Irrigation Disparities in Gujarat: A Comparative Analysis of Tribal and Non-Tribal Districts

Dr. Amit A. Valvi
Assistant Professor,
Department of Economics,
Krantiguru Shyamji Krishna Verma Kachchh University, Bhuj.

Abstract:

This study examines the regional disparities in irrigation infrastructure between tribal-dominated and top irrigated districts of Gujarat. Using secondary data from government sources for the year 2022–23, the analysis focuses on irrigation sources, net and gross irrigated area, and cropping intensity across selected districts. The findings reveal significant gaps in irrigation development, with tribal districts like Dang and Narmada heavily reliant on minor sources such as tanks and wells, while top irrigated districts like Bansakantha and Rajkot benefit from extensive canal and tubewell systems. The study attributes these disparities to a combination of geographical limitations, historical neglect in infrastructure investment, and socio-economic disadvantages in tribal areas. Recommendations include targeted public investment, micro-irrigation promotion, revival of traditional practices, and institutional support to enhance irrigation access in underdeveloped regions. Bridging this irrigation gap is vital for achieving agricultural equity, improving rural livelihoods, and ensuring inclusive growth across Gujarat.

Introduction:

Irrigation is a key driver of agricultural productivity, especially in regions with irregular rainfall like Gujarat. While the state has made progress in expanding irrigation coverage, significant disparities exist in how irrigation resources are distributed across districts. Some areas benefit from extensive canal and well networks, while others—particularly tribal-dominated regions—remain dependent on less reliable sources such as tanks and seasonal streams.

Districts with a high proportion of Scheduled Tribe (ST) population often face infrastructural challenges, limited investment, and lower access to modern irrigation systems. In contrast, agriculturally advanced districts typically enjoy better access to diversified and large-scale irrigation facilities. These differences in irrigation access have direct implications for cropping patterns, income levels, and rural development outcomes across Gujarat.

Review of Literature

- Desai (2015), "Regional Disparities in Irrigation Development of Gujarat", found that irrigation infrastructure in tribal areas lags behind non-tribal districts due to uneven public investment.
- Patel and Shah (2018), "Access to Irrigation in Tribal Gujarat", highlighted that fragmented landholdings and weak infrastructure limit canal and tubewell access in tribal regions.

- Rathod (2020), "Irrigation Dependence in Tribal Areas of Western India", observed that tribal districts rely more on tanks and local water sources, making them vulnerable during dry spells.

- Jain Lokesh (2016), “Living and Sustainable Traditions of Tribal for Water Resources Management in TSP area of Gujarat” researched traditional water management practices in tribal majority districts of Gujarat. The study revealed that the tribals are gradually abandoning their indigenous traditions owing to modern pressures and they have lost access to their rightful share in water resources.
- Vansiya Yogesh & Jamod M.K (2024) “Irrigation Development in Bharat (India) and Gujarat” highlight a shift from canal to groundwater irrigation in India and Gujarat. They emphasize regional disparities and the need for sustainable water management.

Objectives

1. To identify irrigation coverage in Gujarat’s tribal-dominated districts (>50 percentage ST population).
2. To examine source-wise irrigation in the top 10 irrigated districts of Gujarat (2022–23).
3. To compare irrigation patterns between tribal and non-tribal districts to highlight disparities.

Research Methodology

The present study is based on comparative and descriptive research approach for the analysis of irrigation inequalities between tribal and non-tribal area of Gujarat. This study aims to analyze the usage of water sources, irrigated area and cropping intensity through structured secondary data. The goal is to detect geographical differences in access to irrigation and its effects on agricultural development.

The study is based on secondary data acquired from official sources such as Directorate of Economics and Statistics, Government of Gujarat (2024-25) and Census of India (2011). The study focused on six tribal-majority districts with more than 50 % of Scheduled Tribe (ST) population and 10 nontribal districts with greatest gross irrigated area. Draw insights using tables, comparative measurements and thematic interpretation.

Analysis

Gujarat is home to a significant tribal population, predominantly residing in the eastern hilly and forested regions of the state. These communities, officially recognized as Scheduled Tribes (STs), have distinct cultural, social, and economic characteristics. Their presence is

concentrated in specific districts, which are crucial for targeted development and inclusive policy planning.

Table no. 1.1 Gujarat Districts with Over 50 percentage Scheduled Tribe Population

Rank	District	Total Population	ST Population
1	Dangs	2,28,291	2,06,937
2	Dahod	21,26,558	18,37,652
3	Narmada	5,90,379	4,94,300
4	Tapi	8,07,022	6,08,009
5	Valsad	17,05,678	9,66,291
6	Panchmahal	23,90,776	12,27,235

Sources – Census of India 2011.

Graph No.1.1 Gujarat Districts with Over 50 percentage Scheduled Tribe Population

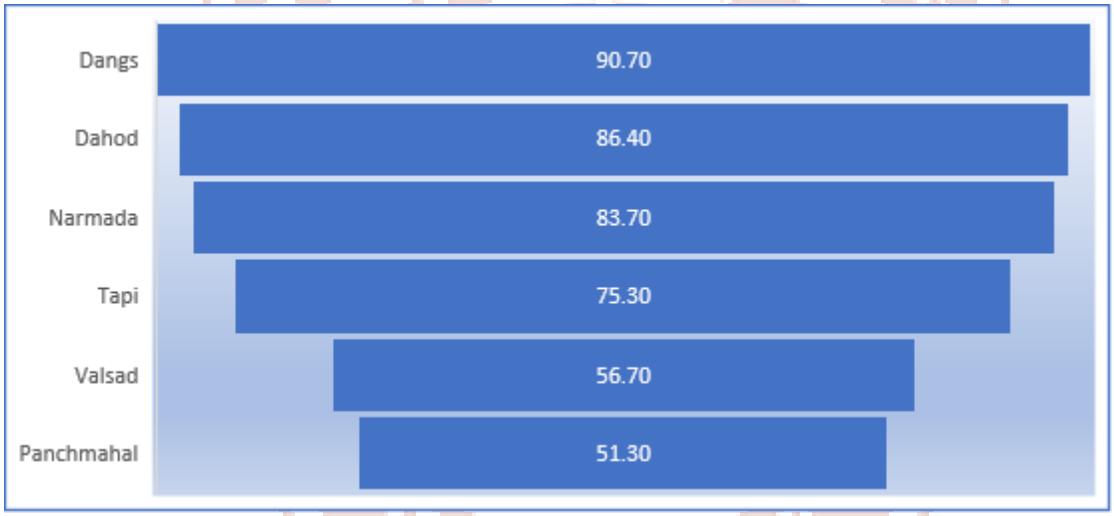


Table no. 1.1 and graph no. 1.1 highlights six districts of Gujarat where STs population is more than 50 percentage of the total population. This shows the areas of major tribal concentration. Among them, Dangs has the largest percentage of tribal population (90.7) in the state but it has the smallest population (2.28 lakh). Dahod follows with 86.4 per cent, although unlike Dangs it has a substantial population base (21.26 lakh) making it the most populated tribal-majority district. High proportion of tribal residents is observed in Narmada (83.7 percentage) and Tapi (75.3 percentage). These districts comprise the basis of Gujarat's eastern tribal belt where tribal identity is the dominant social and cultural entity.

Further down the list, Valsad and Panchmahal have 56.7 percentage and 51.3 percentage ST populations, respectively, suggesting a more mixed demographic profile while still qualifying as tribal-majority districts. Panchmahal, in particular, has the highest total

population among the six (23.90 lakh), indicating a more complex administrative scenario for delivering targeted tribal welfare. The data underlines the need for region-specific policies, especially in sectors such as education, healthcare, land rights, and irrigation. These tribal-majority districts not only represent a significant portion of Gujarat's tribal population but also demand focused developmental attention to bridge socio-economic gaps and ensure inclusive growth.

Tribal-dominated districts of Gujarat such as Dang, Dahod, Narmada, Tapi, Valsad, and Panchmahal face several agricultural challenges despite having significant dependence on farming. These regions often suffer from limited access to assured irrigation, with a heavy reliance on wells, tanks, and other minor sources rather than large-scale canal networks. This fragmented irrigation infrastructure leads to inconsistent water supply, especially during critical crop growth periods. Additionally, undulating terrain, small landholdings, and lack of modern agricultural inputs hinder productivity. The disparity between net area sown and gross area sown in these districts also reflects inadequate cropping intensity and limited capacity for multiple cropping. These structural constraints, combined with socio-economic marginalization, make agricultural development in tribal areas a pressing policy concern.

The dominance of rain-fed agriculture in these tribal regions further exacerbates vulnerability to monsoon fluctuations, making crop failure a recurring risk. Inadequate extension services, limited credit access, and poor market connectivity restrict the adoption of improved farming techniques and diversification into high-value crops. While some districts like Valsad and Dahod show relatively higher gross irrigated areas, others like Dang remain severely under-irrigated, highlighting regional imbalances. The absence of major irrigation projects and lack of institutional support systems in tribal belts hinder sustainable agricultural growth. Addressing these disparities through targeted investments in irrigation infrastructure, water conservation, and tribal-centric agricultural policies is essential for ensuring livelihood security and inclusive rural development in Gujarat's tribal heartland. Table No.1.2 Water Source Distribution and Agricultural Area in Major Tribal Districts of Gujarat (2022-23) (Area '00 hectare)

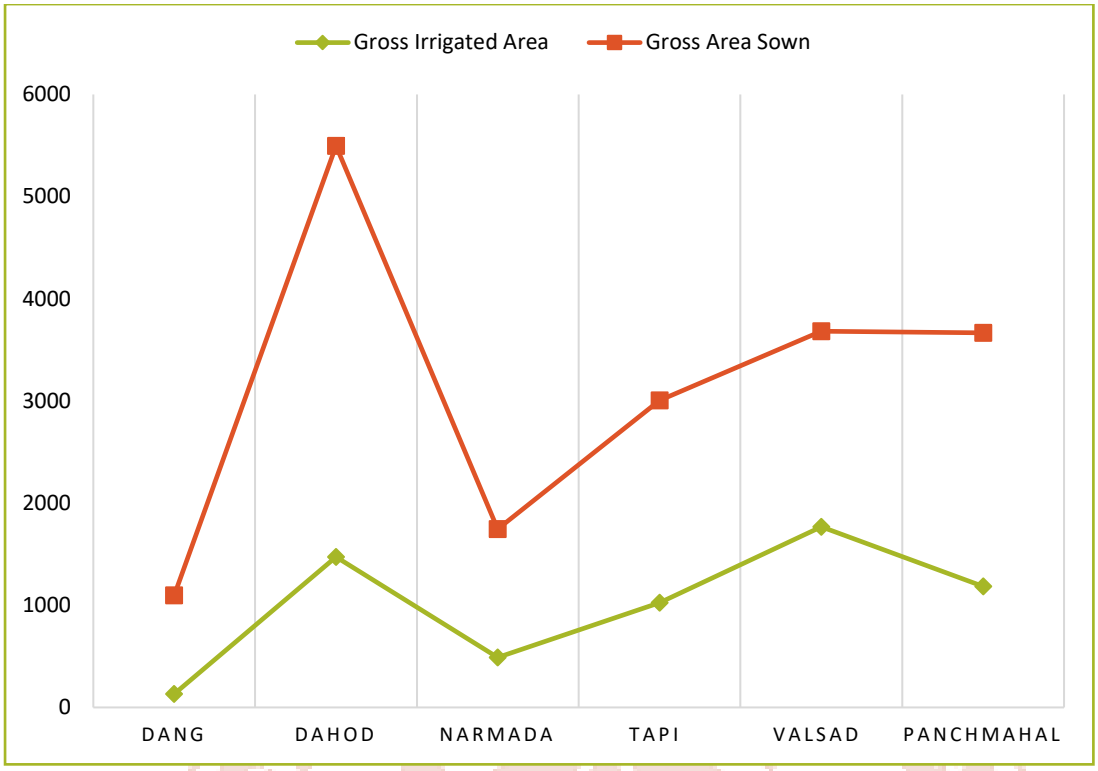
Table No.1.2 Water Source Distribution and Agricultural Area in Major Tribal Districts of Gujarat (2022-23) (Area '00 hectare)

Sr No	District Name	Canal	Tank	Well Including Tubewell	Other Sources	Net Irrigated Area	Gross Irrigated Area	Net Area Sown	Gross Area Sown
1	Dang	0	86	38	8	77	132	561	965
2	Dahod	597	241	487	147	522	1472	2268	4025
3	Narmada	214	0	193	82	373	489	1011	1256
4	Tapi	521	0	427	76	749	1024	1335	1982
5	Valsad	515	199	526	528	1296	1768	1531	1913
6	Panchmahal	663	176	274	71	500	1184	1678	2483

Source – Irrigation in Gujarat 2024-25, Directorate of Economics and Statistics, Government of Gujarat

The Table No.1.2 presents a detailed view of irrigation sources across six major tribal-dominated districts in Gujarat—Dang, Dahod, Narmada, Tapi, Valsad, and Panchmahal. A clear disparity emerges in the availability and distribution of water sources. Canal irrigation is most prevalent in Panchmahal (663 '00 ha) and Dahod (597 '00 ha), indicating better integration with formal irrigation infrastructure. In contrast, Dang lacks any canal irrigation, highlighting a major infrastructural deficit. Well and tubewell irrigation is prominent in all districts, particularly in Valsad (526 '00 ha) and Dahod (487 '00 ha). Tank irrigation is substantial in Dang (86 '00 ha) and Valsad (199 '00 ha), showing that traditional water storage systems remain relevant in hilly and forested terrains. Notably, Valsad also records the highest irrigation from "Other Sources" (528 '00 ha), likely pointing to diverse small-scale or community-managed water systems such as check dams and lift irrigation.

Graph No 1.2 Agricultural Area in Major Tribal Districts of Gujarat (2022-23) (Area '00 hectare)



Irrigation coverage, both net and gross, shows significant variation among districts. Valsad leads in net irrigated area (1296 '00 ha) and gross irrigated area (1768 '00 ha), followed closely by Dahod and Tapi, suggesting higher water availability and more intense agricultural activity. On the other hand, Dang lags far behind, with only 77 '00 ha of net irrigated area and 132 '00 ha of gross irrigated area—indicating that most cultivation in Dang is rain-fed and highly vulnerable to climatic uncertainty. The gap between net and gross irrigated area across districts like Dahod and Panchmahal reflects the practice of multiple cropping, which is made possible by relatively better irrigation infrastructure.

The net and gross area sown gives insight into land utilization and cropping intensity. Dahod stands out with the largest gross area sown (4025 '00 ha) and net area sown (2268 '00 ha), indicating extensive agricultural engagement. Panchmahal and Valsad also show significant agricultural activity. However, in Dang, although the net area sown is 561 '00 ha, the minimal irrigation limits cropping options, resulting in lower productivity and limited double cropping. This reinforces the correlation between irrigation availability and agricultural performance. Furthermore, the high gross area sown in Dahod and Panchmahal suggests more intensive use of land through seasonal or multi-cropping systems, supported by better irrigation access.

the data illustrates a varied pattern of irrigation dependence across the tribal districts, reflecting differences in both natural resource availability and infrastructural development.

Canal irrigation is a key source in districts like Panchmahal and Dahod, while tank and well irrigation dominate in areas such as Valsad and Dang. The presence of "other sources" is notably high in Valsad, indicating the use of alternative or decentralized water systems. Net and gross irrigated areas are highest in Valsad and Dahod, aligning with their broader access to multiple water sources. In contrast, the low irrigated figures in Dang, despite a relatively moderate area under cultivation, point to a reliance on non-irrigated or rain-fed farming. The gap between gross and net sown areas further suggests that districts with better irrigation are able to support more intensive cropping cycles. Overall, the distribution of irrigation types and extent closely mirrors the agricultural intensity observed across these districts.

Table No.1.3 Water Source Distribution and Agricultural Area in Top 10 Irrigated Districts of Gujarat (2022-23) (Area '00 hectare)

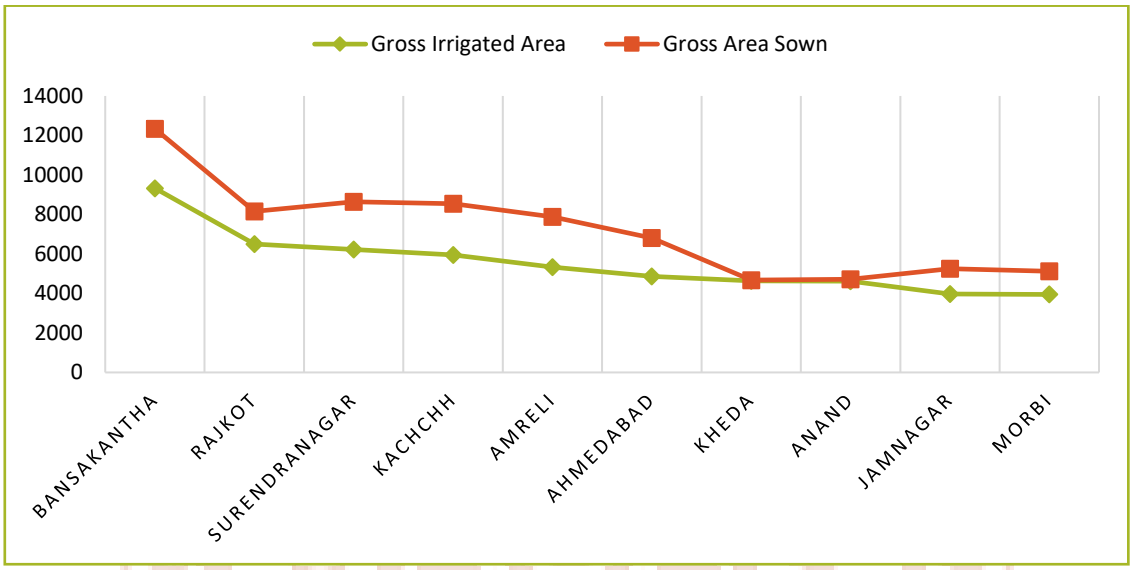
Rank	District Name	Canal	Tank	Well Including Tubewell	Other Sources	Net Irrigated Area	Gross Irrigated Area	Net Area Sown	Gross Area Sown
1	Bansakantha	2460	56	6780	32	4579	9328	6943	12337
2	Rajkot	1224	221	4433	616	3804	6494	5293	8152
3	Surendranagar	2121	70	4022	5	3803	6218	6176	8649
4	Kachchh	2289	367	2848	439	3549	5943	6979	8551
5	Amreli	446	193	4625	70	2980	5334	5554	7880
6	Ahmedabad	1719	436	2067	636	2626	4858	4631	6810
7	Kheda	1444	281	2749	169	2315	4643	2766	4677
8	Anand	2341	191	1583	508	1901	4623	1989	4711
9	Jamnagar	575	77	2694	633	3041	3979	3672	5252
10	Morbi	1796	84	1950	119	2729	3949	3558	5121

Source – Irrigation in Gujarat 2024-25, Directorate of Economics and Statistics, Government of Gujarat

The data across the top 10 irrigated districts of Gujarat reveals a strong reliance on groundwater through wells and tubewells, with Bansakantha (6780 '00 ha), Amreli (4625 '00 ha), and Rajkot (4433 '00 ha) showing exceptionally high figures. Canal irrigation is also significant in many districts, particularly Bansakantha (2460 '00 ha), Anand (2341 '00 ha), and Kachchh (2289 '00 ha), indicating the presence of robust canal networks in these regions. In

contrast, tank irrigation remains a minor component overall, with Ahmedabad (436 '00 ha) and Kachchh (367 '00 ha) recording the highest usage. The category "Other Sources" shows varied contributions, highest in Jamnagar (633 '00 ha) and Ahmedabad (636 '00 ha), likely reflecting lift irrigation, Narmada pipeline usage, or non-conventional sources. This diversified water source base contributes to relatively resilient irrigation systems in these districts.

Graph No.1.3 Gross Area Irrigated and Gross Area Sown in Top 10 Irrigated Districts of Gujarat (2022-23) (Area '00 hectare)



A high level of irrigation development is evident from the large net and gross irrigated areas reported. Bansakantha leads with 4579 '00 ha of net irrigated area and 9328 '00 ha of gross irrigated area, followed by Rajkot (3804 and 6494 '00 ha) and Surendranagar (3803 and 6218 '00 ha), indicating extensive use of irrigation for both single and multiple cropping. Even districts like Kachchh, traditionally semi-arid, show high irrigation usage (gross irrigated area of 5943 '00 ha), which reflects infrastructure expansion in recent years. The difference between net and gross irrigated areas also suggests widespread practice of double or triple cropping in these districts, made possible by better irrigation infrastructure and access to groundwater.

Agricultural intensity in these districts is strongly supported by irrigation, as reflected in their net and gross sown areas. Bansakantha again tops with 6943 '00 ha of net area sown and 12337 '00 ha of gross area sown, showing a high cropping intensity. Similar trends are observed in Surendranagar, Kachchh, and Rajkot, where gross sown area exceeds 8000 '00 ha. These districts demonstrate efficient utilization of irrigated land and intensive agricultural practices. The close alignment between gross irrigated area and gross area sown in these

districts indicates a stable relationship between water availability and land use, contributing to high productivity and sustained cultivation cycles throughout the year.

Irrigation Disparities between Tribal-Dominated and Top Irrigated Districts in Gujarat

The irrigation landscape of Gujarat reveals a stark contrast between tribal-dominated districts and the state's top irrigated districts. In tribal regions like Dang, Dahod, Tapi, Narmada, Valsad, and Panchmahal, irrigation infrastructure remains limited and unevenly distributed. These districts rely more heavily on minor irrigation sources such as wells, tanks, and other decentralized systems. For example, Dang has no canal irrigation at all and depends on tank and well sources with very low net and gross irrigated area. In contrast, top irrigated districts such as Bansakantha, Rajkot, Surendranagar, and Kachchh exhibit well-developed irrigation systems dominated by extensive use of wells/tubewells and canal irrigation, supported by larger-scale infrastructure and groundwater exploitation.

The disparity becomes more apparent when comparing irrigated areas. In tribal districts, the gross irrigated area rarely exceeds 1700 '00 ha, with Dang as low as 132 '00 ha, while in top irrigated districts like Bansakantha and Rajkot, gross irrigated areas reach over 9000 and 6000 '00 ha respectively. This indicates that tribal areas are mostly dependent on monsoonal rains with lower irrigation coverage, whereas non-tribal districts have the capacity to support multiple cropping seasons. Additionally, the gap between net and gross irrigated area is wider in top districts, suggesting a stronger ability to engage in intensive farming and crop rotation.

The contrast in cropping intensity also reflects these irrigation differences. Tribal districts show modest gross sown areas compared to their net sown areas, revealing limited double cropping potential. For instance, Dahod’s gross area sown is 4025 '00 ha compared to a net area sown of 2268 '00 ha. In comparison, Bansakantha’s gross sown area is 12337 '00 ha, nearly double its net sown area of 6943 '00 ha, signaling highly intensive agricultural practices. This disparity illustrates how superior irrigation access in top districts not only enhances land use but also boosts productivity and agricultural stability. In contrast, tribal districts remain constrained by inadequate water access, affecting both crop choice and output levels.

Regional and Geographical Reasons:

The geographical landscape of tribal-dominated districts such as Dang, Narmada, and Tapi is characterized by hilly, forested, and undulating terrain, which poses natural limitations to the development of large-scale canal systems and mechanized farming. These regions often have shallow soils, hard rock geology, and poor groundwater potential, making both surface and subsurface irrigation infrastructure difficult and expensive to implement. Despite receiving moderate to high rainfall, the lack of proper rainwater harvesting and storage systems leads to

low irrigation utilization. In contrast, top irrigated districts like Bansakantha, Rajkot, and Kachchh are located in flatter plains with deeper soils and better aquifer systems, making them more suitable for extensive irrigation development and efficient water management.

Socio-Economic and Institutional Reasons:

The socio-economic disparities between tribal and non-tribal districts also contribute significantly to irrigation gaps. Tribal areas typically have small, fragmented landholdings, low access to institutional credit, and weaker market linkages, which hinder investment in irrigation infrastructure and adoption of modern technology. These regions have historically received less attention in state-level irrigation planning and suffer from poor implementation of government schemes due to administrative challenges and lack of awareness. Moreover, the absence of strong cooperative structures, low political influence, and limited participation in decision-making further marginalize tribal farmers. In contrast, the top irrigated districts benefit from better connectivity, organized farming systems, and institutional support, enabling greater access to water resources and higher agricultural productivity.

Findings

- Tribal-dominated districts such as Dang, Narmada, and Tapi have limited or no access to canal irrigation, in contrast to districts like Bansakantha and Kachchh, where canal irrigation is a major water source.
- Tribal districts rely heavily on tanks, wells, and other minor sources. For example, Valsad's high usage of "other sources" reflects dependence on small-scale decentralized systems.
- The gross irrigated area in most tribal districts is below 2000 '00 ha, with Dang at just 132 '00 ha, while top irrigated districts like Bansakantha exceed 9000 '00 ha, reflecting vast disparities in irrigation coverage.
- Top irrigated districts like Rajkot, Amreli, and Bansakantha show high use of wells and tubewells, backed by deeper aquifers and mechanization, a feature absent in many tribal districts.
- Tribal districts exhibit lower cropping intensity, as seen in smaller differences between net and gross area sown, indicating fewer instances of double or multiple cropping compared to non-tribal districts.
- Hilly terrain, shallow soils, and poor groundwater retention in tribal districts restrict large-scale irrigation projects, unlike the flat and aquifer-rich landscapes in non-tribal regions.

- Districts like Surendranagar and Rajkot show efficient land use with gross area sown exceeding 8000 '00 ha, supported by strong irrigation systems—an agricultural advantage not observed in tribal belts.
- Most tribal farming depends on the monsoon, making it highly vulnerable to climatic fluctuations, whereas non-tribal districts are equipped with infrastructure to support year-round cultivation.
- Tribal areas face issues like poor access to institutional credit, weak extension systems, and lack of farmer cooperatives, limiting their ability to develop and manage irrigation systems.
- State-level planning and investment have historically favored commercial agricultural zones, while tribal areas have seen underinvestment, contributing to the persistent irrigation gap.

Suggestions

- Encourage construction of check dams, farm ponds, lift irrigation units, and percolation tanks in hilly and forested tribal districts where large canals are not feasible.
- Implement integrated watershed development programs to improve groundwater availability, particularly in hard rock regions like Dang and Narmada.
- Revive and modernize traditional tribal water management systems (e.g., small tanks, nala bunds) by integrating them with scientific techniques and community-based maintenance.
- Subsidize and promote micro-irrigation technologies in tribal regions to improve water-use efficiency, especially where water sources are limited or seasonal.
- Formulate special irrigation development packages for ST-majority districts under state and centrally sponsored schemes (e.g., PMKSY, NABARD RIDF).
- Allocate higher budgetary resources specifically for irrigation development in tribal districts, addressing the historical underinvestment in these regions.
- Facilitate easy access to irrigation loans, subsidies, and technical guidance through tribal development corporations, cooperatives, and SHGs.
- Mandate that tribal villages directly benefit from nearby large irrigation projects (like dams and pipelines), through dedicated distributary canals or lift systems.
- Promote community-based water user associations (WUAs) in tribal areas to manage, maintain, and distribute water equitably, ensuring tribal inclusion in decision-making.

- Deploy dedicated extension workers and mobile advisory units in tribal belts to educate farmers on water-saving technologies, crop planning, and irrigation scheduling.

Conclusion

A study of irrigation practices in Gujarat's tribal-dominated and top-irrigated areas finds deep-seated inequalities in water resources, infrastructure and agricultural outcomes. The non-tribal districts are better endowed with a well-developed canal system, exploitation of groundwater, and diversified sources of irrigation, whereas the tribal districts continue to depend on rain-fed agriculture and minor sources of irrigation mainly due to the constraints imposed by difficult terrain, limited investment, and institutional neglect. These discrepancies reduce agricultural output in tribal areas and increase the socio-economic inequities between regions. The low agricultural intensity and inadequate irrigation coverage in tribal areas indicate the need for region-specific planning, increased public investment, and better institutional assistance on an urgent basis. Addressing these irrigation inequities is necessary for inclusive rural development, for ensuring food and livelihood security of tribal groups and for promoting equitable growth across Gujarat's diversified agro-ecological landscape.

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