National River Conservation Directorate
Ministry of Jal Shakti,
Department of Water Resources,
River Development & Ganga Rejuvenation
Government of India

Revenue Map of Krishna River Basin

November 2025

Revenue Map of Krishna River Basin

National River Conservation Directorate (NRCD)

The National River Conservation Directorate, functioning under the Department of Water Resources, River Development & Ganga Rejuvenation, and Ministry of Jal Shakti providing financial assistance to the State Government for conservation of rivers under the Centrally Sponsored Schemes of 'National River Conservation Plan (NRCP)'. National River Conservation Plan to the State Governments/ local bodies to set up infrastructure for pollution abatement of rivers in identified polluted river stretches based on proposals received from the State Governments/ local bodies.

www.nrcd.nic.in

Centres for Krishna River Basin Management Studies (cKrishna)

The Centres for Krishna River Basin Management Studies (cKrishna) is a Brain Trust dedicated to River Science and River Basin Management. Established in 2024 by NIT Warangal and NIT Surathkal, under the supervision of cGanga at IIT Kanpur, the center serves as a knowledge wing of the National River Conservation Directorate (NRCD). cKrishna is committed to restoring and conserving the Krishna River and its resources through the collation of information and knowledge, research and development, planning, monitoring, education, advocacy, and stakeholder engagement.

www.ckrishna.org

Centre for Ganga River Basin Management and Studies (cGanga)

cGanga is a think tank formed under the aegis of NMCG, and one of its stated objectives is to make India a world leader in river and water science. The Centre is headquartered at IIT Kanpur and has representation from most leading science and technological institutes of the country. cGanga's mandate is to serve as think-tank in implementation and dynamic evolution of Ganga River Basin Management Plan (GRBMP) prepared by the Consortium of 7 IITs. In addition to this, it is also responsible for introducing new technologies, innovations, and solutions into India.

www.cganga.org

Acknowledgment

This report is a comprehensive outcome of the project jointly executed by NIT Warangal (Lead Institute) and NIT Surathkal (Fellow Institute) under the supervision of cGanga at IIT Kanpur. It was submitted to the National River Conservation Directorate (NRCD) in 2024. We gratefully acknowledge the individuals who provided information and photographs for this report.

Disclaimer

This report is a preliminary version prepared as part of the ongoing Condition Assessment and Management Plan (CAMP) project. The analyses, interpretations and data presented in the report are subject to further validation and revision. Certain datasets or assessments may contain provisional or incomplete information, which will be updated and refined in the final version of the report after comprehensive review and verification.

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Preface

In an era of unprecedented environmental change, understanding our rivers and their ecosystems has never been more critical. This report aims to provide a comprehensive overview of our rivers, highlighting their importance, current health, and the challenges they face. As we explore the various facets of river systems, we aim to equip readers with the knowledge necessary to appreciate and protect these vital waterways.

Throughout the following pages, you will find an in-depth analysis of the principles and practices that support healthy river ecosystems. Our team of experts has meticulously compiled data, case studies, and testimonials to illustrate the significant impact of rivers on both natural environments and human communities. By sharing these insights, we hope to inspire and empower our readers to engage in river conservation efforts.

This report is not merely a collection of statistics and theories; it is a call to action. We urge all stakeholders to recognize the value of our rivers and to take proactive steps to ensure their preservation. Whether you are an environmental professional, a policy maker, or simply someone who cares about our planet, this guide is designed to support you in your efforts to protect our rivers.

We extend our heartfelt gratitude to the numerous contributors who have generously shared their stories and expertise. Their invaluable input has enriched this report, making it a beacon of knowledge and a practical resource for all who read it. It is our hope that this report will serve as a catalyst for positive environmental action, fostering a culture of stewardship that benefits both current and future generations.

As you delve into this overview of our rivers, we invite you to embrace the opportunities and challenges that lie ahead. Together, we can ensure that our rivers continue to thrive and sustain life for generations to come.

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Abbreviations and Acronyms

Acronym	Full Form
CGWB	Central Ground Water Board
CWC	Central Water Commission
FSI	Forest Survey of India
GRBMP	Ganga River Basin Management Plan
ICAR	Indian Council of Agricultural Research
IIT	Indian Institute of Technology
ISRO	Indian Space Research Organisation
LISS	Linear Imaging Self-Scanning Sensor
LULC	Land Use / Land Cover
LUP	Land Use Planning
NBSS	National Bureau of Soil Survey and Land Use Planning
NIT	National Institute of Technology
NMCG	National Mission for Clean Ganga
NRCD	National River Conservation Directorate
NRCP	National River Conservation Plan
NRSC	National Remote Sensing Centre
SIP	State Irrigation Plan
PMKSY	Pradhan Mantri Krishi Sinchai Yojana

1. Introduction

Revenue mapping plays a crucial role in understanding land utilization, socio-economic dynamics, and environmental vulnerabilities within a river basin. It provides a spatial and quantitative assessment of how land is categorized, managed, and exploited for various purposes such as agriculture, forestry, water management, and settlements. In the context of the Krishna River Basin, one of India's largest and most significant basins, revenue mapping becomes especially important due to the basin's diverse physiography, multi-state coverage, and extensive dependence on agriculture and water resources. It supports millions of people whose livelihoods are directly linked to agriculture, irrigation, fisheries, forestry, and industry. The basin encompasses a wide range of land categories including forests, irrigated and unirrigated agricultural land, fallow land, barren land, built-up areas, and extensive water bodies created by reservoirs, tanks, and canals. Understanding the spatial distribution and dynamics of these categories is essential for revenue administration, policy formulation, and sustainable development planning.

Moreover, the basin is characterized by large-scale irrigation projects, intensive cultivation of both food crops and cash crops, and regions facing pressures of environmental degradation and over-exploitation. Revenue mapping provides an integrated framework to assess the extent of land under cultivation, production potential, vulnerable areas, and opportunities for sustainable land use strategies. Thus, this report aims to prepare a comprehensive revenue map of the Krishna River Basin and highlight its key implications for management, planning, and sustainable resource utilization.

2. Study Area

The Krishna River Basin, one of the largest and most significant river basins in peninsular India, encompasses an area of approximately 258,948 square kilometers and extends across four principal states: Maharashtra, Karnataka, Telangana, and Andhra Pradesh. Originating in the Western Ghats near Mahabaleshwar in Maharashtra, the Krishna River courses eastward for approximately 1,400 kilometers prior to discharging into the Bay of Bengal.

The basin is geographically diverse, encompassing the Western Ghats, Deccan Plateau, and the coastal plains, with elevation ranging from over 1,300 m in the Ghats to sea level at its mouth. Major tributaries include the Bhima, Tungabhadra, Musi, and Munneru rivers, which collectively contribute to the basin's extensive hydrological network.

From an administrative perspective, the Krishna Basin covers nearly 10 districts in Maharashtra, 18 in Karnataka, 20 in Telangana, and 5 in Andhra Pradesh. The revenue boundaries of these districts and sub-districts play a critical role in water governance, land management, and planning of irrigation and developmental projects.

The basin is also home to numerous large and medium irrigation structures, including the Almatti, Nagarjuna Sagar, Srisailam, Tungabhadra, and Krishna Barrage, which are vital for agriculture, hydropower, and drinking water supply. Land use in the basin is predominantly agricultural, with major crops being paddy, sugarcane, cotton, and maize, while several regions also support industrial clusters and urban centres.

Given its geographical, administrative, and socio-economic diversity, the Krishna Basin represents a complex system where natural resources, infrastructure, and governance structures intersect. The preparation of a Revenue Map for the basin provides an integrated spatial understanding of these administrative divisions, which is essential for effective management, policy formulation, and sustainable development planning.

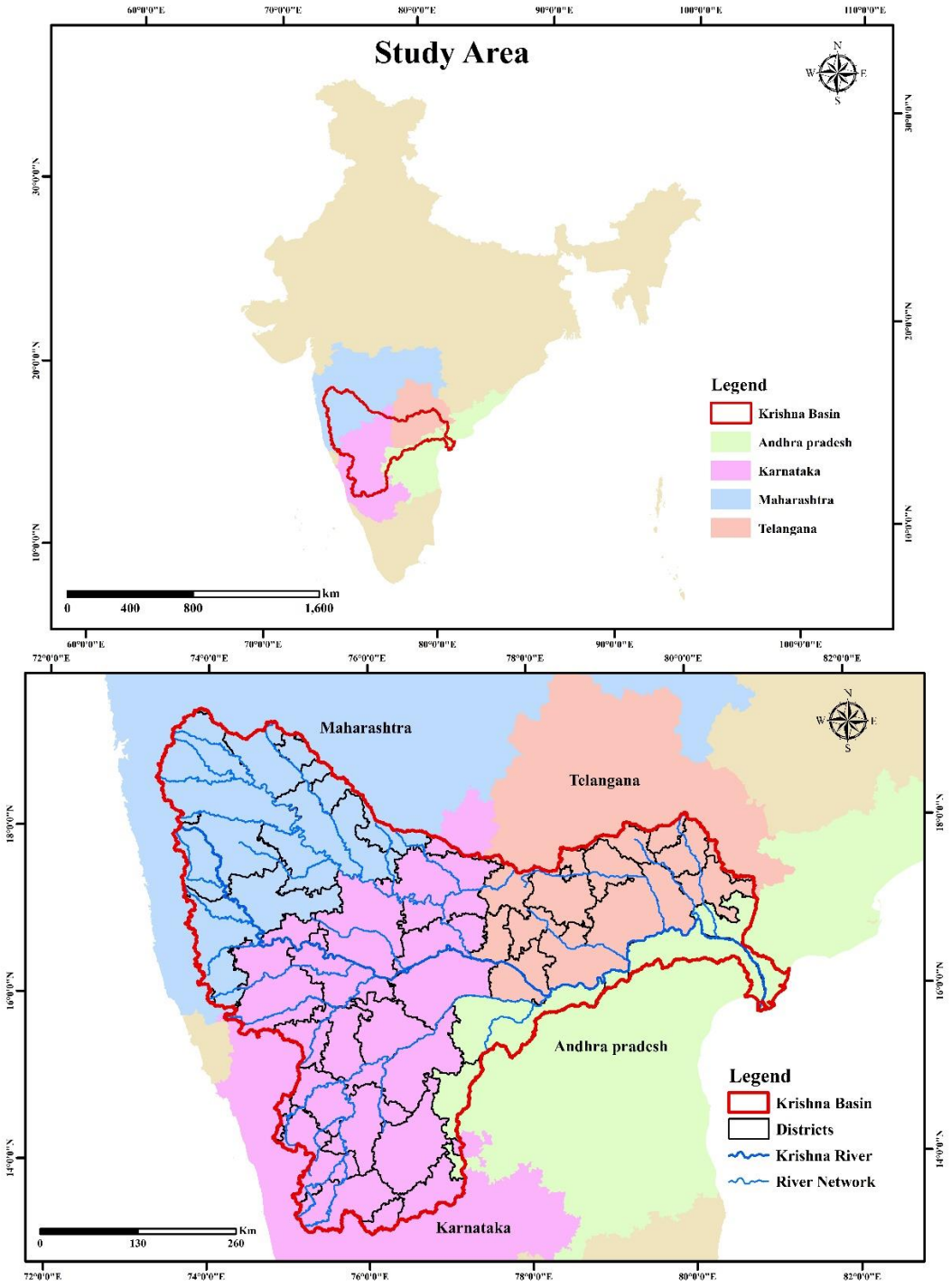

Figure 1 Study Area

3. Land revenue categories

3.1 Area under forest

The Krishna River Basin supports diverse forest ecosystems that play a vital role in regulating the hydrological cycle, conserving biodiversity, preventing soil erosion, and supporting local communities. The total forest area in the basin is 23,411.43 km², unevenly spread across four states. Karnataka accounts for 10,918.93 km², mainly in the Western Ghats and Malnad region, which are biodiversity hotspots. Maharashtra contributes 5,703.99 km², mainly in the upper catchments near the Ghats. Telangana has 4,318.47 km² concentrated in plateau and hilly areas, while Andhra Pradesh holds 2,470.04 km², mostly within the Nallamala hills. Figure 2 shows the spatial distribution of forest cover, with dense patches in the Ghats and isolated clusters in the plateau and hill regions. The distribution is uneven, with ecologically sensitive areas limited to specific belts, while large parts of the basin are used for agriculture or are non-forest land.

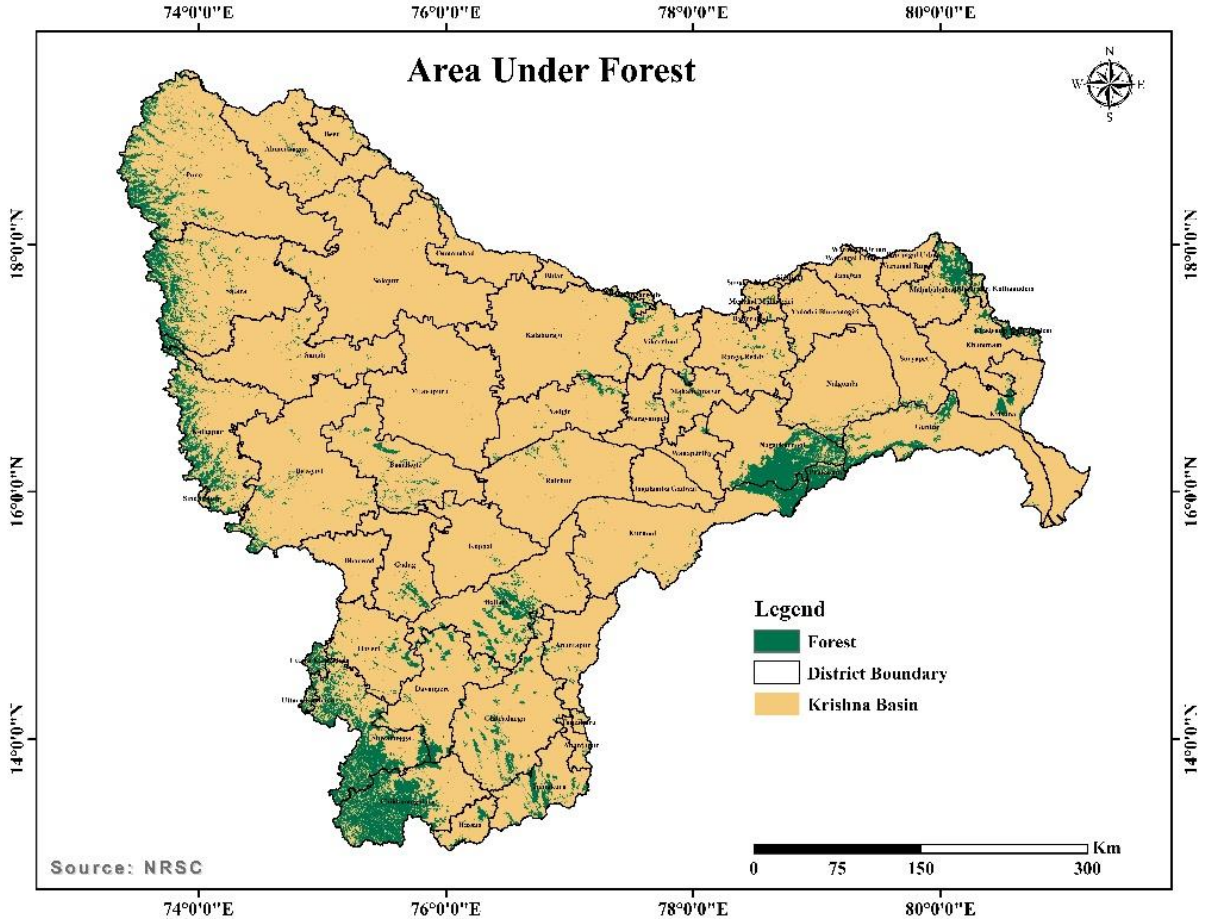

Figure 2 The spatial variation of area under forest in the Krishna basin

At the district scale, Figure 3 highlights further variation. Chikkamagaluru has the highest forest extent, surpassing 3,200 km², followed by Uttara Kannada and Belagavi, each with

substantial forest areas exceeding 2,000 km². These districts are part of the Western Ghats and serve as key ecological reserves. In contrast, districts such as Davanagere, Ballari, Kalaburagi, Raichur, and Solapur record very low forest cover, often less than 200 km². Urbanized districts in Telangana and Andhra Pradesh, including Hyderabad, Ranga Reddy, and Guntur, also exhibit minimal forest presence, reflecting extensive land use changes.

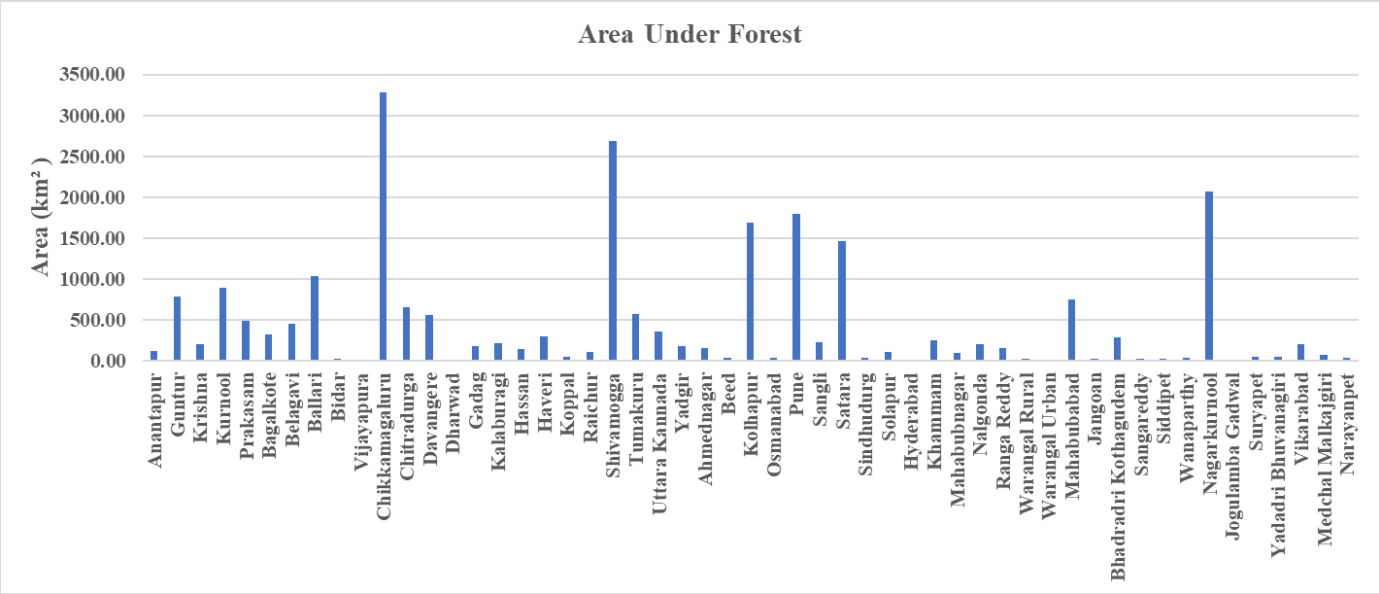

Figure 3 Barplot showing district wise area under forest

Overall, the distribution of forests across the Krishna Basin shows a clear ecological imbalance. While the Western Ghats districts hold significant forest wealth, large parts of the basin are dominated by agriculture, built-up land, or barren land, emphasizing the need for conservation and afforestation measures in non-forest regions.

3.2 Agriculture Land

Agriculture is the main land use in the Krishna River Basin, with clear spatial differences across states. The distribution of fallow land, net sown area, and land not available for cultivation shows the region's reliance on both natural and managed resources.

3.2.1 Fallow Land

Karnataka records the highest fallow land, 26,811.64 km², concentrated in semi-arid northern districts such as Vijayapura, Bagalkot, and Raichur, where rainfall variability and limited irrigation frequently result in temporarily abandoned fields. Maharashtra follows with 12,998.24 km², much of it spread across rainfed districts adjoining the Ghats, while Telangana and Andhra Pradesh have 6,029.08 km² and 6,305.89 km² respectively. The spatial clusters of

fallow land are clearly shown in Figure 4. District-wise variation is further illustrated in Figure 5.

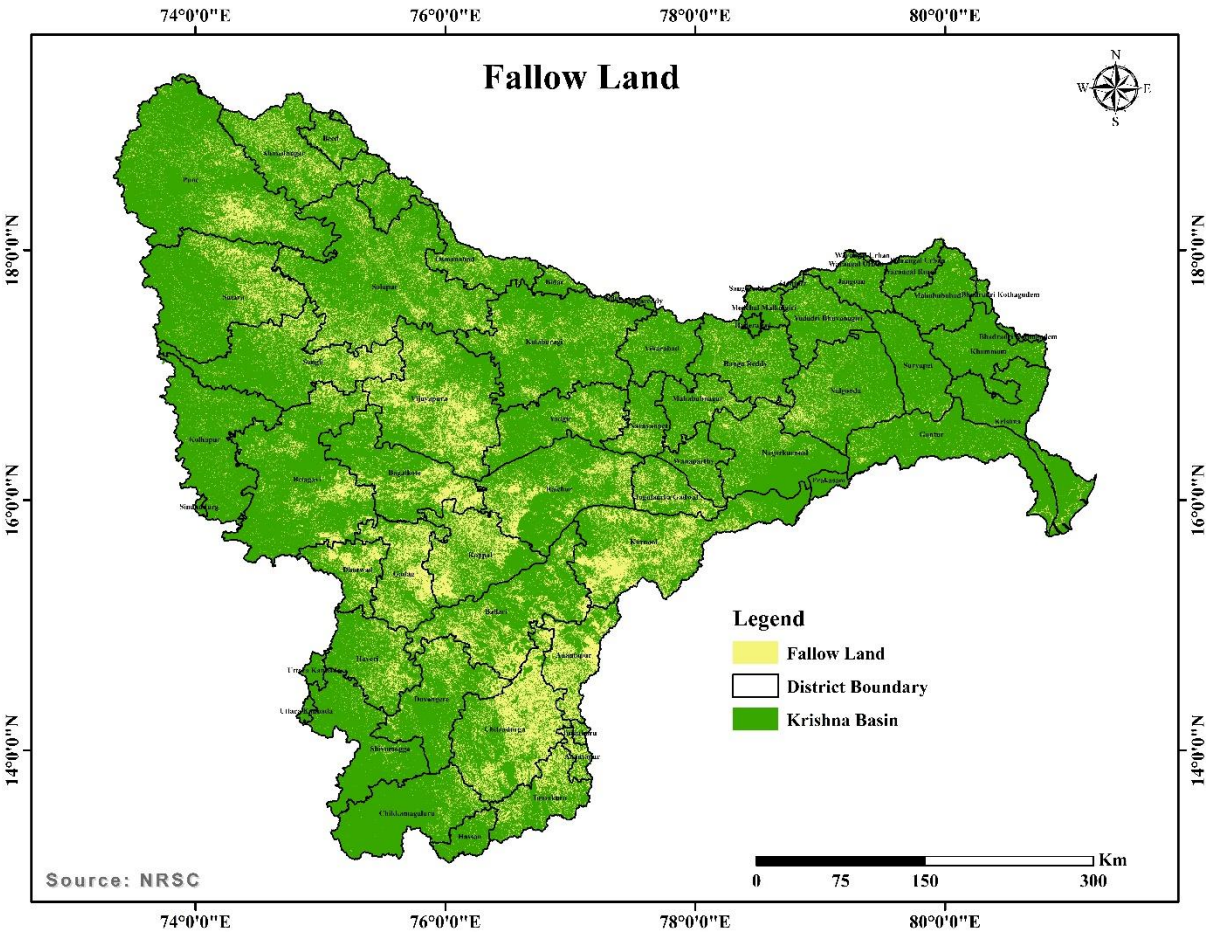

Figure 4 The spatial variation of area under fallow land in the Krishna basin

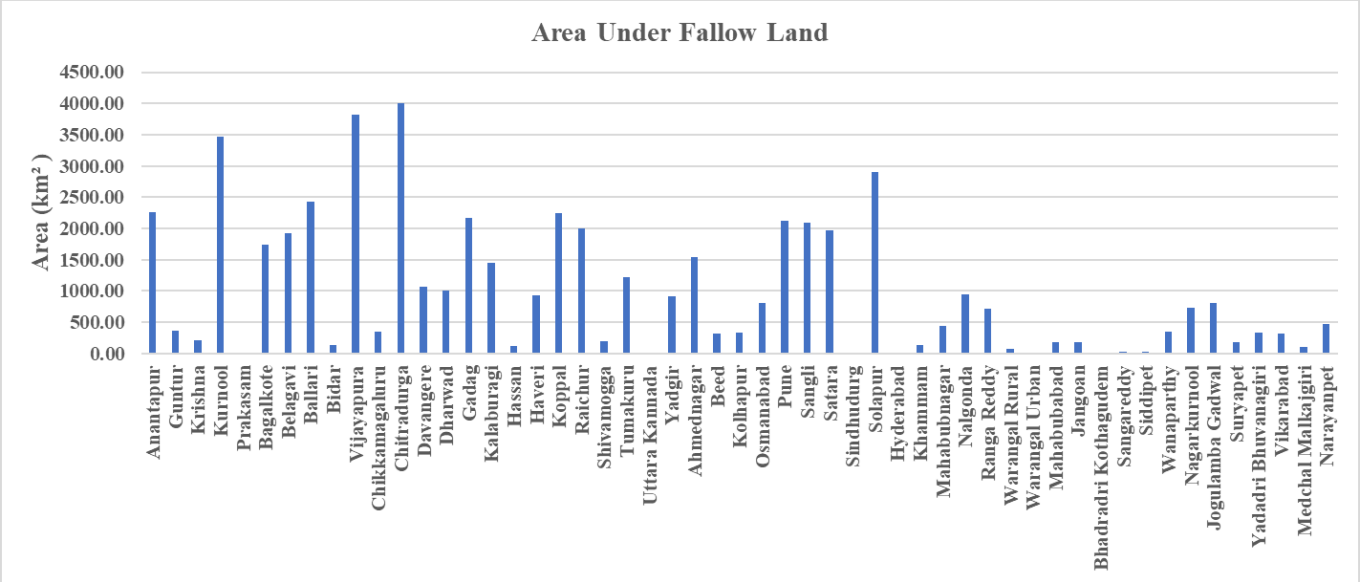

Figure 5 Barplot showing district wise area under fallow land

3.2.2 Net Sown Area

Net sown area represents the most productive portion of agricultural land. Karnataka dominates with 60,766.85 km² under active cultivation, followed by Maharashtra at 44,064.08 km², Telangana with 34,278.10 km², and Andhra Pradesh at 13,489.83 km². Intensive cultivation is supported by irrigation from major reservoirs and command areas such as Tungabhadra, Almatti, and Nagarjuna Sagar, as well as fertile deltaic plains in Andhra Pradesh. Figure 6 maps the distribution of net sown area. District-wise variation of net sown area is further illustrated in Figure 7.

3.2.3 Irrigated and Unirrigated Land

The Krishna River Basin shows significant spatial diversity in the distribution of irrigated and unirrigated land, primarily determined by rainfall variability and irrigation infrastructure. Figure 8 illustrates the irrigated and unirrigated land, while the district-wise data (Figure 9) provides a more precise breakdown.

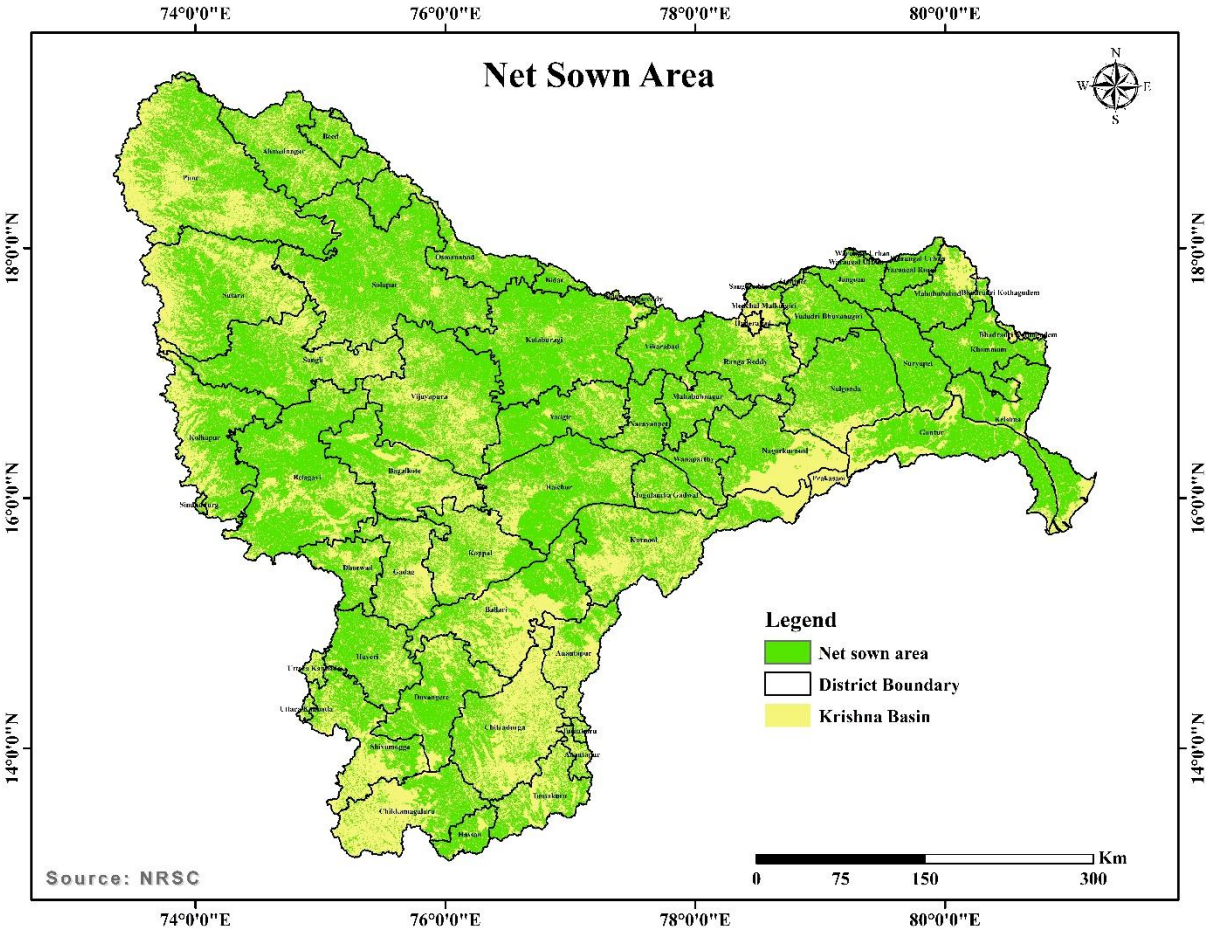

Figure 6 The spatial variation of area under net sown area in the Krishna basin

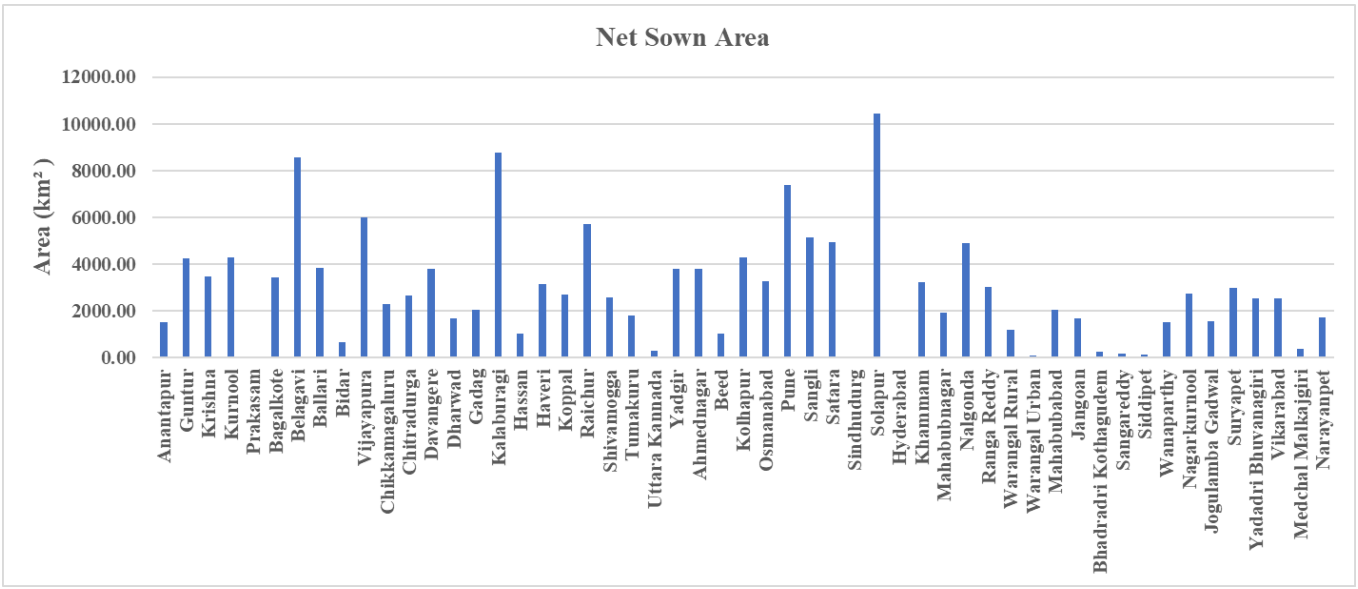

Figure 7 Barplot showing district wise area under net sown area

Karnataka has the largest extent of unirrigated land at 27,124.87 km², reflecting its reliance on rainfed farming, especially in the interior semi-arid tracts. However, it also records 16,849.66 km² under irrigation, mainly supported by canal systems in the Tungabhadra and Upper Krishna projects. Maharashtra follows with 18,937.02 km² unirrigated and 9,774.96 km² irrigated land, where irrigation is concentrated in Bhima sub-basin command areas.

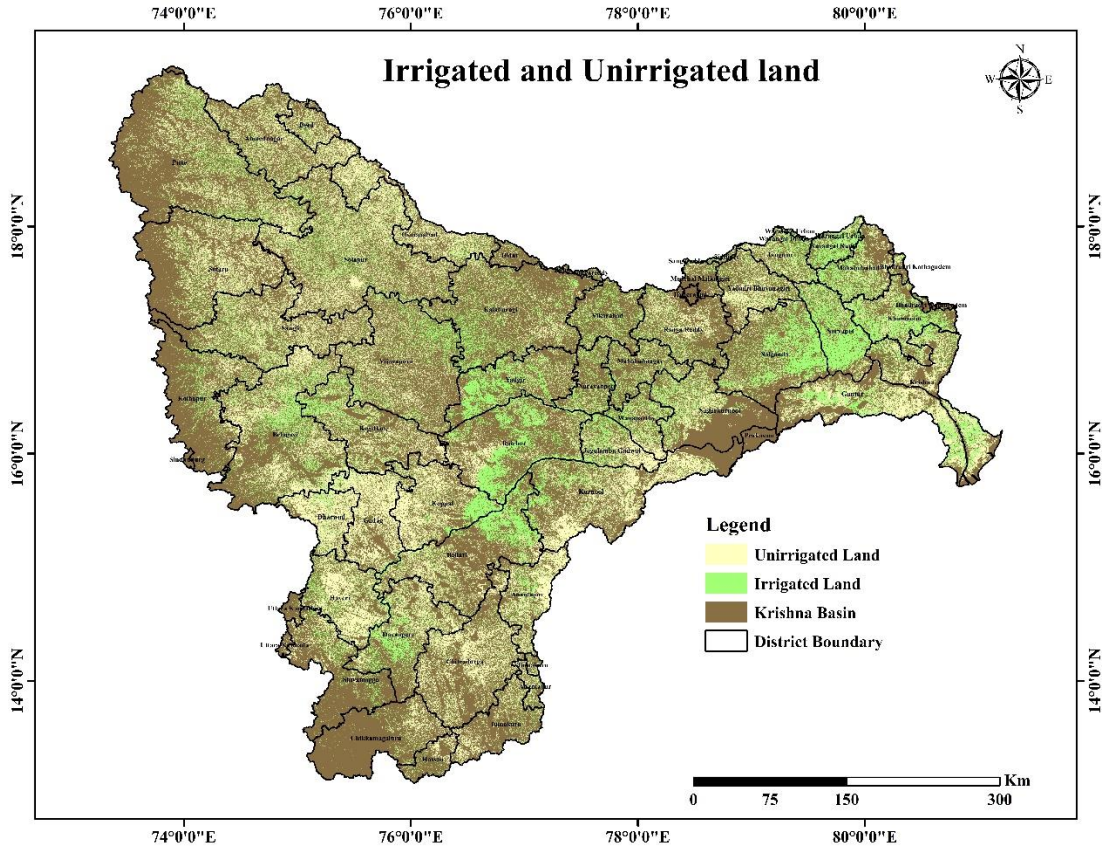

Figure 8 The spatial variation of Irrigated and Unirrigated area in the Krishna basin

Andhra Pradesh reports 8,980.77 km² of unirrigated and 4,038.92 km² of irrigated land, primarily fed by the large irrigation networks of Nagarjuna Sagar and Srisailam projects. Telangana stands out with a relatively higher extent of irrigated land (13,735.52 km²) compared to unirrigated land (9,188.30 km²), attributed to extensive tank irrigation and canal systems. Figure 9 shows the district-wise variation of irrigated and unirrigated areas of the basin.

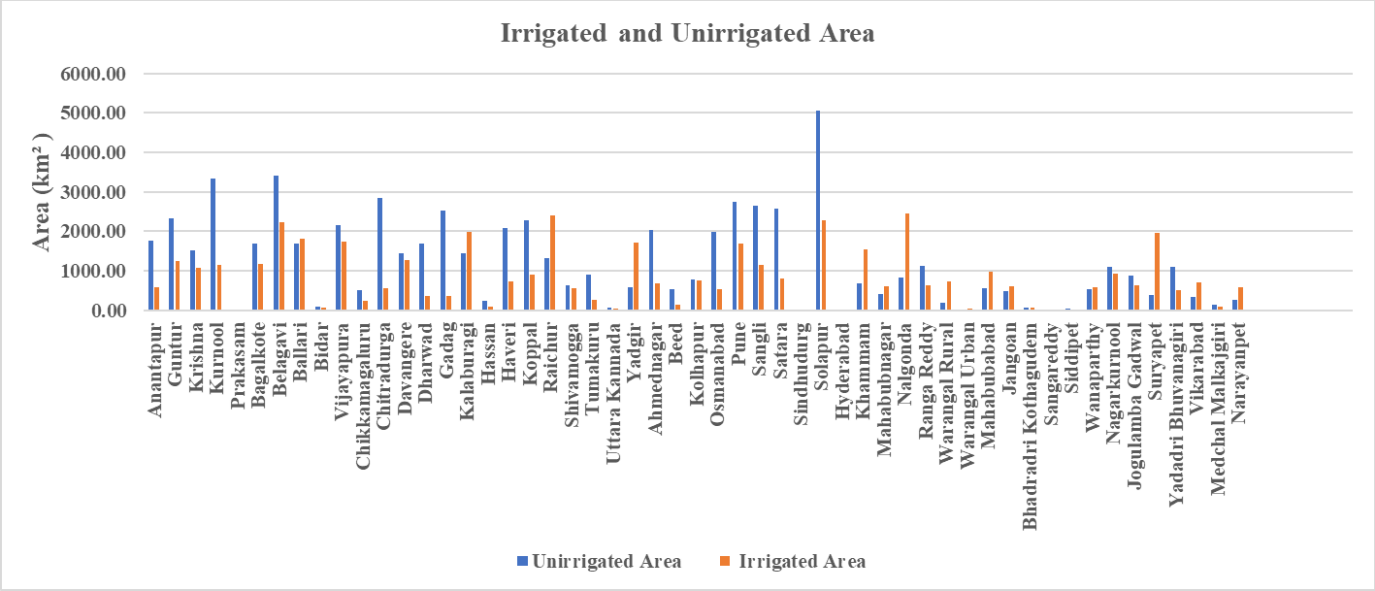

Figure 9 Barplot showing district wise irrigated and unirrigated land

3.3 Areas not available for cultivation

Non-cultivable land, although smaller in total area, represents significant constraints on land productivity. Maharashtra has the largest share at 9,883.76 km², mainly in its rocky plateau and hilly regions. Karnataka has 7,428.72 km², mostly in drier northern districts, while Telangana and Andhra Pradesh have 5,279.10 km² and 2,498.61 km² respectively. Figure 10 illustrates the areas unsuitable for intensive agriculture. The district-level variation of non-cultivable land is depicted in Figure 11.

Figure 10 The spatial variation of area not cultivated in the Krishna basin

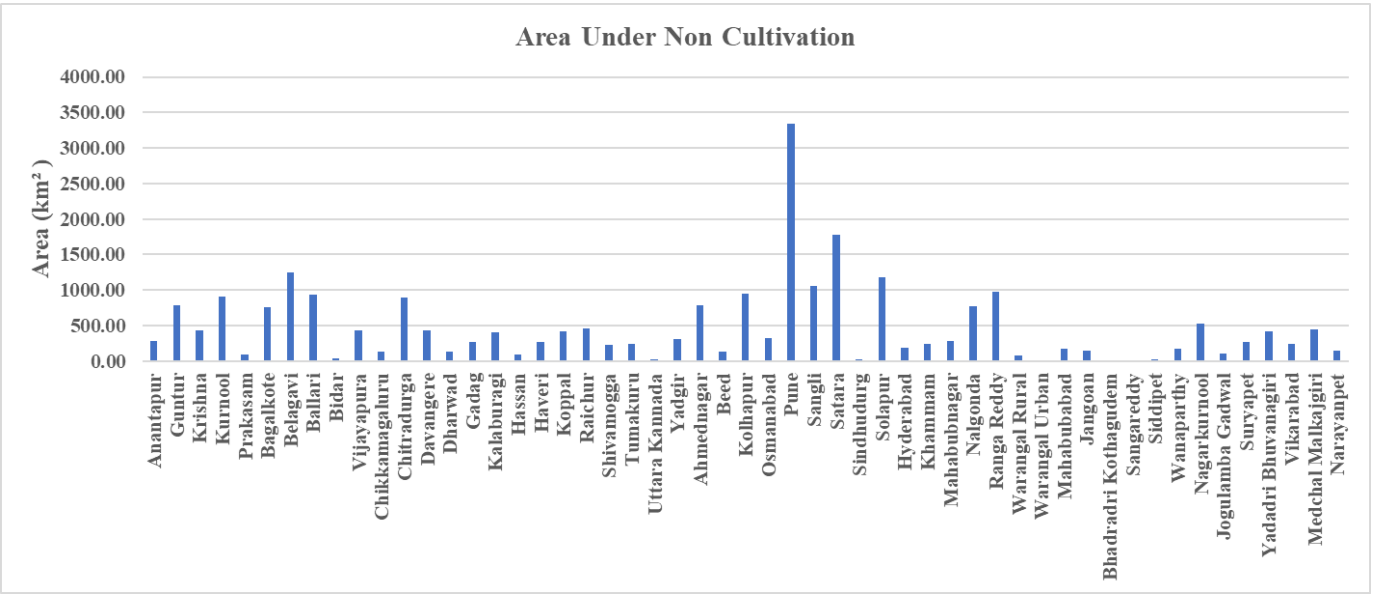

Figure 11 Barplot showing district wise non cultivated area

3.4 Area Under Water Bodies

Water bodies in the Krishna River Basin, including rivers, reservoirs, lakes, and tanks, play a crucial role in sustaining agriculture, domestic use, fisheries, and groundwater recharge. The basin covers a total of 6,763.43 km² under water bodies, distributed across the four riparian states. Karnataka accounts for the largest area with 2,294.21 km², reflecting the presence of major reservoirs such as Almatti, Tungabhadra, and Narayanpur, along with extensive tank irrigation systems. Maharashtra follows with 1,619.72 km², largely concentrated in the upper Krishna and Bhima sub-basins where reservoirs like Koyna and Ujjani are situated. Telangana contributes 1,660.08 km², supported mainly by reservoirs and tanks across districts adjoining the Musi and Munneru tributaries. Andhra Pradesh has 1,189.41 km², with significant concentrations in the Krishna delta region, where large irrigation and multipurpose projects like Srisailam and Nagarjuna Sagar reservoirs dominate the landscape. Figure 12 illustrates the spatial distribution of water bodies across the Krishna River Basin. Figure 13 shows the district-wise variation of area under water bodies.

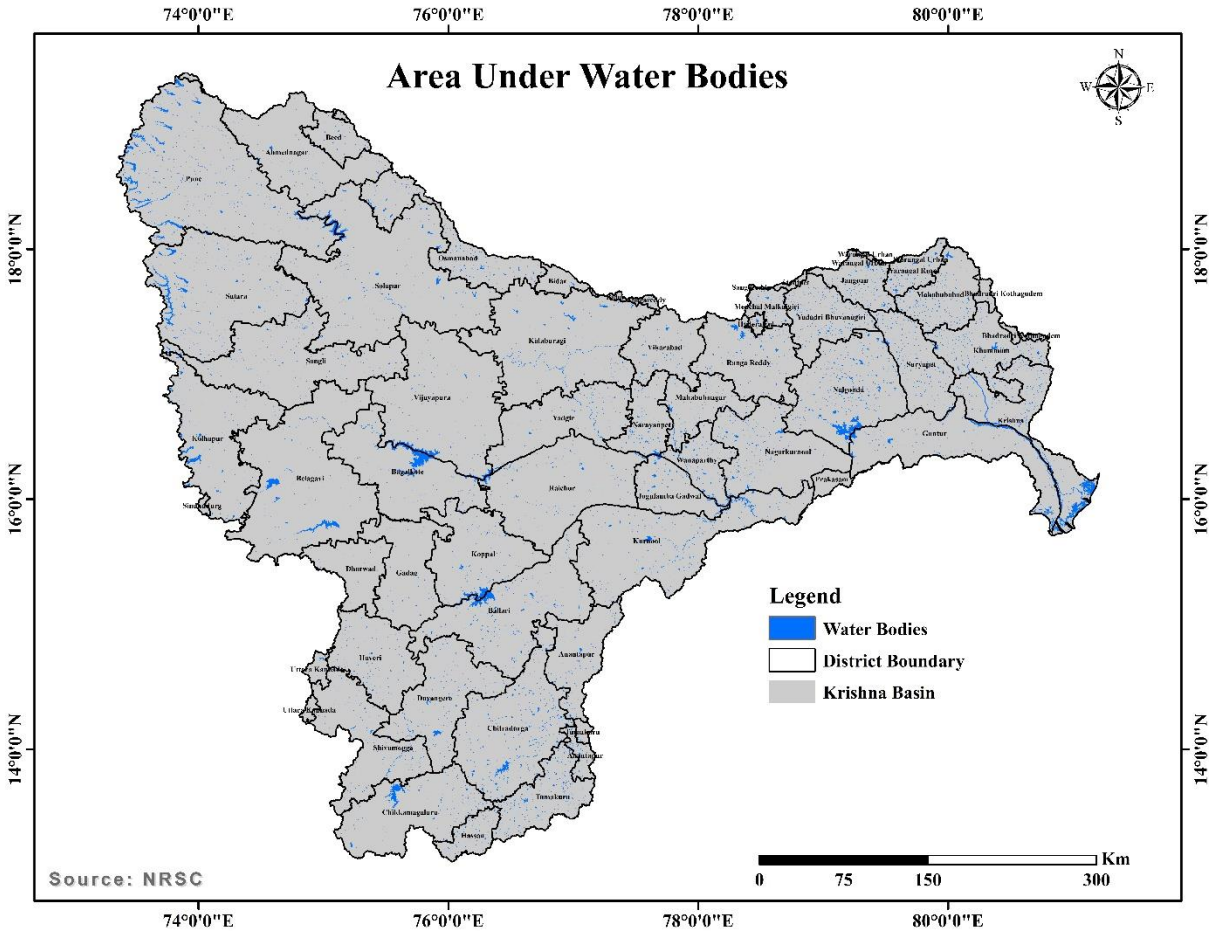

Figure 12 The spatial variation of area under water bodies in the Krishna basin

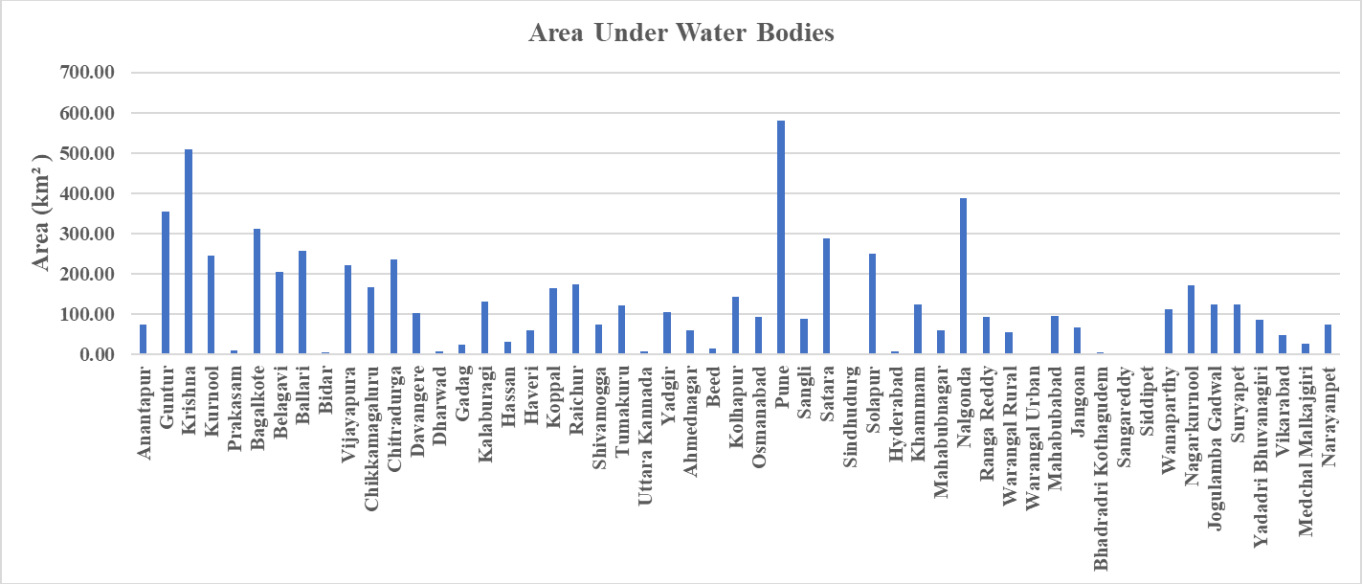

Figure 13 Barplot showing district wise area under water bodies.

3.5 Area under build-up land

The Krishna River Basin encompasses a rapidly expanding built-up landscape, reflecting the growth of urban centers, industrial clusters, and peri-urban settlements. The total built-up land across the basin amounts to 9,776.26 km², with Maharashtra contributing the highest share of 3,701.27 km², followed by Karnataka with 2,970.34 km², Telangana with 2,271.93 km², and Andhra Pradesh with 832.72 km². Figure 14 illustrates the spatial distribution of built-up areas across the basin. A clear concentration of urban land use can be observed around major metropolitan regions such as Pune, Hyderabad, and Bengaluru's periphery, which stand out as dense clusters of red patches. Additionally, medium-scale urbanization is visible around district headquarters and industrial belts in Belagavi, Vijayapura, Solapur, and Kolhapur, while Andhra Pradesh exhibits relatively smaller built-up extents, concentrated mainly in Guntur, Kurnool, and Krishna districts. The district-wise distribution shown in the bar plot in Figure 15 highlights Pune, Hyderabad, Ranga Reddy, and Kolhapur as leading contributors to urban expansion, reflecting both population growth and the presence of economic hubs.

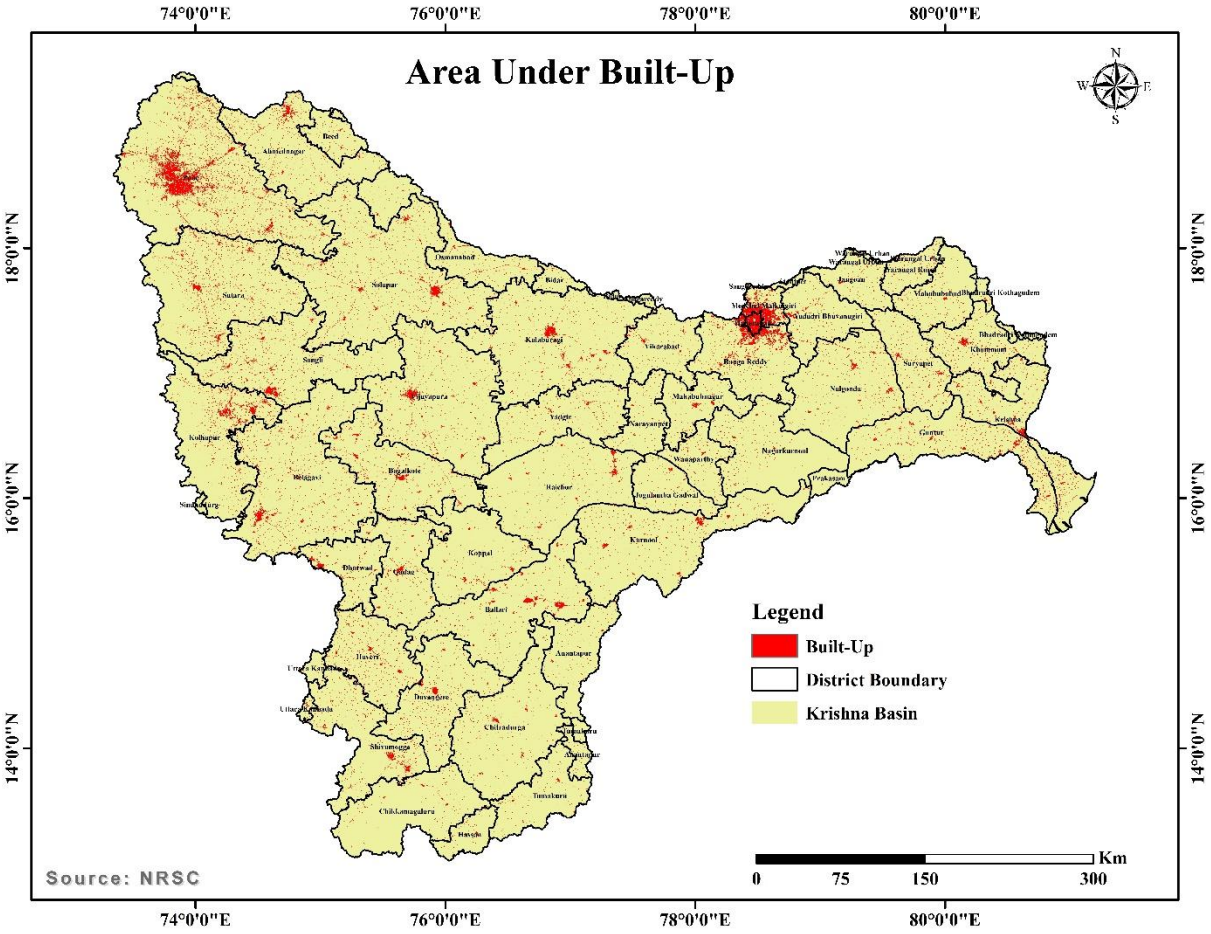

Figure 14 The spatial variation of built-up area in the Krishna basin

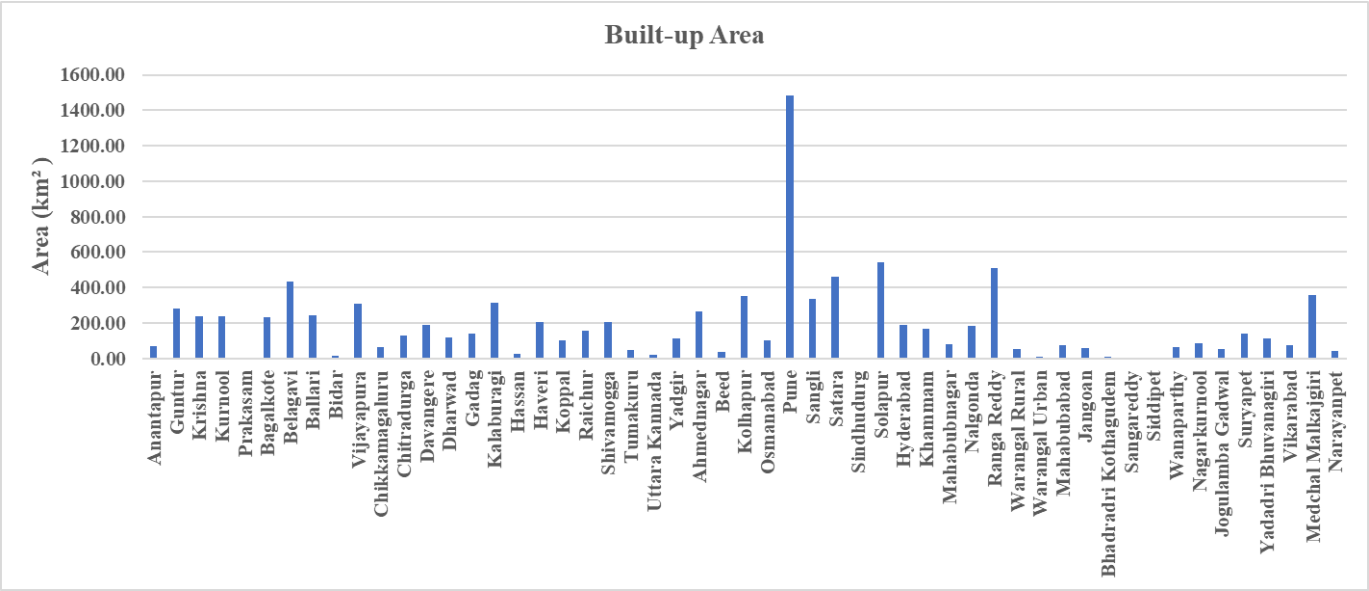

Figure 15 Barplot showing district wise built-up area

3.6 Area Under Barren land

Barren land in the Krishna River Basin refers to areas unsuitable for cultivation due to rocky terrain, shallow soils, or degradation from erosion and deforestation. The basin comprises a total barren land area of 15,313.93 km², distributed across four riparian states. Maharashtra contributes the highest share with 6,182.48 km², followed by Karnataka with 4,458.39 km², Telangana with 3,007.17 km², and Andhra Pradesh with 1,665.89 km². The spatial distribution map (Figure 16) highlights clusters of barren land along the Western Ghats foothills, northern Deccan plateau, and semi-arid tracts of Telangana and Andhra Pradesh. District-level analysis reveals significant variations across the basin (Figure 17). In Maharashtra, Pune, Satara, and Solapur exhibit the largest extents of barren land, driven by rugged terrain and shallow soils in the plateau and hilly regions. Karnataka shows major concentrations in Belagavi, Bagalkote, and Vijayapura, where semi-arid conditions and soil degradation restrict cultivation. In Telangana, Nalgonda and Mahabubnagar dominate the barren land category, with extensive rocky tracts and degraded patches. In Andhra Pradesh, the most affected districts are Anantapur and Kurnool, known for their arid conditions and stony surfaces.

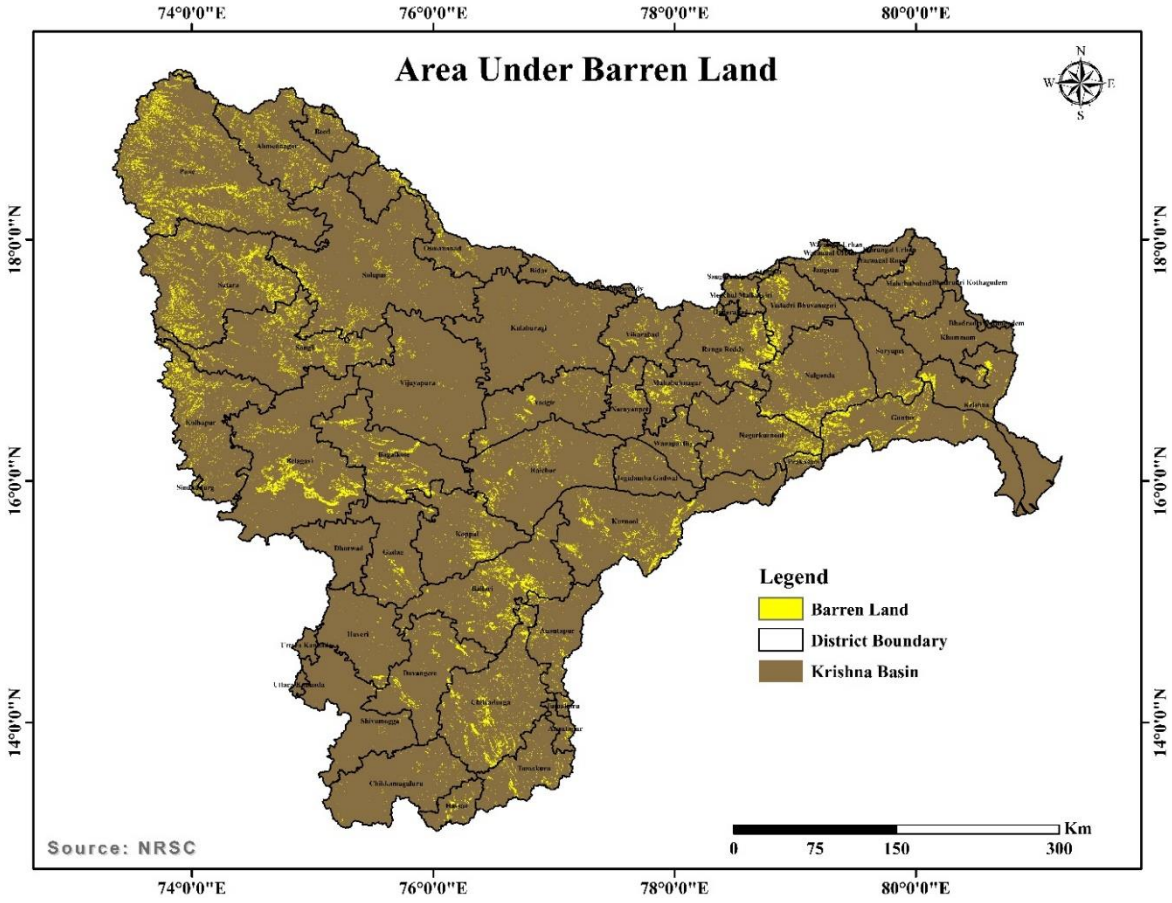

Figure 16 The spatial variation of area under barren land in the Krishna basin

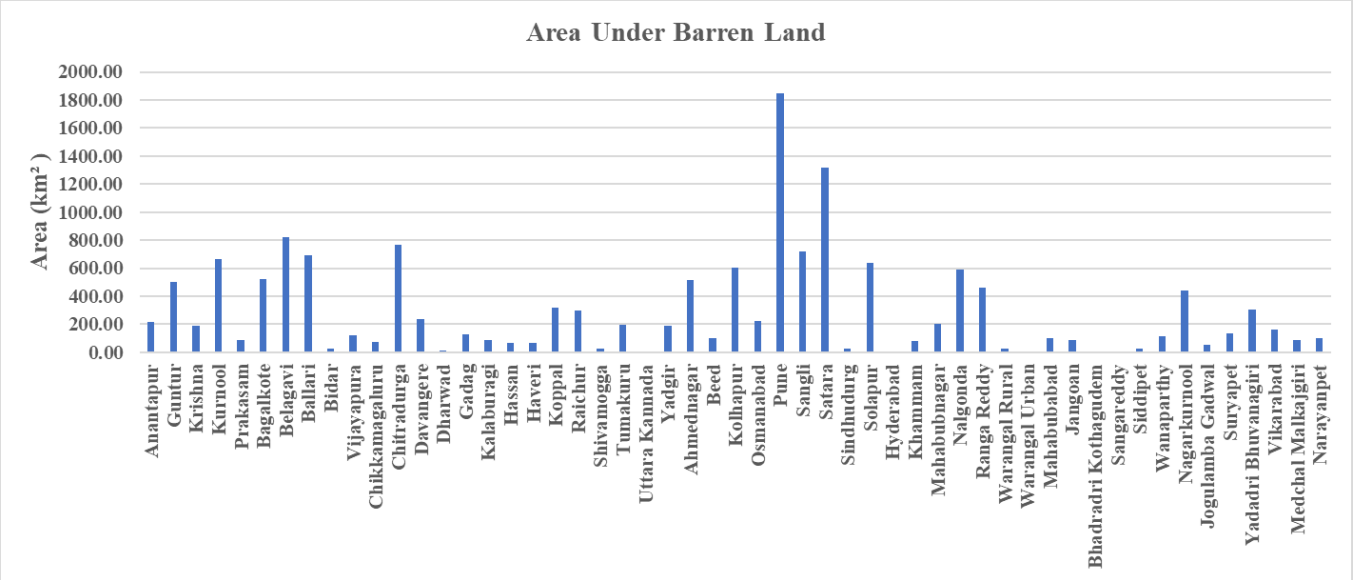

Figure 17 Barplot showing district wise barren land area

4. Production of different crops

Agriculture in the basin supports a diverse cropping system, influenced by rainfall seasonality, irrigation availability, soil types, and market integration. The major crops grown in the basin include rice, maize, jowar, bajra, wheat, gram, arhar/tur, moong, urad, groundnut, soyabean, cotton, sugarcane, sunflower, sesame, coconut, arecanut, spices (turmeric, coriander, chillies), and a range of fruits and vegetables. The cropping pattern is broadly organized into Kharif (monsoon), Rabi (winter), and Summer (hot dry) seasons, along with perennial plantation crops that persist year-round. Kharif is characterized by large-scale cultivation under monsoon-fed conditions, particularly rice, cotton, maize, soyabean, and arhar/tur. Rabi shifts toward cereals and pulses, especially gram, jowar, wheat, and post-monsoon rice and maize where irrigation allows. Summer cultivation remains limited and localized, mainly in command-irrigated areas. Collectively, these cropping systems demonstrate a balance between food security crops (cereals and pulses) and commercial crops (oilseeds, fibres, sugar crops, and plantation crops). However, the relative dominance shifts seasonally, revealing the basin's adaptation to climatic and hydrological constraints. Table 1 shows the area under cash crops and non-cash crops in the Krishna river basin for different seasons

Table 1 Area under cash crops and non-cash crops in the Krishna river basin for different seasons

Season	Cash Crop Area (ha)	Non-Cash Crop Area (ha)
Kharif	45,95,923	76,04,716
Rabi	4,01,010	51,44,580
Summer	51,340	3,73,215
Whole Year	26,72,549	6,42,089

4.1 Area under cash crops

Cash crops constitute an important segment of the basin's agriculture, providing market-linked income, raw material for agro-processing industries, and opportunities for value addition. The dominant cash crops in the basin include cotton, sugarcane, soyabean, groundnut, sunflower, coconut, arecanut, and spices (chillies, turmeric, coriander). During the Kharif season, cash crop cultivation reaches its peak, accounting for approximately 46 lakh ha, primarily under cotton and soyabean. Cotton alone occupies ~21.8 lakh ha, making it the single largest cash crop in the basin and reflecting the region's strong integration with ginning and textile supply chains. Soyabean (~16 lakh ha) and groundnut (~8.5 lakh ha) further indicate the role of the basin as a major oilseed-producing region of India. In contrast, Rabi season records only ~0.4 lakh ha under cash crops, since winter cropping is dominated by food grains and pulses. Summer season cash cropping is minimal (~0.05 lakh ha), restricted to pockets with assured irrigation. Perennial plantation cash crops—especially arecanut and coconut are important in the humid coastal and canal-fed belts, contributing significantly to annualized farm incomes. Table 2 shows the area of major cash crops in the basin.

Table 2 Area of major cash crops in the basin

Crop	Area (ha)
Cotton (Lint)	2,182,726
Sugarcane	1,601,701
Soyabean	1,601,614
Groundnut	846,965
Arecanut	517,743
Coconut	515,458

4.2 Area under non-cash crops

Non-cash crops form the foundation of food supply, dietary security, and livestock support. During Kharif, non-cash crops expand to roughly 76 lakh ha, with rice (~33.20 lakh ha) and maize (~22.75 lakh ha) as staples. Rabi season (~51.44 lakh ha under non-cash crops) is dominated by gram, jowar, wheat, and maize, reflecting reliance on residual moisture and irrigation. Summer cropping (~3.73 lakh ha) is limited but strategically supports rice and fodder requirements in command-irrigated regions. Table 3 shows the area of major non-cash crops in the basin.

Table 3 Area of major non-cash crops in the basin

Crop	Area (ha)
Rice	3,319,687
Maize	2,275,152
Gram	1,657,980
Arhar/Tur	1,560,565
Jowar	1,363,195
Moong (Green Gram)	579,303

5. People to Land Ratio

The land-to-people ratio is an important indicator that reflects the availability of land resources per person within a region. It provides insight into population pressure on land, land use sustainability, and potential stress on natural resources. A higher land-to-people ratio indicates more land available per capita, typically associated with lower population density, whereas a lower ratio suggests greater demographic pressure and limited land resources.

Figure 18 illustrates the spatial distribution of the land-to-people ratio across the Krishna River Basin. The ratio varies considerably among districts, influenced by differences in population density, agricultural land availability, and urban expansion. Districts in the forest-dominated and hilly regions of Karnataka, such as Chikkamagaluru (0.62), Uttara Kannada (0.46), and Shivamogga (0.47), exhibit relatively high ratios due to lower population densities and larger extents of natural landscape. In contrast, intensively populated and urbanized districts like

Hyderabad (0.01), Warangal Urban (0.09), and Ranga Reddy (0.19) show significantly low ratios, reflecting high settlement concentration and limited land availability per person.

Figure 19 presents the district-wise land-to-people ratio in a bar chart, highlighting nuanced spatial differences. Districts in the semi-arid tracts of Nagarkurnool (0.70), Vijayapura (0.48), Gadag (0.44), Raichur (0.44), and Osmanabad (0.45) demonstrate comparatively favourable ratios, which may support agriculture-based livelihoods but also indicate sensitivity to rainfall variability. Conversely, Solapur, Prakasam, Krishna, and parts of Telangana exhibit medium to low ratios, indicating gradual population pressure and potential challenges for sustainable resource management.

Overall, the land-to-people ratio analysis suggests that districts with lower ratios may face higher stress on land resources, requiring improved land management, urban planning, and livelihood diversification strategies. Conversely, regions with higher ratios have spatial potential for sustainable agricultural expansion but also require careful ecological monitoring to avoid overexploitation.

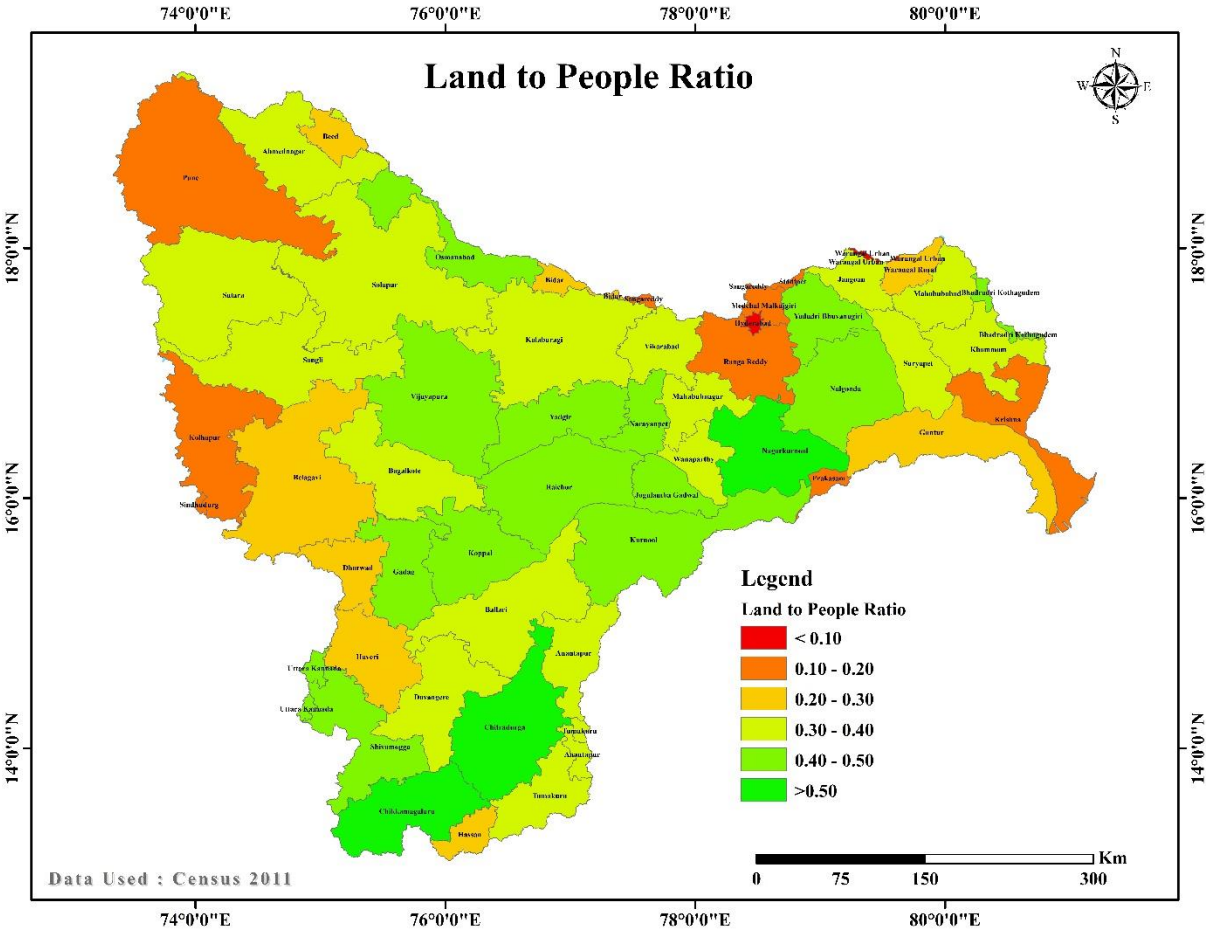

Figure 18 The spatial variation of people to land ratio in the Krishna basin

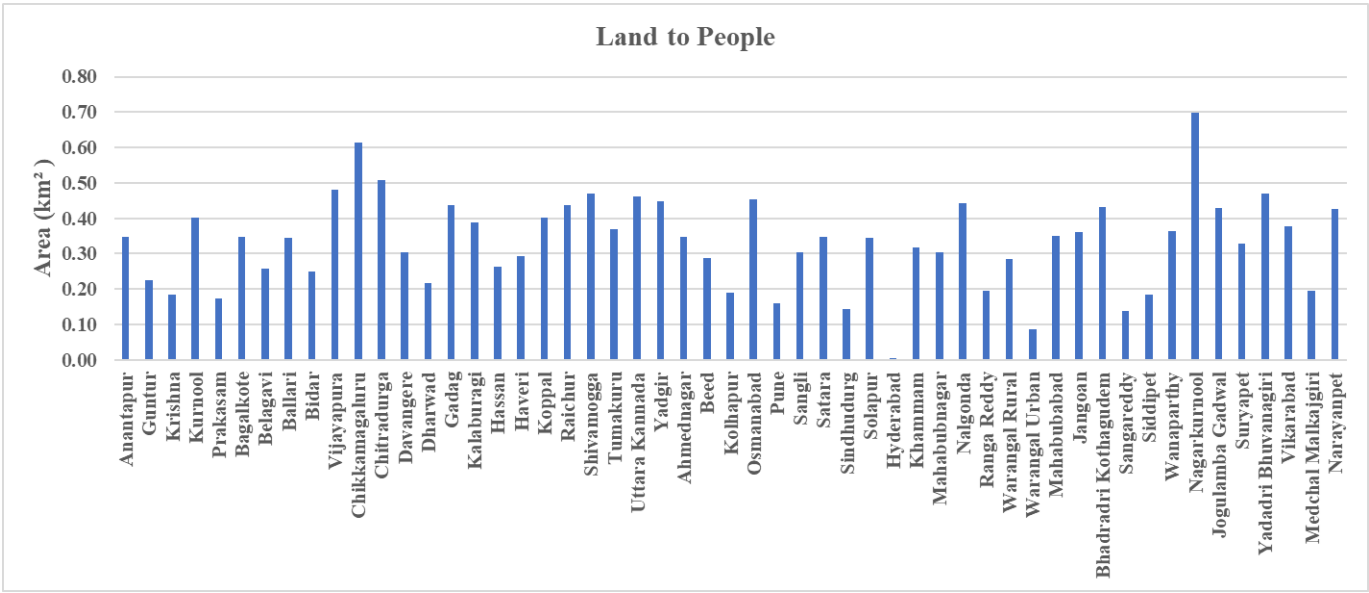

Figure 19 . Barplot showing district wise people to land ratio

6. Vulnerable Areas in Terms of Environmental Degradation

The Krishna River Basin exhibits several zones facing acute environmental stress driven by climatic variability, high population pressure, agricultural intensification, and land-use change. Analysis of land-to-people ratio, the extent of barren land, and spatial patterns of forest and agricultural land suggests that western hilly districts in Karnataka and Maharashtra show higher ecological sensitivity, while semi-arid plateau regions in Telangana and Andhra Pradesh show higher anthropogenic pressures. Districts with lower land-to-people ratios, such as Hyderabad (0.01), Warangal Urban (0.09), Pune (0.16), Krishna (0.18), and Siddipet (0.18), reflect high population density relative to available land resources, increasing pressure on land.

6.1 Over-Exploited Areas

Groundwater extraction records indicate that several districts in the basin fall under over-exploited and critical categories, particularly in Telangana (Nagarkurnool, Wanaparthy, Mahabubnagar, Ranga Reddy) and Karnataka (Vijayapura, Bagalkote, Kalaburagi), where groundwater extraction exceeds recharge rates (CGWB, 2022). Additionally, barren and degraded land is more concentrated in Maharashtra (6182.48 km²) and Karnataka (4458.39 km²), associated with intensive cultivation, deforestation, and open-cast mining activities. Western Ghats districts (Chikkamagaluru, Uttara Kannada, Hassan) face risks associated with landslide susceptibility and slope instability due to steep terrain and rainfall erosivity.

6.2 Areas of Possibility

Areas showing higher land-to-people ratios (indicating more available land per capita), such as Nagarkurnool (0.70), Chikkamagaluru (0.62), Vijayapura (0.48), and Yadgir (0.45), provide opportunities for planned land-use development, eco-restoration, agroforestry expansion, and climate-resilient agriculture. Regions with existing water bodies, particularly along the Krishna and Tungabhadra command areas, support potential for micro-irrigation development, crop diversification, and tank-based aquaculture.

7. Development and Sustainable Land-Use Strategies

To ensure long-term resource sustainability in the Krishna Basin, the following strategies are recommended:

- **Watershed-based land management**, particularly in drought-prone Telangana and Rayalaseema, to enhance soil moisture conservation.

- **Promotion of micro-irrigation** (drip and sprinkler) to reduce groundwater dependency and improve water-use efficiency.
- **Agroforestry and farm-boundary plantations** in erosion-prone and barren lands to restore soil organic carbon and prevent degradation (ICAR, 2020).
- **Strict regulation of riverbed sand mining**, especially along Tungabhadra, Bhima, and mainstem Krishna, where excessive extraction alters channel morphology (MoEFCC, 2016).
- **Crop diversification**, shifting from high water-demand crops (rice, sugarcane) to millets, pulses, and oilseeds in semi-arid belts.
- **Community-based forest management** to conserve remaining forest patches in Western Ghats and Nallamala regions.

8. Challenges in Revenue Mapping

8.1 Shortcomings / Drawbacks / Gaps

- Variability in land classification standards across states creates inconsistency in aggregated basin-wide analysis.
- Temporal differences in datasets (e.g., Census vs. LULC maps) reduce synchronization between population and land-use statistics.
- Limited spatial resolution of freely available satellite data constrains the detection of small-scale land-use transitions.
- Underreporting of informal land-use activities, such as encroachment and undocumented riverbed mining.

8.2 Proposed Solutions

- Standardize land classification frameworks across states through a basin-level coordination protocol.
- Use high-resolution remote sensing datasets (Sentinel-2, 10m; LISS-IV, 5.8m) for annual change detection mapping.
- Develop real-time monitoring dashboards integrating land-use, water-use, and population data for adaptive planning.
- Encourage participatory land governance, involving local communities, irrigation corporations, and watershed committees.

9. Conclusion and Recommendations

9.1 Summary of Key Findings

The Krishna River Basin exhibits notable spatial differences in land use, agricultural activity, forested areas, and settlement growth. Forest cover is most extensive in Karnataka because of the Western Ghats, whereas Maharashtra and Telangana have large areas of barren and fallow land. Urban and peri-urban regions experience high population pressure, leading to increased environmental stress.

9.2 Recommendations and Improvements

- Promote climate-resilient agriculture and micro-irrigation in semi-arid belts.
- Enhance forest restoration programs in ecologically fragile zones.
- Implement land-use zoning and sand mining regulations at the basin scale.
- Establish a centralized basin-wide land information system for continuous monitoring and planning.

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