor water delivery to tail-end users often result in reduced efficiency and reliability.

Sindhudurg, a coastal district in Maharashtra, offers a unique case. Despite receiving high annual rainfall—averaging around 3,287 mm and exceeding 4,200 mm in areas like Sawantwadi—the district frequently grapples with seasonal water shortages, particularly during dry periods. This inconsistency directly affects crop yield and overall agricultural productivity. While traditional systems such as the historic Dhamapur Dam and the more recent Sarambala Medium Irrigation Scheme have supported farming in the region, they are increasingly falling short in meeting growing water demands amid changing climate conditions.

In this scenario, Pipe Distribution Networks (PDNs) present a modern and efficient alternative. As closed conduit systems, PDNs drastically cut water losses, require far less land, and allow for uniform distribution even across difficult terrain. A notable example of this approach is the Tarandale Minor Irrigation Project in Kankavali Taluka, where replacing the proposed open canal system with a PDN led to a significant expansion of the Culturable Command Area (from 550 to 744 hectares), a dramatic 85% reduction in land acquisition needs, and improved overall irrigation efficiency—particularly by enabling micro-irrigation techniques.

This paper aims to examine the current state of irrigation infrastructure in Sindhudurg and argue for the wider adoption of PDNs across the district. By integrating geographic, climatic, and agricultural data with insights from field surveys, stakeholder discussions, and official reports, the study seeks to underline both the practical feasibility and long-term benefits of PDNs in transforming irrigation practices for a more sustainable and productive future.

II. LITERATURE ANALYSIS

The Konkan region, encompassing districts like Sindhudurg, is characterized by its coastal proximity, hilly terrain, and high annual rainfall, averaging between 3,000 to 4,000 mm. Despite this abundance, the region faces significant challenges in water management, particularly concerning percolation losses, evaporation losses, and the complexities introduced by its topography.

A. Percolation Losses:

The predominant lateritic soils in the Konkan region are highly porous, leading to rapid infiltration and percolation of rainwater. This characteristic results in minimal surface water retention, causing water scarcity during non-monsoon months. The high percolation rates not only reduce the availability of water for irrigation but also lead to the leaching of essential nutrients, adversely affecting soil fertility and crop yields.

B. Evaporation Losses:

Evaporation losses in the Konkan region have been documented to range between 5% to 11% of the live storage capacity in irrigation projects. The combination of high humidity and temperature accelerates water loss from open water bodies, further diminishing the water available for agricultural purposes. These losses underscore the inefficiencies of traditional open canal systems in the region.

C. Topographical Challenges:

The undulating and hilly terrain of the Konkan region poses significant challenges for conventional irrigation methods. The steep slopes and fragmented landholdings make the construction and maintenance of canal networks both technically challenging and economically unviable. Additionally, the terrain contributes to increased runoff and soil erosion, further complicating water management efforts.

D. Implications for Irrigation Practices:

Given these challenges, there is a growing consensus on the need to transition towards more efficient and terrain-adaptive irrigation systems. Pipe Distribution Networks (PDNs) offer a viable solution, minimizing water losses due to percolation and evaporation, and providing a more controlled and equitable water distribution mechanism suitable for the region's topography.

Furthermore, studies have highlighted the benefits of integrating micro-irrigation techniques, such as drip and sprinkler systems, with PDNs. For instance, research conducted at Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth demonstrated that micro-irrigation methods significantly improved water use efficiency and crop yields in the region

III. SUMMARY OF LITERATURE REVIEW

Research shows that the Konkan region—including Sindhudurg district—faces a distinct set of irrigation challenges, largely due to its porous lateritic soils, steep slopes, and heavy seasonal rainfall. Traditional open canal systems tend to be inefficient in such conditions, with significant water loss occurring through seepage and evaporation, particularly after the monsoon season ends. Several studies point to Pipe Distribution Networks (PDNs) as a more effective alternative. These systems help minimize water loss, ensure more reliable delivery, and are better suited to the region's fragmented landholdings and uneven terrain. When combined with micro-irrigation methods, PDNs can further boost water-use efficiency and enhance crop yields. Altogether, the shift toward modern irrigation practices—especially the adoption of PDNs—is seen as a crucial step for achieving sustainable and productive agriculture in this part of Maharashtra.

IV. RESULT AND DISCUSSION

A review of current literature and local data clearly shows that traditional open canal irrigation systems are becoming increasingly unsustainable in the Konkan region, especially in Sindhudurg district. Even though the area receives substantial rainfall—often more than 3,000 mm annually—water shortages during the dry months remain common. This is largely due to the rapid percolation of water through porous lateritic soils and significant evaporation losses from surface water sources. Adding to the problem is the region's rugged, hilly terrain, which makes building and maintaining gravity-fed canals both technically challenging and costly.

Evidence from across Maharashtra, including the successful Tarandale Minor Irrigation Project, highlights the potential benefits of switching to Pipe Distribution Networks (PDNs). In Tarandale, replacing the initially planned canal system with a PDN led to an 85% reduction in land acquisition needs and a notable increase in the Culturable Command Area (CCA), along with improved water delivery—especially to tail-end plots—and lower losses. These outcomes are particularly relevant for Sindhudurg, where farmland is often fragmented and spread out across steep slopes.

Additionally, research from Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth shows that combining PDNs with micro-irrigation technologies like drip and sprinkler systems can significantly boost water efficiency and crop yields. These systems not only suit the region's topography but also support long-term sustainability goals by encouraging better resource management and climate-resilient agriculture.

Given the region-specific challenges and growing water demands, adopting PDNs in Sindhudurg is not just practical—it's essential. This shift addresses the core limitations of traditional methods and offers a scalable, modern solution for efficient irrigation in the Konkan's unique agro-climatic conditions.

Moreover, the integration of PDNs with micro-irrigation technologies, such as drip and sprinkler systems, as demonstrated in research from Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, significantly enhances water use efficiency and agricultural output. Such systems are not only more suitable for the region's topography but also align with sustainable development goals by promoting efficient resource utilization and climate-resilient agriculture.

Therefore, based on the literature and region-specific challenges, the adoption of PDNs in Sindhudurg is not only viable but necessary. It addresses the core inefficiencies of traditional systems and offers a scalable model for modern irrigation infrastructure in similar agro-climatic zones of the Konkan region.

V. CONCLUSION

This study highlights the pressing need to modernize irrigation infrastructure in Sindhudurg district by adopting Pipe Distribution Networks (PDNs). Despite the region's high annual rainfall, seasonal water shortages remain a recurring issue—primarily due to the rapid percolation of water through lateritic soils, evaporation losses, and the inefficiencies of traditional open canal systems, especially in hilly and uneven terrain. Insights from existing literature and proven examples like the Tarandale Minor Irrigation Project clearly demonstrate that PDNs offer significant advantages in terms of water use efficiency, reduced land acquisition, and more reliable water delivery.

By minimizing conveyance losses and ensuring more equitable distribution, PDNs are particularly well-suited to the challenges of Sindhudurg, where farmland is often fragmented and spread across diverse landscapes. Their compatibility with micro-irrigation systems such as drip and sprinkler methods further enhances their potential to improve agricultural productivity while conserving water. More importantly, these improvements can lead to stronger economic stability for local farmers and promote sustainable development in the region.

In conclusion, shifting toward PDNs in Sindhudurg is not only feasible but necessary. It presents a practical and scalable solution to ongoing irrigation challenges, with far-reaching benefits for both agriculture and rural livelihoods. It is strongly recommended that local and state authorities prioritize this approach in future planning and policy decisions aimed at building resilient and efficient irrigation systems in the Konkan region.

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