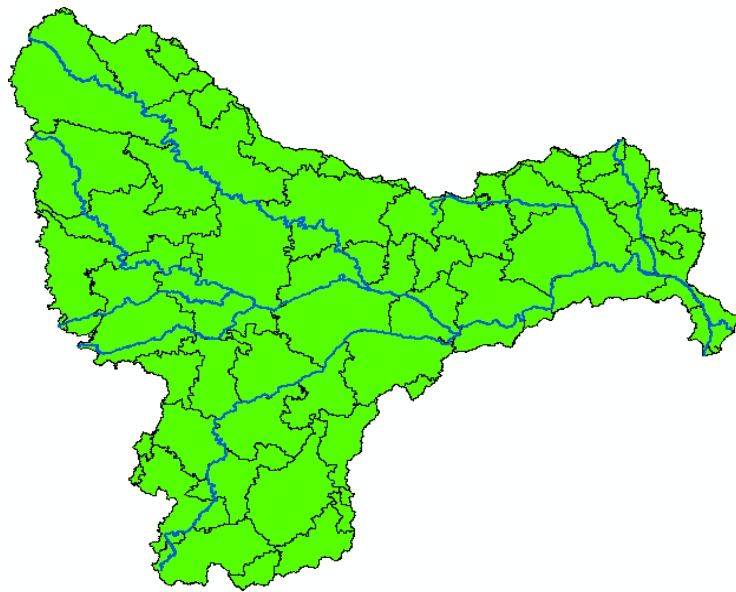




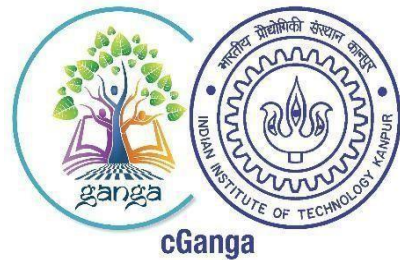
National River Conservation Directorate

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

Agriculture Profile of Krishna River Basin



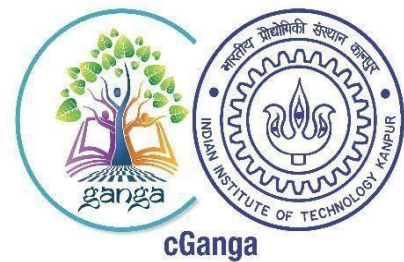
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Agriculture Profile of Krishna River Basin

May 2026



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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 NITK 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

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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.

Centers for Krishna River Basin Management Studies (cKrishna)

NIT Warangal and NITK, Surathkal

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1. Introduction

The Krishna River Basin is one of the major river basins in India, covering parts of Maharashtra, Karnataka, Telangana, and Andhra Pradesh. The basin supports a large agricultural population and plays a crucial role in ensuring regional food security, economic development, and rural livelihoods. Agriculture within the basin is highly influenced by variations in climate, soil characteristics, topography, irrigation infrastructure, and water availability across different sub-basins including Upper Krishna, Middle Krishna, Lower Krishna, Bhima, and Tungabhadra. The basin exhibits diverse agricultural practices with cultivation of food grains, pulses, oilseeds, commercial crops, and horticultural crops under both irrigated and rainfed conditions.

Agricultural land use forms a significant proportion of the total geographical area in many districts of the basin, indicating strong dependence on farming activities and irrigation resources. The assessment of cropping pattern, cropping intensity, irrigated area, agricultural land distribution, and farming practices is essential for understanding agricultural productivity, land utilization efficiency, and water resource management within the basin.

In context, It presents a comprehensive analysis of the agricultural profile of the Krishna River Basin using district-wise and sub-basin-wise data collected from various secondary sources including District at a Glance (DAG), District Statistical Reports (DSR) Report of Dynamic Water resources of India, NABARD and ICRISAT datasets. The study examines agricultural land distribution, cropping intensity, crop-wise irrigated area, and farming practices across the basin to identify regional variations and agricultural trends. The report also highlights the growing dependence on irrigation and groundwater resources, along with challenges related to water scarcity, land degradation, and sustainable agricultural development. The findings of this study will support better planning and management strategies for improving agricultural productivity, water-use efficiency, and long-term sustainability within the Krishna River Basin.

1.1 Geographic and Physiographic Features

Geographically, the Krishna River basin lies between 73°17'–81°9' E longitude and 13°10'–19°22' N latitudes, with a maximum length of 701 km and width of 672 km. It is bounded by the Balaghat Range to the north, the Eastern Ghats to the south and east, and the Western Ghats to the west. The basin exhibits a diverse range of landscapes traversing the Upper Krishna, Middle Krishna, and Lower Krishna sub-basins — from the steep slopes and higher elevations of the Western Ghats in the Upper Krishna sub-basin with laterite and red soils, to undulating plateau regions with black cotton soils in the Middle Krishna sub-basin, and flat alluvial delta plains in the Lower Krishna sub-basin near the Bay of Bengal. The basin topography is mostly rolling and undulating; soil types include black soils, red soils, laterite,

alluvium, mixed soils, and saline and alkaline soils, and the basin is geologically dominated by Deccan Traps in the northwest, unclassified crystalline in the centre, and the Cuddapah Group in the east.

1.2 Administrative Jurisdiction and Demography

Administratively, the Krishna Basin spans four states — Karnataka holding the largest share at 1,13,271 sq. km, followed by Andhra Pradesh at 76,252 sq. km, and Maharashtra at 69,425 sq. km, with Telangana constituting the remaining portion. In Karnataka total 21 districts with in the basin, including Belgaum, Bagalkot, Bijapur, Bidar, Raichur, Koppal, Bellary, Dharwad, Gadag, Haveri, Chitradurga, Davangere, Shimoga, Tumkur, Hassan, Chikmagalur, Gulbarga, Yadgir, Dakshina Kannada, Uttar Kannada and Vijayanagara; in Maharashtra, 9 districts like Satara, Sangli, Solapur, Pune, Kolhapur, Beed, Osmanabad and Ahmednagar are deeply embedded in basin-related water management. In Telangana 20 districts like, the river passes through Narayanpet, Gadwal, Nagarkurnool, Nalgonda, and Suryapet districts, while in Andhra Pradesh 10 districts like, Kurnool, Prakasam, Guntur, and Krishna districts represent the downstream extent. The basin supports approximately 80 million people and spans 56 Parliamentary constituencies, with the majority of the population dependent on agriculture; about 75% of the basin's water is used for agriculture and related purposes.

1.3 Ecological Significance and Biodiversity

Ecologically, the Krishna Basin hosts a wide array of ecosystems — forests occupy 10.04% of the basin area, rangelands 4%, and water bodies 4.07%, collectively supporting ecological balance, diverse wildlife habitats, and aquatic life. The basin includes key conservation landscapes such as the Sahyadri Tiger Reserve on the Western Ghats, home to tigers, gaurs, leopard cats, panthers, and sloth bears, while the grasslands of Solapur district shelter the critically endangered Great Indian Bustard. The Nagarjuna Sagar–Srisailem Tiger Reserve, through which the Krishna flows for over 200 km, supports Mugger crocodiles, Smooth-Coated Otters, and numerous bird and turtle species across tropical dry and moist deciduous forests. At its estuary, the Krishna Wildlife Sanctuary (194.81 km²) in Andhra Pradesh harbours one of the last remaining tracts of primary mangrove forests in South India, spread across Krishna and Guntur districts, encompassing reserve forests including Sorlagondi, Nachugunta, and Kottapalem, and serving as a nursery for fish, shrimps, and shellfish, making it one of the rarest eco-regions in the world.

2. Graphical Delineation of Significant Agricultural Areas

Graphical Delineation of Significant Agricultural Areas refers to the mapping and visual representation of major agricultural regions within the Krishna River Basin using geo-spatial and Land Use Land Cover (LULC) data. It helps in identifying the spatial distribution, extent, and intensity of agricultural land across different districts and sub-basins. This analysis

provides important insights into regional agricultural patterns, land utilization, and areas with high dependence on farming activities.

2.1 Area under agriculture by districts in Krishna River basin

The spatial and temporal analysis of agricultural land use in the Krishna River Basin is essential to understand the distribution and dynamics of cultivated areas across different regions. Land Use Land Cover (LULC) data for the year 2024 has been derived from Sentinel-2 imagery using the Esri platform. The analysis has been carried out at the district level for each sub-basin to capture variations in agricultural land use. The resulting maps provide insights into the extent of agricultural areas and their spatial distribution, forming the basis for further district-wise assessment within each sub-basin.

Upper Krishna Basin: The distribution of agricultural land across districts in the Upper Krishna sub-basin, revealing significant variation in land use patterns. Districts such as Vijayapura (95.1%) and Dharwad (93.39%) have very high agricultural land percentages, indicating intensive farming and strong dependence on agriculture. Similarly, Yadgir, Raichur, Koppal and Gadag all show high values above 84%, reflecting a predominantly agrarian landscape. Sangli (81.21%), Belagavi (79.76%) and Bagalkot (78.57%) also maintain substantial agricultural coverage. In contrast, Satara (55.31%) and Kolhapur (51.62%) have moderate levels, suggesting a mix of agriculture with other land uses. Notably, Sindhudurg has a very low percentage (6.52%), which may be due to forest cover, hilly terrain, or coastal geography limiting agricultural expansion. Overall, the data highlights strong regional dependence on agriculture, with variations shaped by physical geography and resource availability. The agricultural land use distribution in districts of Upper Krishna basin is shown in figure 1 below.

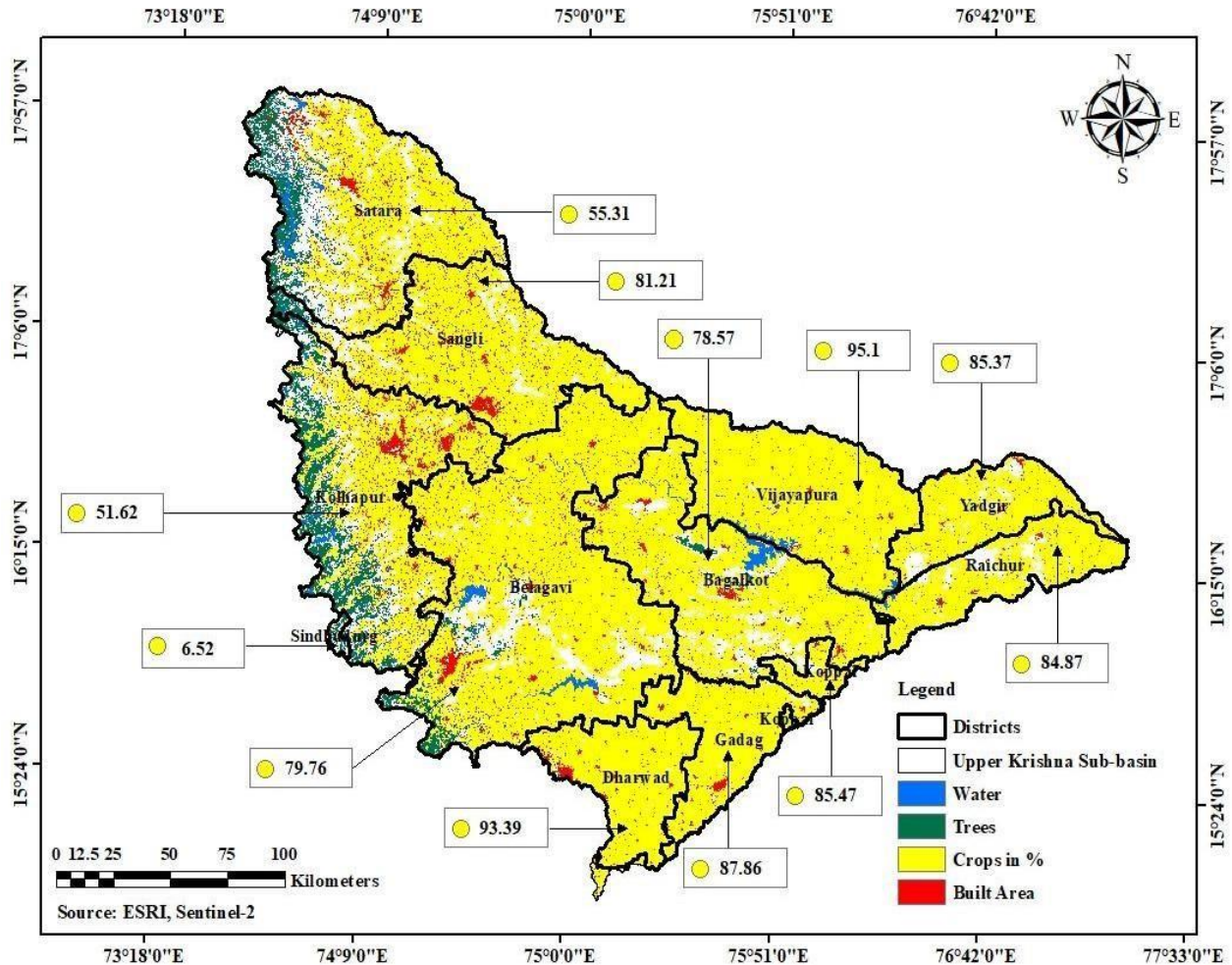


Figure 1: Agriculture Land Use in the Districts of Upper Krishna basin

Middle Krishna Basin: The agricultural land across districts in the Middle Krishna sub-basin, showing significant variation in land use patterns. Districts like Jogulamba Gadwal (89.38%), Raichur (84.87%), Yadgir (85.37%), and Narayanpet (83.48%) have very high proportions of land under agriculture, indicating strong dependence on farming activities. Similarly, Wanaparthy, Nalgonda, and Vikarabad also show high agricultural utilization, all above 75%. In contrast, districts such as Nagarkurnool and Nandyal have moderate levels, with just over half of their land used for agriculture. A striking outlier is Prakasam, with only 1.18%, suggesting either different land use priorities or geographical constraints. Overall, the data highlights a predominantly agrarian landscape in most districts, with a few exceptions that may require further investigation. The agricultural land use distribution in districts of Middle Krishna basin is shown in figure 2 below.

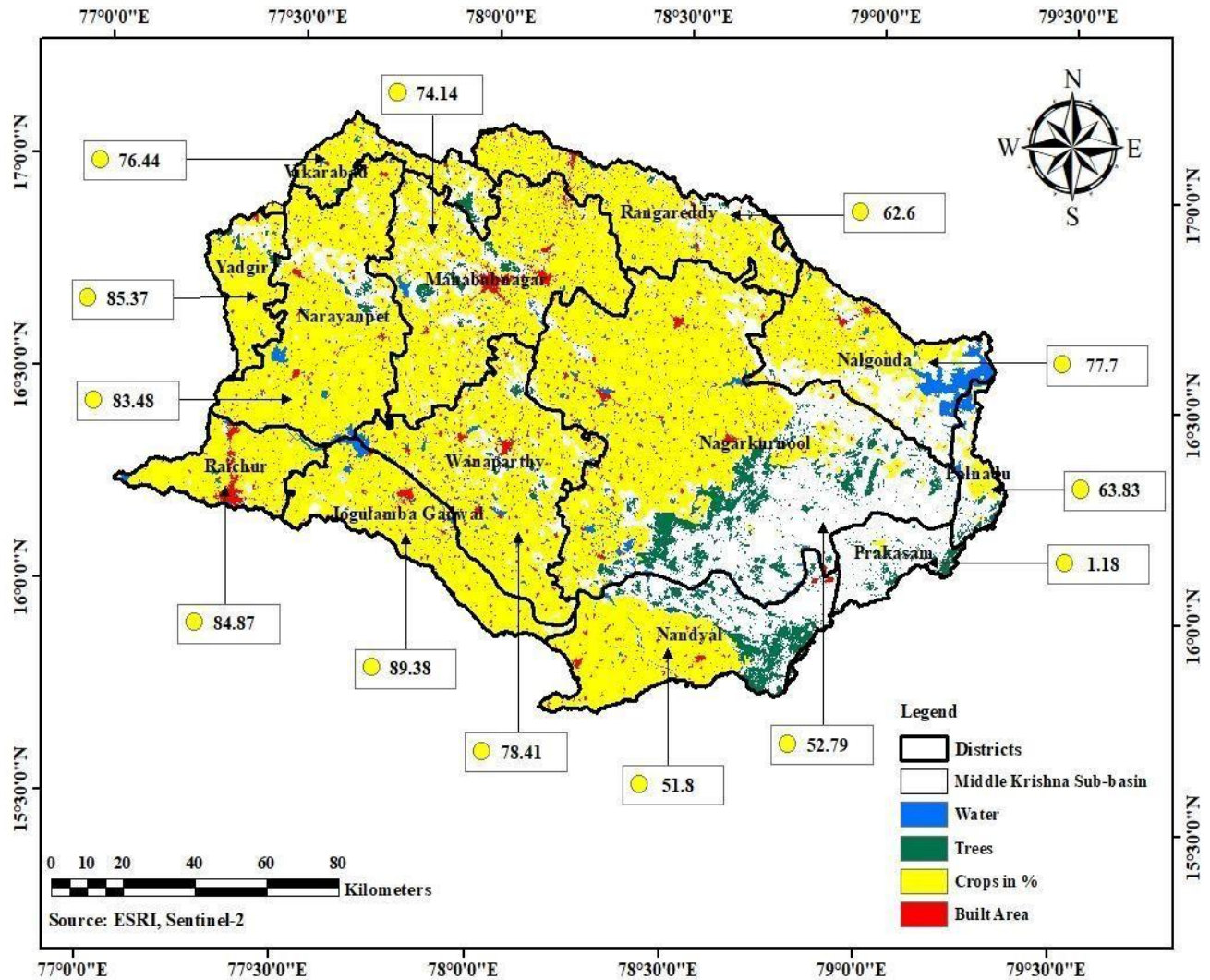


Figure 2: Agriculture Land Use in the Districts of Middle Krishna basin

Lower Krishna Basin: The map shows the percentage of agricultural land across districts in the Lower Krishna sub-basin, revealing a wide range of land-use patterns. Several districts such as Hanumakonda (89.85%), Warangal (86.75%), Jangaon (86.73%), Suryapet (85.27%), and Khammam (82.16%) have very high agricultural land percentages, indicating strong reliance on farming. Districts like Guntur, Nalgonda, Yadadri Bhuvanagiri, and Vikarabad also show substantial agricultural activity, all above 75%. Moderate levels of agricultural land are observed in Krishna, Bapatla, NTR, Palnadu, Siddipet, and Rangareddy, generally ranging between 50% and 70%. In contrast, Bhadradri Kothagudem and Medchal Malkajgiri have lower agricultural shares, suggesting more forested, industrial, or urban land use. Hyderabad stands out as an extreme outlier with only 0.04%, reflecting its highly urbanized nature. Overall, the data highlights a predominantly agrarian region with significant variation influenced by urbanization and geographical factors. The agricultural land use distribution in districts of Lower Krishna basin is shown in figure 3 below.

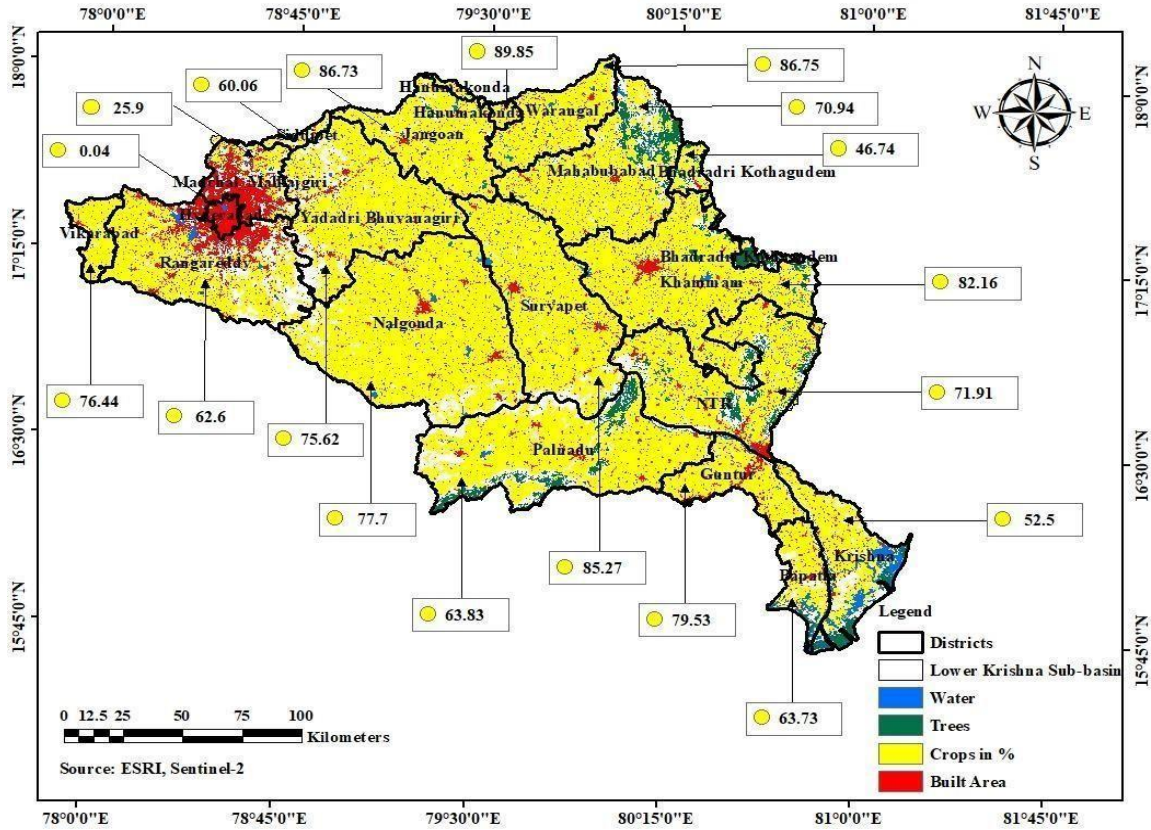


Figure 3: Agriculture Land Use in the Districts of Lower Krishna basin

Upper Bhima Basin: The agricultural land across districts in the Upper Bhima sub-basin, showing notable variation in land use patterns. Districts like Vijayapura (95.1%), Solapur (91.66%), and Dharashiv (91.51%) have a very high proportion of land dedicated to agriculture, indicating strong dependence on farming activities. Similarly, Beed (82.49%), Sangli (81.21%), and Ahmednagar (80.96%) also exhibit significant agricultural land coverage. In contrast, Pune (54.33%) and Satara (55.31%) have comparatively lower percentages, suggesting a more diversified land use that may include urbanization, industry, or forest areas. Overall, the data highlights that most districts in the basin are predominantly agrarian, with agriculture playing a central role in their economy. The variation also reflects differences in geography, water availability, and development patterns across the region. The agricultural land use distribution in districts of Upper Bhima basin is shown in figure 4 below.

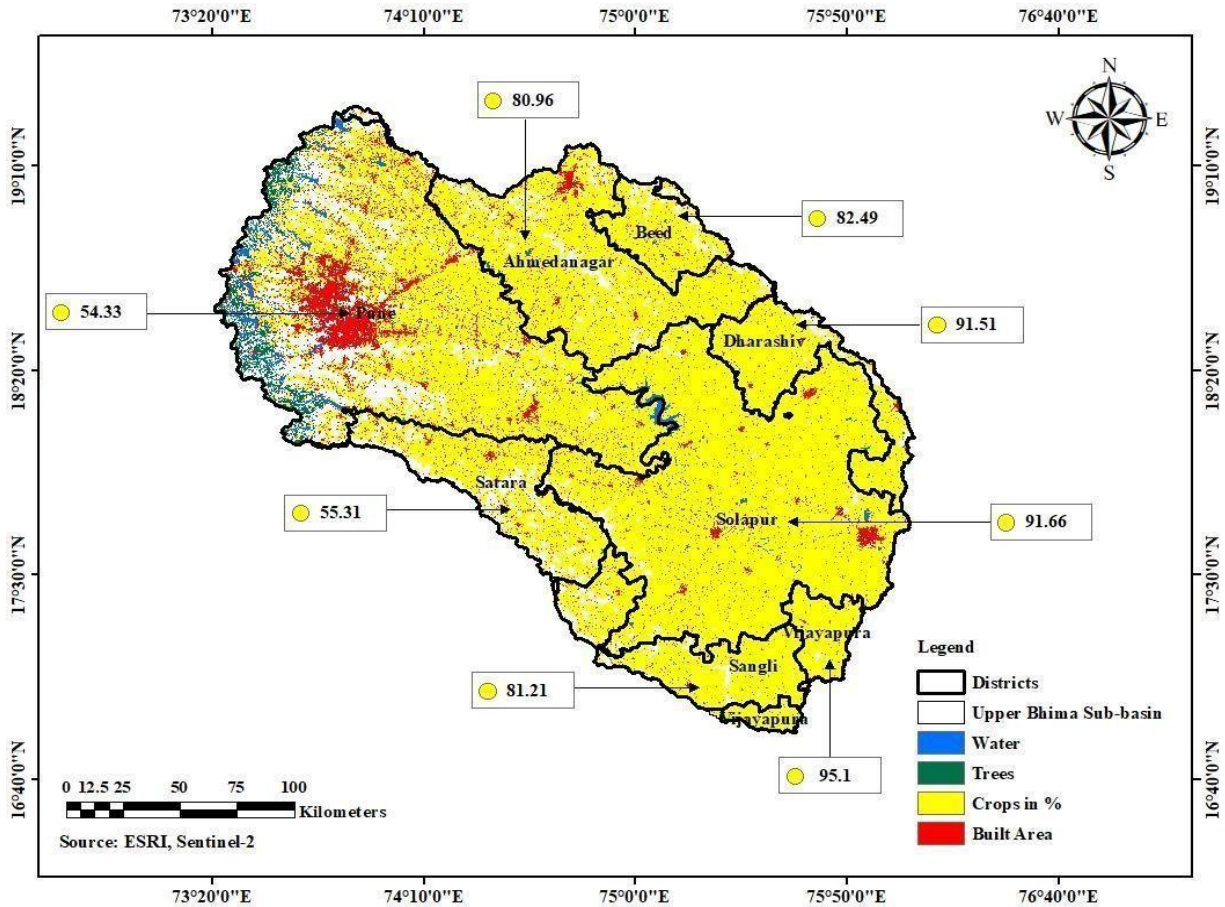


Figure 4: Agriculture Land Use in the Districts of Upper Bhima basin

Lower Bhima basin: The agricultural land across districts in the Lower Bhima sub-basin, indicating a predominantly agriculture-based landscape. Districts such as Vijayapura (95.1%), Solapur (91.66%), and Dharashiv (91.51%) have very high agricultural land coverage, reflecting intensive farming practices and strong reliance on agriculture. Kalaburagi (89.43%) and Yadgir (85.37%) also demonstrate substantial agricultural presence. Meanwhile, Vikarabad (76.44%) and Sangareddy (74.75%) have moderately high agricultural land percentages, suggesting a balance between farming and other land uses. Bidar (72.1%) has the lowest among the listed districts, though agriculture still occupies a significant portion of land. Overall, the data highlights that the Lower Bhima sub-basin is largely agrarian, with slight regional variations likely influenced by factors such as soil type, irrigation availability, and urban development. The agricultural land use distribution in districts of Lower Bhima basin is shown in figure 5 below.

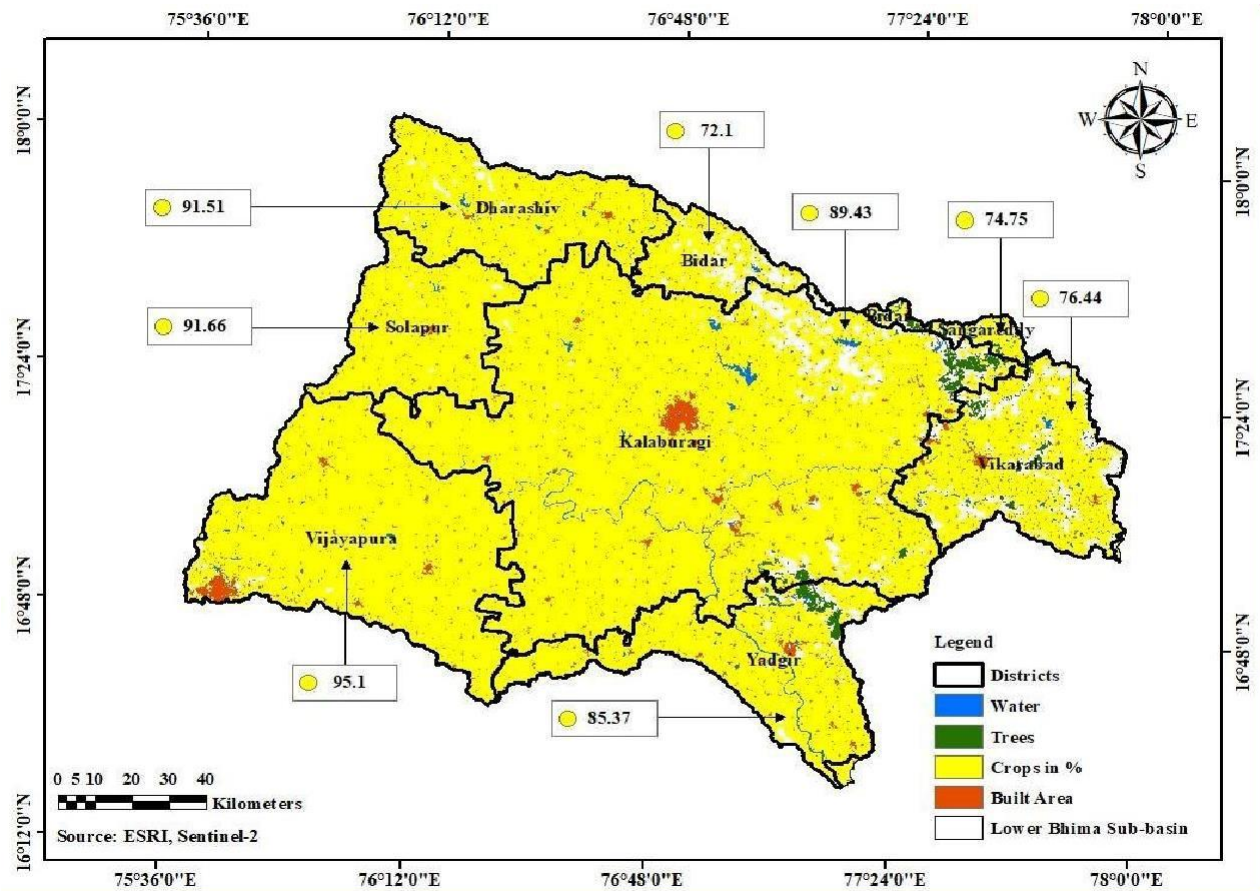


Figure 5: Agriculture Land Use in the Districts of Lower Bhima basin

Upper Tungabhadra Basin: The percentage of agricultural land across districts in the Upper Tungabhadra sub-basin, showing notable variation in land utilization. Districts such as Dharwad (93.39%), Gadag (87.86%), Haveri (86.3%), and Koppal (85.47%) have very high agricultural land percentages, indicating intensive farming activities and strong dependence on agriculture. Moderate to high levels are observed in Davangere, Chitradurga, Vijayanagara, and Ballari, where agricultural land ranges between roughly 67% and 76%. In contrast, districts like Shivamogga (42.91%) and Uttar Kannada (33.68%) show lower agricultural land use, possibly due to greater forest cover or different geographical conditions. Chikkamagaluru has the lowest share at 22.98%, suggesting hilly terrain or plantation-based land use rather than extensive agriculture. The agricultural land use distribution in districts of Upper Tungabhadra basin is shown in figure 6 below.

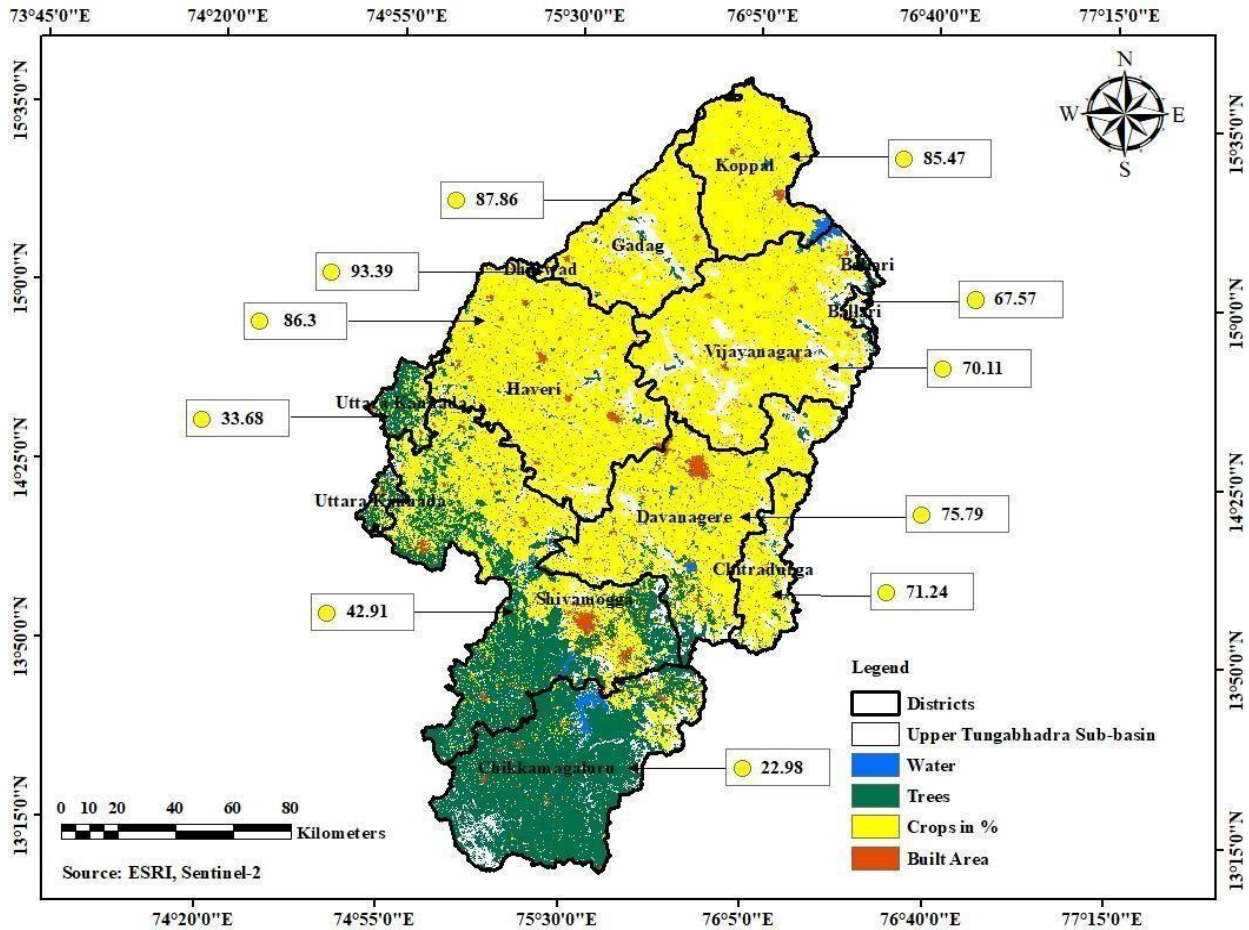


Figure 6: Agriculture Land Use in the Districts of Upper Tungabhadra basin

Lower Tungabhadra Basin: The agricultural land across districts in the Lower Tungabhadra sub-basin, indicating a largely agriculture-driven region with some variation. Districts such as Jogulamba Gadwal (89.38%), Ananthapur (87.28%), Koppal (85.47%), and Raichur (84.87%) have very high percentages of agricultural land, reflecting strong dependence on farming. Kurnool and Sri Sathya Sai also show high agricultural usage, both above 75%. Moderate levels are observed in Davangere, Chitradurga, Vijayanagara, and Ballari, where agricultural land ranges between about 67% and 76%. Districts like Tumakuru, Hassan, and Nandyal have comparatively lower shares, around 50–56%, suggesting more diversified land use. Chikkamagaluru stands out with the lowest percentage (22.98%), likely due to hilly terrain and plantation crops rather than extensive agriculture. The agricultural land use distribution in districts of Lower Tungabhadra basin is shown in figure 7 below.

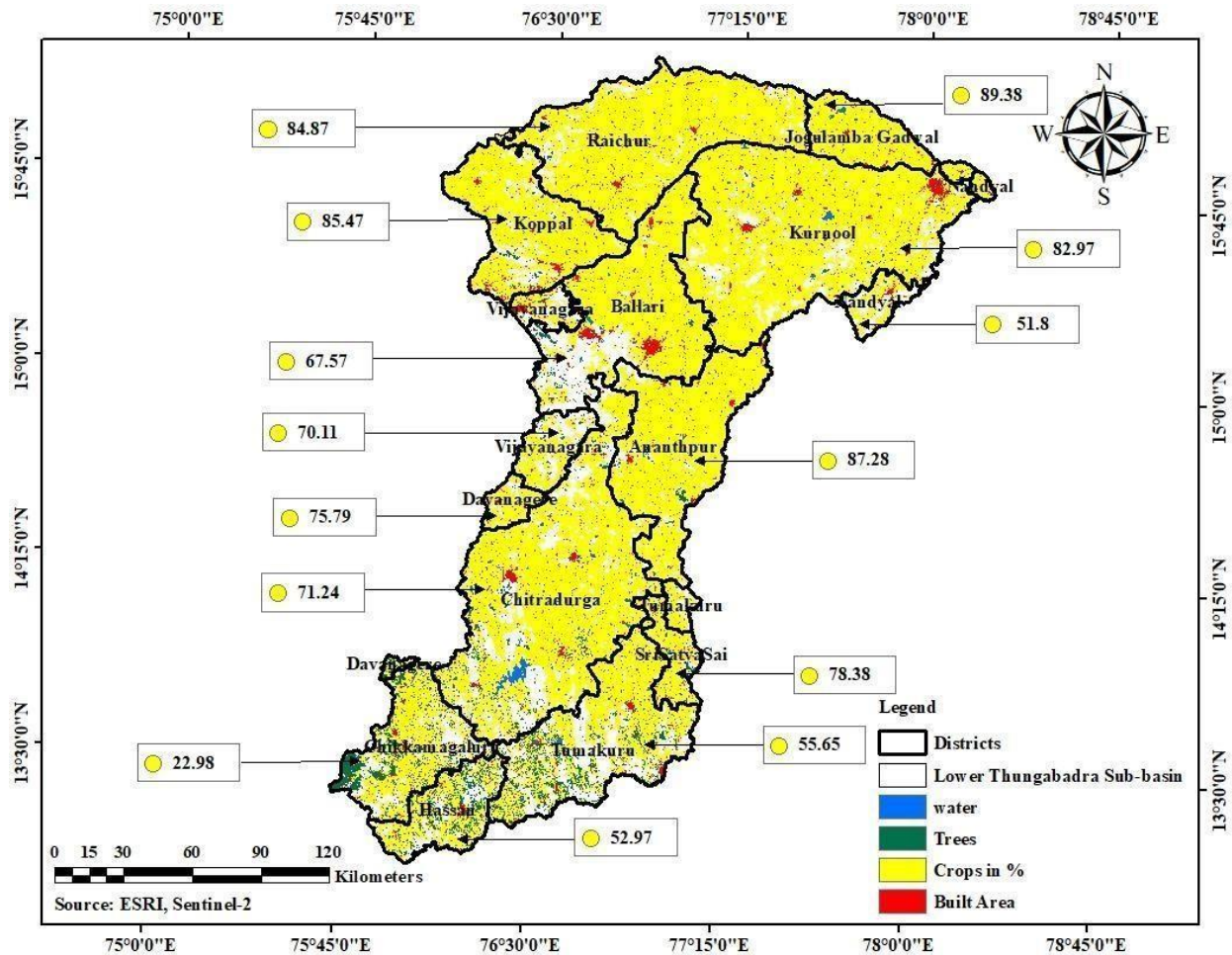


Figure 7: Agriculture Land Use in the Districts of Lower Tungabhadra basin

3. Cropping Pattern and Cropping Intensity

Cropping Pattern refers to the percentage of area that is under different crops at a given time and place. Whereas the cropping Intensity is a crucial input variable for many global climates, land surface and crop models. It is also playing the role in crop yield and food security at the local, regional and national levels.

Cropping Intensity is the number of planting cycles per year which is crucial for exchanging food production and safety at local, regional and national levels. It is computed using formula

$$\text{Cropping Intensity (\%)} = \frac{\text{Gross Cropped Area}}{\text{Net sown Area}} * 100$$

The above formula is useful for determining the intensity of land use for agricultural production, providing information on land utilization and farming efficiency.

The data such as Gross cropped area, Net sown area, Cropping Pattern and Cropping Intensity data used in this study has been obtained from the potential linked credit plan 2025-2026 reports of each district of National Bank for Agriculture and Rural Development. District-wise tables for individual sub-basins are presented in the following tables to illustrate the spatial distribution of Cropping Pattern and Cropping Intensity across the Krishna River basin.

Table 1: Cropping Intensity in the districts of Upper Krishna Basin

Sl.No	Districts	Total Geographical Area (sq.km)	Gross Cropped Area (ha)	Net Sown Area (ha)	Cropping Intensity (%)
1	Satara	10480	8,10,000	6,03,000	134.33
2	Sangli	8588.5	6,12,000	4,88,000	125.41
3	Sindhudurg	5207	2,15,000	2,06,000	104.37
4	Kolhapur	7,685	4,27,00	3,96,000	107.83
5	Dharwad	4260	5,58,000	3,23,000	172.76
6	Belagavi	13433	14,34,000	9,50,000	150.95
7	Bagalkot	6588	7,17,000	5,07,000	141.42
8	Raichur	8,358	8,39,000	6,48,000	129.48
9	Vijayapura	10498	10,90,000	9,34,000	116.7
10	Yadgiri	5160	4,95,000	3,96,000	125
11	Gadag	4657.15	5,00,000	3,40,000	147.06
12	Haveri	4851	5,60,000	3,76,000	148.94
13	Koppal	5,525	5,49,000	4,13,000	132.93

Table 2: Cropping Intensity in the districts of Middle Krishna Basin

Sl.No	Districts	Total Geographical Area (sq.km)	Gross Cropped Area (ha)	Net Sown Area (ha)	Cropping Intensity (%)
1	Prakasam	14323	272000	262000	103.81
2	Palnadu	7300	347000	316000	109.81
3	Nalgonda	7122	346000	311000	111.25
4	Jogulamba Gadwal	2576.54	216574	177116	122
5	Vikarabad	3655	283000	228000	124.12
6	Yadgiri	5160	495000	396000	125
7	Raichur	8358	839000	648000	129.48
8	Rangareddy	5030	231000	172000	134.3

9	Nagarakurnool	6924	338320	250607	135
10	Narayanpet	2336.84	238000	174000	137
11	Mahabubnagar	2751.03	210000	149000	140.94
12	Wanaparthy	2165	193000	122000	157

Table 3: Cropping Intensity in the districts of Lower Krishna Basin

Sl.No	Districts	Total Geographical Area (sq.km)	Gross Cropped Area (ha)	Net Sown Area (ha)	Cropping Intensity (%)
1	Nalgonda	7122	346000	311000	111.25
2	NTR	3315	163600	143300	114
3	Bapatla	3828.84	309000	264000	117.04
4	Bhadradri Kothagudem	7483	200000	163000	122.7
5	Vikarabad	3655	283000	228000	124.12
6	Khammam	4361	360000	273000	131.87
7	Rangareddy	5030	231000	172000	134.3
8	Medchal Malkajgiri	1089.89	20000	11000	137
9	Warangal	1796	167000	121000	138.02
10	Mahabubnagar	2751	210000	149000	140.94
11	Yadadri Bhuvanagiri	3464	189000	134000	141.04
12	Guntur	2440	219000	155900	141.29
13	Jagoan	2188	244000	160000	152.5
14	Siddipet	3652	366000	230000	159.13
15	Hanumakonda	1679	186000	108000	172.22
16	Krishna	3370	302000	171000	177
17	Suryapet	3615	17100000	2498000	687.63

Table 4: Cropping Intensity in the districts of Upper Bhima Basin

Sl.No	Districts	Total Geographical Area (sq.km)	Gross Cropped Area (ha)	Net Sown Area (ha)	Cropping Intensity (%)
1	Vijayapura	10498	1090000	934000	116.7
2	Ahmednagar	17143	1352000	1142243	118.37
3	Sangli	8588.5	612000	488000	125.41
4	Solapur	14895	1103000	850000	132
5	Satara	10480	810000	603000	135
6	Pune	15643	108000	78000	138.46
7	Belgaum	13433	1434000	950000	150.95
8	Beed	10693	1348000	844000	159.72

Table 5: Cropping Intensity in the districts of Lower Bhima Basin

Sl.No	Districts	Total Geographical Area (sq.km)	Gross Cropped Area (ha)	Net Sown Area (ha)	Cropping Intensity (%)
1	Bidar	5448	478000	415000	115.18
2	Kalaburgi	10941	969588	846041	114
3	Vijayapura	10498	1090000	934000	116.7
4	Vikarabad	3655	283000	228000	124
5	Yadgiri	5160	495000	396000	125
6	Sangareddy	4498	365000	288000	126.74
7	Solapur	14895	1103000	850000	132

Table 6: Cropping Intensity in the districts of Upper Tungabhadra Basin

Sl.No	Districts	Total Geographical Area (sq.km)	Gross Cropped Area (ha)	Net Sown Area (ha)	Cropping Intensity (%)
1	Koppal	5,525	5,49,000	4,13,000	132.93
2	Gadag	4657.15	5,00,000	3,40,000	147.06
3	Vijayanagara	5562	4,32,000	3,34,000	129.34
4	Haveri	4851	5,60,000	3,76,000	148.94
5	Davangere	4,489	4,11,000	3,10,000	132.58

6	Uttar Kannada	10277	1,46,000	1,23,000	118.7
7	Shivamogga	8478	3,08,000	2,37,000	129.96
8	Chikkamagaluru	7220.75	4,16,000	2,70,000	154.07
9	Chitradurga	7707	5,79,000	4,46,000	129.82

Table 7: Cropping Intensity in the districts of Lower Tungabhadra Basin

Sl.No	Districts	Total Geographical Area (sq.km)	Gross Cropped Area (ha)	Net Sown Area (ha)	Cropping Intensity (%)
1	Raichur	8,358	8,39,000	6,48,000	129.48
2	Ballari	4000	3,23,000	2,51,000	135.71
3	Chitradurga	7707	5,79,000	4,46,000	129.82
4	Tumakuru	10597	3,25,000	2,27,000	143.17
5	Hassan	6814	55971.3	41716.6	134.17
6	Chikkamagaluru	7220.75	4,16,000	2,70,000	154.07
7	Koppal	5,525	5,49,000	4,13,000	132.93
8	Vijayanagara	5562	4,32,000	3,34,000	129.34
9	Davangere	4,489	4,11,000	3,10,000	132.58
10	Kurnool	7977	4,19,000	3,91,000	106.07
11	Ananthapur	10,200	570686	528753	106
12	SriSatyaSai	8925.65	3.23.000	1,72,000	107
13	Nandyal	9681	4,06,000	3,95,000	102.52
14	Jogulamba Gadwal	2576.54	2,16,574	1,77,116	122

4. Agricultural Land Distribution and Farming Practices

Agricultural land distribution and farming practices play a significant role in determining the agricultural productivity, water utilization patterns, and socio-economic conditions within the Krishna River Basin. The basin supports diverse agricultural activities due to variations in climate, soil characteristics, topography, and availability of irrigation facilities across different regions. Agricultural land within the basin is distributed among various categories of landholdings ranging from marginal and small farmers to medium and large landholders. Farming practices in the basin include both traditional and modern agricultural techniques, influenced by irrigation availability, crop type, technological adoption, and regional agricultural conditions. The basin is characterized by cultivation of food grains, commercial crops, pulses, oilseeds, and horticultural crops, which contribute significantly to the regional economy and livelihood security.

Assessment of agricultural land distribution and farming practices is essential for understanding cropping patterns, irrigation dependency, land utilization efficiency, and sustainable agricultural development within the basin. The analysis also helps in identifying regions facing agricultural stress due to water scarcity, land degradation, and changing climatic conditions.

4.1 Crop-wise Irrigated Area in Krishna River Basin

Crop-wise irrigated area represents the extent of irrigation support provided to different agricultural crops cultivated within the Krishna River Basin. Irrigation plays a crucial role in improving crop productivity, ensuring crop stability during dry periods, and supporting multiple cropping practices across the basin. The extent of irrigated area varies among different crops depending on water requirements, climatic conditions, soil characteristics, and availability of irrigation infrastructure. Major crops cultivated in the basin such as sugarcane, cotton, rice, maize, groundnut, and chickpea exhibit varying levels of irrigation dependency based on regional agricultural practices and water availability. Analysis of crop-wise irrigated areas provides important insights into agricultural water demand, cropping intensity, and irrigation management within the basin.

The crop-wise irrigated area data has been collected from ICRISAT datasets, where historical agricultural data was available from 1970 to 2020. Based on the availability of long-term data, decadal analysis has been carried out for the years 1970 to 2020 for major crops including sugarcane, cotton, rice, maize, groundnut, and chickpea cultivated within the basin. Tables have been prepared for each selected crop to analyze the variation in irrigated area during the period from 1970 to 2020 across the basin.

Table 8: Maize Irrigated Area in the districts of Krishna River Basin

Maize Irrigated Area (1000ha)							
Source: ICRISAT							
SL.No	Districts	Year					
		1970	1980	1990	2000	2010	2020
1	Chikkamagaluru	0	0	0.02	0	0	0.791
2	Chitradurga	1.1	6	11.83	20.94	32.92	41.702
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	0.2	0	1.06	0.05	6.58	14.224
8	Uttara kannada	0	0	0	0	0.28	2.004
9	Vijayanagara	—	—	—	—	—	—
10	Bagalkot	—	—	—	—	—	—
11	Belgaum	22.1	48	66.54	105.47	122.42	164.11
12	Dharwad	0	7	17.97	55.91	72.6	106.96
13	Kolhapur	1.5	1.9	0.1	0.7	0	0
14	Raichur	0.4	4	5.39	11.77	25.07	24.298
15	Sangli	0.7	1.7	2	4.6	0	0
16	Satara	0.9	0	0.7	3.4	0	0
17	Sindhudurg	—	—	—	—	—	—
18	Vijayapura	8.4	22	48.36	67.28	156.39	146.92
19	Yadgir	—	—	—	—	—	—
20	Ananthapur	0.5	1.4	0.35	2.88	13.06	18.241
21	Kurnool	0.1	0.2	0.213	1.323	11.956	33.13
22	Nandyal	—	—	—	—	—	—
23	Sri satya sai	—	—	—	—	—	—
24	Ballari	1.2	15	16.18	37.62	36.17	34.894
25	Hassan	0.3	0.1	0.07	0.14	5.82	37.97
26	Jogulamba Gadwal	—	—	—	—	—	—
27	Tumkur	0.5	0.5	2.42	4.37	7.25	3.21
28	Ahmednagar	0.8	1.4	3.3	8.3	0	0
29	Beed	0.5	0.8	3.1	2	0	0
30	Osmanabad	1.4	1.7	3.2	1.1	0	0
31	Pune	1.1	1.9	4.6	8.2	0	0
32	Solapur	5.5	13.3	9.2	9.6	0	0
33	Bidar	0.1	0.4	0.11	0.14	0.52	0.857
34	Kalburgi	0.4	0.1	0.3	0.13	4.25	1.736
35	Vikarabad	—	—	—	—	—	—
36	Sangareddy	—	—	—	—	—	—
37	Palnadu	—	—	—	—	—	—
38	Prakasam	—	—	—	—	—	—
39	Mahabubnagar	0	0	0.16	0.76	3.74	0.412
40	Nagar kurnool	—	—	—	—	—	—
41	Nalgonda	0.1	0.1	0.06	0.15	0.14	0.031
42	Narayanpet	—	—	—	—	—	—
43	Rangareddy	—	—	—	—	—	—
44	Wanaparthi	—	—	—	—	—	—
45	Bapatla	—	—	—	—	—	—
46	Guntur	0.4	0.2	0.449	2.007	69.526	45.596
47	Krishna	0.1	0.6	0.98	3.68	17.48	24.43
48	NTR	—	—	—	—	—	—
49	Bhadradi kothagudem	—	—	—	—	—	—
50	Hanumakonda	—	—	—	—	—	—
51	Hyderabad	0.2	0.7	0	0.49	1.85	0.103
52	Jangoan	—	—	—	—	—	—
53	Khammam	0.7	0.4	0.87	2.11	22.58	31.977
54	Siddipet	—	—	—	—	—	—
55	Suryapet	—	—	—	—	—	—
56	Warangal	14.3	17	9.31	16.84	32.89	43.958
57	Yadadri Bhuvangiri	—	—	—	—	—	—
58	Mehaboobabad	—	—	—	—	—	—
59	Medchal Malkajiri	—	—	—	—	—	—

Table 9: Groundnut Irrigated Area in the districts of Krishna River Basin

Groundnut Irrigated Area (1000ha)							
Source: ICRISAT							
SL.No	Districts	Year					
		1970	1980	1990	2000	2010	2020
1	Chikkamagaluru	0	0.6	1.97	1.23	0.28	0.009
2	Chitradurga	25.1	15.8	18.67	12.54	8.86	24.681
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	3.2	2.3	7.65	2	0.4	0.245
8	Uttara kannada	0	0.1	0.11	0.12	0.02	0.4
9	Vijayanagara	—	—	—	—	—	—
10	Bagalkot	—	—	—	—	—	—
11	Belgaum	1.8	5.3	11.71	10.76	9.81	10.224
12	Dharwad	2.1	10.4	17.37	17.88	15.62	33.126
13	Kolhapur	0	0	1.1	2.3	0	0
14	Raichur	19.3	28.7	45.74	48.64	57.51	45.028
15	Sangli	0.4	0.8	7	3	0	0
16	Satara	0.3	0.4	3.1	6.2	0	0
17	Sindhudurg	—	—	—	—	—	—
18	Vijayapura	1.1	9.5	27.69	26.49	62.1	71.766
19	Yadgir	—	—	—	—	—	—
20	Ananthapur	19.3	24.4	35.59	32.19	28.57	72.736
21	Kurnool	43.8	40.5	49.893	39.513	26.996	32.329
22	Nandyal	—	—	—	—	—	—
23	Sri satya sai	—	—	—	—	—	—
24	Ballari	12.6	18.7	35.99	16.98	13.69	24.908
25	Hassan	0	0.2	0.51	3.11	0.52	0.27
26	Jogulamba Gadwal	—	—	—	—	—	—
27	Tumkur	2.3	2	12.32	15.22	3.68	7.114
28	Ahmednagar	2.8	6.6	31.4	13.8	0	0
29	Beed	1.4	2.7	24.9	3.5	0	0
30	Osmanabad	1.8	3.1	13.7	4.8	0	0
31	Pune	1.1	6.7	10.5	7.4	0	0
32	Solapur	8.3	7.4	43.3	15.6	0	0
33	Bidar	0	0.2	1.17	1.04	0.6	0.405
34	Kalburgi	0.9	1	49.29	64.78	37.48	27.052
35	Vikarabad	—	—	—	—	—	—
36	Sangareddy	—	—	—	—	—	—
37	Palnadu	—	—	—	—	—	—
38	Prakasam	—	—	—	—	—	—
39	Mahabubnagar	23.6	28.1	52.8	42.99	97.54	3.883
40	Nagar kurnool	—	—	—	—	—	—
41	Nalgonda	23.3	4.2	22.59	13.04	15.46	7.475
42	Narayanpet	—	—	—	—	—	—
43	Rangareddy	—	—	—	—	—	—
44	Wanaparthi	—	—	—	—	—	—
45	Bapatla	—	—	—	—	—	—
46	Guntur	38	8.1	27.837	4.574	4.636	5.534
47	Krishna	4.7	5	12.93	4.33	1.63	0.274
48	NTR	—	—	—	—	—	—
49	Bhadradi kothagudem	—	—	—	—	—	—
50	Hanumakonda	—	—	—	—	—	—
51	Hyderabad	1.3	1.6	4.88	4.88	8.29	0.878
52	Jangoan	—	—	—	—	—	—
53	Khammam	3.5	5.2	19.16	3.46	4.55	1.676
54	Siddipet	—	—	—	—	—	—
55	Suryapet	—	—	—	—	—	—
56	Warangal	16.2	15.5	47.94	21.84	25.35	4.798
57	Yadadri Bhuvangiri	—	—	—	—	—	—
58	Mehaboobabad	—	—	—	—	—	—
59	Medchal Malkajgiri	—	—	—	—	—	—

Table 10: Chickpea Irrigated Area in the districts of Krishna River Basin

Chickpea Irrigated Area (1000ha)							
Source: ICRISAT							
SL.No	Districts	Year					
		1970	1980	1990	2000	2010	2020
1	Chikkamagaluru	0	0	0	0	0	0.001
2	Chitradurga	0	0	0	0.32	0.1	0.555
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	0	0	0	0	0	0.008
8	Uttara kannada	0	0	0	0	0	0
9	Vijayanagara	—	—	—	—	—	—
10	Bagalkot	—	—	—	—	—	—
11	Belgaum	0.8	2.9	6.78	10.23	20.92	27.781
12	Dharwad	0	0.5	3.56	14.71	17.22	25.106
13	Kolhapur	0.1	0.6	3.6	3.2	0	0
14	Raichur	0.2	0.1	0	0.51	1.97	5.997
15	Sangli	0.9	2.4	4.8	9.3	0	0
16	Satara	3	4.5	5.1	4.7	0	0
17	Sindhudurg	—	—	—	—	—	—
18	Vijayapura	0.1	1.4	6.17	8.89	42.74	8.699
19	Yadgir	—	—	—	—	—	—
20	Ananthapur	0	0.3	1.1	0.77	1.18	0.396
21	Kurnool	0.06	0.284	5.53	1.859	0	0.3
22	Nandyal	—	—	—	—	—	—
23	Sri satya sai	—	—	—	—	—	—
24	Ballari	0.1	4.9	2.78	1.49	22.41	0.394
25	Hassan	0	0	0	0	0	0.227
26	Jogulamba Gadwal	—	—	—	—	—	—
27	Tumkur	0	0	0	0.11	0	0
28	Ahmednagar	5.2	6.3	18	18.8	0	0
29	Beed	2	6.2	14.5	12.3	0	0
30	Osmanabad	2.5	4.6	15.5	16.6	0	0
31	Pune	5.7	5.2	8.1	14.8	0	0
32	Solapur	3.5	4.8	7.4	10.1	0	0
33	Bidar	0	0.4	3.68	1.77	8.22	1.461
34	Kalburgi	0.4	0.1	3.88	0.99	7.01	6.547
35	Vikarabad	—	—	—	—	—	—
36	Sangareddy	—	—	—	—	—	—
37	Palnadu	—	—	—	—	—	—
38	Prakasam	—	—	—	—	—	—
39	Mahabubnagar	0	0	0.01	0.01	0.03	0.02
40	Nagar kurnool	—	—	—	—	—	—
41	Nalgonda	0	0	0	0	0	0.038
42	Narayanpet	—	—	—	—	—	—
43	Rangareddy	—	—	—	—	—	—
44	Wanaparthy	—	—	—	—	—	—
45	Bapatla	—	—	—	—	—	—
46	Guntur	0.1	0	0	0.041	0.02	0.587
47	Krishna	0	0	0	0	0	0.011
48	NTR	—	—	—	—	—	—
49	Bhadradi kothagudem	—	—	—	—	—	—
50	Hanumakonda	—	—	—	—	—	—
51	Hyderabad	0	0	0	0.05	0	0
52	Jangoan	—	—	—	—	—	—
53	Khammam	0	0	0	0.01	0.01	0.028
54	Siddipet	—	—	—	—	—	—
55	Suryapet	—	—	—	—	—	—
56	Warangal	0	0	0.01	0.07	0.14	0.029
57	Yadadri Bhuvangiri	—	—	—	—	—	—
58	Mehaboobabad	—	—	—	—	—	—
59	Medchal Malkajgiri	—	—	—	—	—	—

Table 11: Sugarcane Irrigated Area in the districts of Krishna River Basin

Sugarcane Irrigated Area(1000ha)							
Source : ICRISAT							
Sl.No	District	Year					
		1970	1980	1990	2000	2010	2020
1	Chikkamagaluru	1.5	1.4	1.77	2.04	1.71	0.323
2	Chitradurga	1.9	5.8	8.01	19.03	10.02	2.054
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	5.4	6.4	19.59	10.23	7.69	0.961
8	Uttara kannada	1.50	2.1	2.04	1.36	1.29	13.293
9	Vijayanagara	—	—	—	—	—	—
10	Bagalkot	—	—	—	—	—	—
11	Belgaum	29.6	48	97.86	174.71	282.34	465.183
12	Dharwad	2	2.4	3.78	11.39	14.02	39.897
13	Kolhapur	39.9	20.3	67.8	96.8	0	0
14	Raichur	4.4	5.2	1.88	1.76	2.38	3.708
15	Sangli	19.8	30.4	30.1	54	0	0
16	Satara	13.4	21.1	46.1	47	0	0
17	Sindhudurg	—	—	—	—	—	—
18	Vijayapura	3	11.6	33.69	82.48	176.14	280.851
19	Yadgir	—	—	—	—	—	—
20	Ananthapur	4.4	2.8	2.73	0.82	0.24	0.074
21	Kurnool	0.4	1.5	0.808	0.228	2.781	0.308
22	Nandyal	—	—	—	—	—	—
23	Sri satya sai	—	—	—	—	—	—
24	Ballari	10.1	9.9	8.51	7.17	4.68	15.036
25	Hassan	3.2	3.4	3.92	5.59	9.71	3.129
26	Jogulamba Gadwal	—	—	—	—	—	—
27	Tumkur	2.4	3	2.62	2.33	2.98	0.574
28	Ahmednagar	52	69	66.9	81.6	0	0
29	Beed	2	6.4	22	36.5	0	0
30	Osmanabad	7.5	17.1	39.3	59.7	0	0
31	Pune	16.2	25.3	45.2	66.8	0	0
32	Solapur	15.2	20.3	49.7	74.4	0	0
33	Bidar	5.1	12.4	24.35	30.93	33.34	17.337
34	Kalburgi	1.1	2.3	4.44	8.67	24.86	33.901
35	Vikarabad	—	—	—	—	—	—
36	Sangareddy	—	—	—	—	—	—
37	Palnadu	—	—	—	—	—	—
38	Prakasam	—	—	—	—	—	—
39	Mehabubnagar	0.1	0.1	0.12	0.07	2.03	0.126
40	Nagar kurnool	—	—	—	—	—	—
41	Nalgonda	0.0	1.9	1.71	0.19	0.91	0.119
42	Narayanpet	—	—	—	—	—	—
43	Rangareddy	—	—	—	—	—	—
44	Wanaparthi	—	—	—	—	—	—
45	Bapatla	—	—	—	—	—	—
46	Guntur	3	3.8	6.573	3.165	1.765	0.29
47	Krishna	10.4	14.8	13.47	22.47	30.93	8.988
48	NTR	—	—	—	—	—	—
49	Bhadradi kothagudem	—	—	—	—	—	—
50	Hanumakond	—	—	—	—	—	—
51	Hyderabad	1	1.7	1.3	2.39	2.73	0
52	Jangoan	—	—	—	—	—	—
53	Khammam	0.0	0.1	2.03	5.78	6.75	4.981
54	Siddipet	—	—	—	—	—	—
55	Suryapet	—	—	—	—	—	—
56	Warangal	0.0	0.0	0.02	0.0	0.0	0.0
57	Yadadri Bhuvangiri	—	—	—	—	—	—
58	Mehaboobabad	—	—	—	—	—	—
59	Medchal Malkajgiri	—	—	—	—	—	—

Table 12: Cotton Irrigated Area in the districts of Krishna River Basin

Cotton Irrigated Area(1000ha)							
Source: ICRISAT							
Sl.No	District	Year					
		1970	1980	1990	2000	2010	2020
1	Chikkamagaluru	0.0	0.5	0.0	0.15	0.0	0.011
2	Chitradurga	1.1	3.1	11	3.66	13.5	3.89
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	0	0.3	1.08	0.0	0.0	0.173
8	Uttara kannada	0.0	0.0	0.02	0.0	0.0	0.0
9	Vijayanagara	—	—	—	—	—	—
10	Bagalkot	—	—	—	—	—	—
11	Belgaum	7.6	12.6	31.49	17.01	13.28	11.877
12	Dharwad	0.8	7.7	26.72	8.66	27.08	26.145
13	Kolhapur	0	0	0	0	0	0
14	Raichur	40.7	8.1	17.48	8.46	12.91	65.026
15	Sangli	1.7	1.8	1.3	3.3	0	0
16	Satara	7.2	5.6	0.9	5.6	0	0
17	Sindhudurg	—	—	—	—	—	—
18	Vijayapura	8.2	13	5.35	14.87	10.48	31.67
19	Yadgir	—	—	—	—	—	—
20	Ananthapur	0.4	5.1	6.99	5.16	1.77	5.298
21	Kurnool	0.4	3.5	9.674	23.165	18.635	17.357
22	Nandyal	—	—	—	—	—	—
23	Sri satya sai	—	—	—	—	—	—
24	Ballari	1.7	18.8	43.28	10	18.05	21.163
25	Hassan	0	0	0.13	0.3	0	0.322
26	Jogulamba Gadwal	—	—	—	—	—	—
27	Tumkur	0	0.5	0.18	0.5	0.7	1.609
28	Ahmednagar	8.5	17.2	0.4	6.9	0	0
29	Beed	2.3	6.7	10.3	19	0	0
30	Osmanabad	0.1	0.1	0	0	0	0
31	Pune	7.6	5.6	0	0.7	0	0
32	Solapur	7.6	10.3	0.7	5.9	0	0
33	Bidar	0	0.1	0.25	0.01	0.01	0.082
34	Kalburgi	0	1.4	0.91	8.49	34.36	62.358
35	Vikarabad	—	—	—	—	—	—
36	Sangareddy	—	—	—	—	—	—
37	Palnadu	—	—	—	—	—	—
38	Prakasam	—	—	—	—	—	—
39	Mehabubnagar	0.1	0.2	3.09	5.62	6.32	16.132
40	Nagar kurnool	—	—	—	—	—	—
41	Nalgonda	0.0	0.5	0.38	1.47	0.31	26.223
42	Narayanpet	—	—	—	—	—	—
43	Rangareddy	—	—	—	—	—	—
44	Wanaparthi	—	—	—	—	—	—
45	Bapatla	—	—	—	—	—	—
46	Guntur	6.3	4.5	18.914	23.926	40.579	60.449
47	Krishna	3.6	0.4	0.06	0.11	1.03	2.262
48	NTR	—	—	—	—	—	—
49	Bhadradi kothagudem	—	—	—	—	—	—
50	Hanumakond	—	—	—	—	—	—
51	Hyderabad	0	0.1	0	0	0	0
52	Jangoan	—	—	—	—	—	—
53	Khammam	0.0	0.2	2.89	12.43	15.26	59.702
54	Siddipet	—	—	—	—	—	—
55	Suryapet	—	—	—	—	—	—
56	Warangal	0.0	0.8	28.49	73.0	114.0	57.7
57	Yadadri Bhuvangiri	—	—	—	—	—	—
58	Mehaboobabad	—	—	—	—	—	—
59	Medchal Malkajgiri	—	—	—	—	—	—

Table 13: Rice Irrigated Area in the districts of Krishna River Basin

Rice Irrigated Area (1000ha)							
Source: ICRISAT							
Sl.No	District	Year					
		1970	1980	1990	2000	2010	2020
1	Chikkamagaluru	28.2	21.4	15.32	14.18	15.4	3.292
2	Chitradurga	47.6	48	57.25	130.57	155.93	130.276
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	136.9	141.9	131.36	113.37	97.35	57.311
8	Uttara kannada	17.8	13.3	12.42	9.95	8.47	2.952
9	Vijayanagara	—	—	—	—	—	—
10	Bagalkot	—	—	—	—	—	—
11	Belgaum	18.2	10.3	5.74	9.31	7.06	5.252
12	Dharwad	61	41.7	24.88	42.32	41.19	39.601
13	Kolhapur	5.7	5.9	3	2.8	0	0
14	Raichur	52.6	68.1	104.06	209.69	252.77	448.769
15	Sangli	5.3	7	4.3	2.1	0	0
16	Satara	10.5	9.9	16.3	7.8	0	0
17	Sindhudurg	—	—	—	—	—	—
18	Vijayapura	3.4	1.1	0	0.25	0.21	0.307
19	Yadgir	—	—	—	—	—	—
20	Ananthapur	71.3	51.8	45.93	61.85	59.68	35.735
21	Kurnool	92.7	102.8	95.352	125.948	162.04	136.594
22	Nandyal	—	—	—	—	—	—
23	Sri satya sai	—	—	—	—	—	—
24	Ballari	27.8	28.9	42	84.01	130.68	181.895
25	Hassan	36.6	55	47.61	68.24	50.18	27.266
26	Jogulamba Gadwal	—	—	—	—	—	—
27	Tumkur	38.9	36.4	16.46	55.5	34.08	4.064
28	Ahmednagar	1.8	2.4	0.8	0	0	0
29	Beed	1.9	3.1	6.5	0	0	0
30	Osmanabad	7.1	6.1	16	0	0	0
31	Pune	3.7	5.4	3	0.5	0	0
32	Solapur	2	1.4	3.4	0.1	0	0
33	Bidar	2.6	2.2	3.03	3.44	2.74	1.162
34	Kalburgi	11.2	6.6	11.26	28.45	98.83	155.009
35	Vikarabad	—	—	—	—	—	—
36	Sangareddy	—	—	—	—	—	—
37	Palnadu	—	—	—	—	—	—
38	Prakasam	—	—	—	—	—	—
39	Mehabubnagar	108.9	125.8	127.34	159.26	192.71	95.206
40	Nagar kurnool	—	—	—	—	—	—
41	Nalgonda	208.8	183.6	269.34	262.3	405.32	345.953
42	Narayanpet	—	—	—	—	—	—
43	Rangareddy	—	—	—	—	—	—
44	Wanaparthy	—	—	—	—	—	—
45	Bapatla	—	—	—	—	—	—
46	Guntur	305.8	367.5	364.979	368.916	401.575	295.834
47	Krishna	346	398	376.88	392.93	355.16	338.617
48	NTR	—	—	—	—	—	—
49	Bhadradi kothagudem	—	—	—	—	—	—
50	Hanumakond	—	—	—	—	—	—
51	Hyderabad	45.4	42.2	54.38	56.49	51.99	68.047
52	Jangoan	—	—	—	—	—	—
53	Khammam	73.3	90.5	132.68	147.62	183.97	203.78
54	Siddipet	—	—	—	—	—	—
55	Suryapet	—	—	—	—	—	—
56	Warangal	127.1	123.8	179.17	213.59	263.1	99.139
57	Yadadri Bhuvangiri	—	—	—	—	—	—
58	Mehaboobabad	—	—	—	—	—	—
59	Medchal Malkajgiri	—	—	—	—	—	—

5. Irrigated Land and Major Irrigation Sources

Irrigation plays a crucial role in supporting agricultural productivity and ensuring water availability for crop cultivation in the Krishna River Basin. Due to the spatial and temporal variability of rainfall across the basin, irrigation systems are essential for sustaining agricultural activities throughout different cropping seasons. The basin comprises diverse irrigation practices supported by both surface water and groundwater resources. Major irrigation sources in the basin include canals, wells, tanks, and other minor irrigation systems, which collectively contribute to enhancing crop production and rural livelihoods. The extent and distribution of irrigated land vary across the basin depending on factors such as water availability, climatic conditions, topography, soil characteristics, and infrastructure development. Assessment of irrigated land and irrigation sources is important for understanding agricultural water utilization patterns, irrigation dependency, and sustainable water resource management within the Krishna River basin.

5.1. Area under irrigation by source: Canals, Wells, Tanks and Other Sources

The area under irrigation by different sources reflects the dependency of agricultural activities on available water resources within the Krishna River Basin. Irrigation in the basin is primarily supported through canals, wells, tanks, and other minor irrigation sources, each contributing differently based on regional hydrogeological and climatic conditions. Canal irrigation forms a major source in command areas supported by reservoirs and river diversion structures, while wells constitute an important groundwater-based irrigation source in several regions of the basin. Tanks and other traditional water storage systems also play a significant role, particularly in semi-arid and rural areas where surface water availability is limited. The variation in irrigation source utilization across the basin highlights differences in water accessibility, agricultural practices, and irrigation infrastructure development.

The irrigated land and irrigation source data for the Krishna River Basin has been compiled using secondary information collected from NABARD Annual Reports (2025–2026) of the respective districts falling within the four states of the basin. The district-wise data has been consolidated and analyzed to prepare a comprehensive irrigation source profile for the entire Krishna River basin.

Canals: The spatial distribution of agricultural area irrigated by the canals within the Krishna River Basin based on district-wise classifications of high, medium, and low agricultural extent. Districts such as Ahmednagar, Bagalkot, Jogulamba Gadwal, Khammam, NTR, Krishna, and Suryapet exhibit high agricultural area coverage, indicating intensive agricultural activities and greater cultivated land extent. Medium agricultural distribution is observed in districts like Satara, Gadag, Vijayanagara, and Mahabubnagar, while several districts across the basin fall under low agricultural coverage. Some districts are marked

with unavailable data, highlighting gaps in agricultural information within certain regions of the basin. The Canals Irrigated area in the districts of Krishna River Basin is shown in figure 8 below.

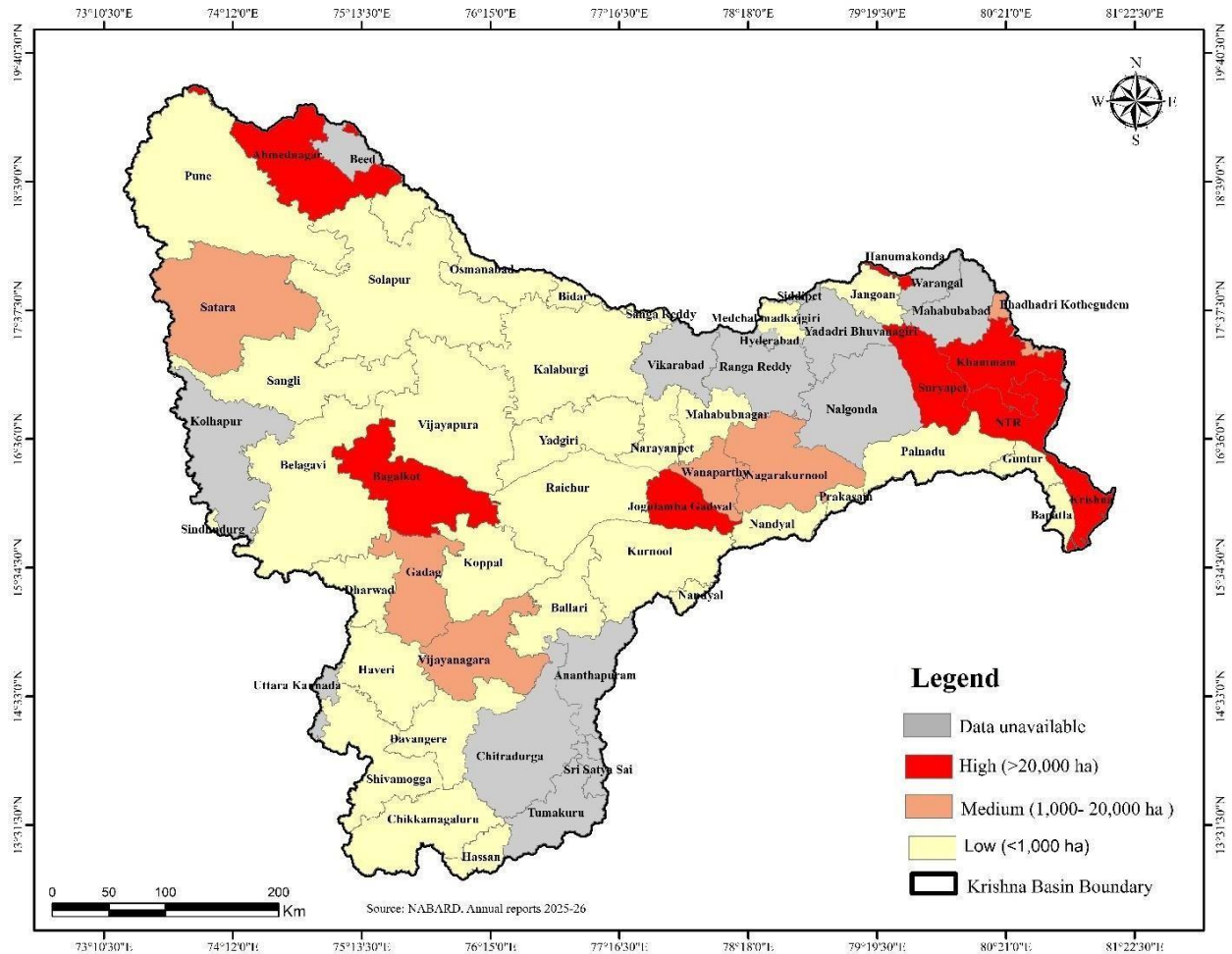


Figure 8: Canals Irrigated area in the districts of Krishna River Basin

Wells: The spatial distribution of agricultural area irrigated by wells in Krishna River Basin is categorized into high, medium, and low agricultural land extent. High agricultural concentration is observed in districts such as Vijayapura, Bagalkot, Koppal, Vijayanagara, Khammam, and Jogulamba Gadwal, indicating intensive cultivation and greater agricultural activity. Medium agricultural coverage is seen in districts like NTR and Krishna, while several districts across the basin fall under low agricultural extent, with some regions showing unavailable data. The Wells Irrigated area in the districts of Krishna River Basin is shown in figure 9 below.

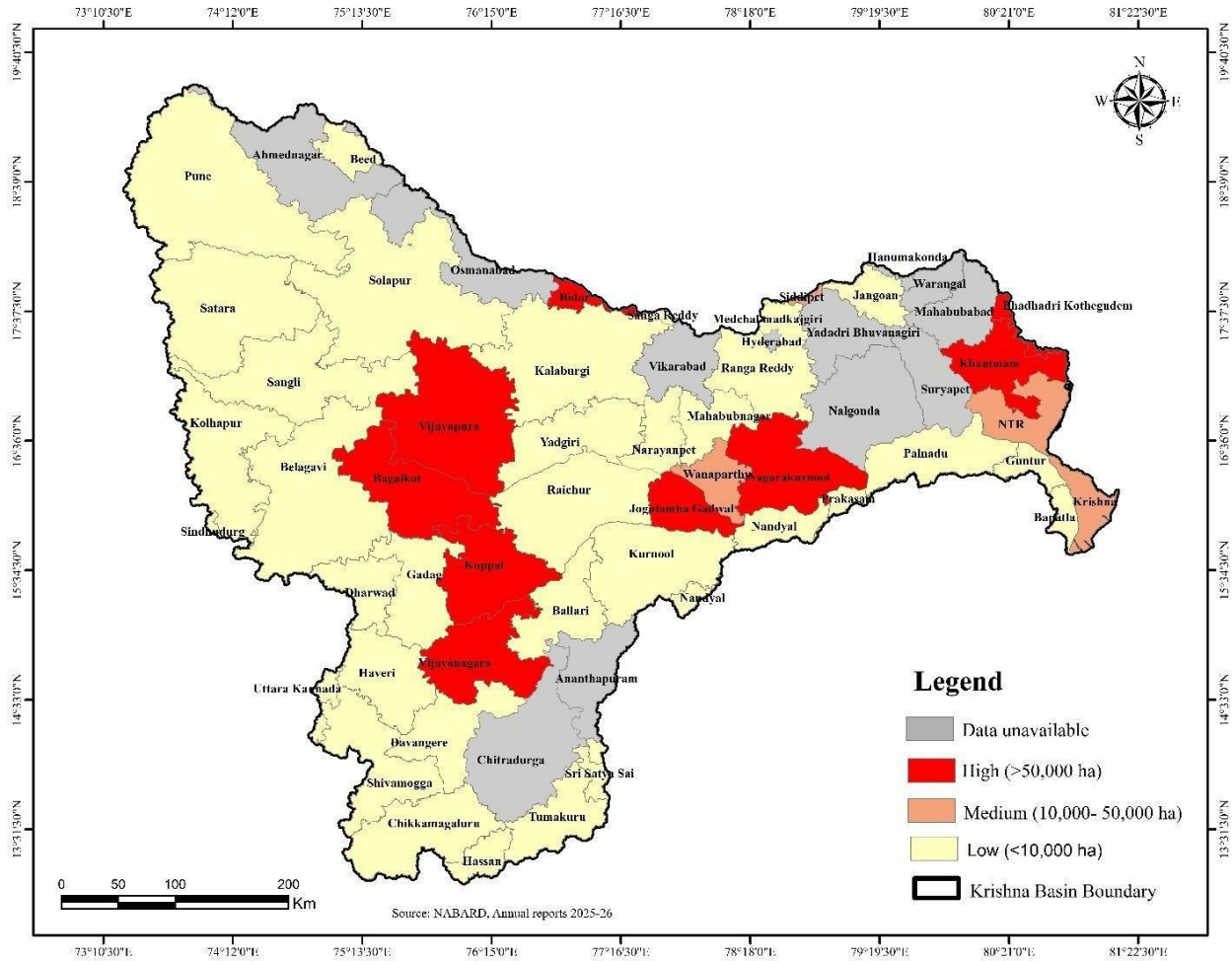


Figure 9: Wells Irrigated area in the districts of Krishna River Basin

Tanks: High agricultural concentration is mainly observed in districts such as Wanaparthy, Suryapet, Khammam, and NTR, while medium agricultural coverage is seen in districts like Vijayapura, Gadag, Vijayanagara, Mahabubnagar, and Krishna. Several districts in the western and central parts of the basin show low agricultural extent or unavailable data, indicating regional variations in cultivation and land utilization patterns. The Tanks Irrigated area in the districts of Krishna River Basin is shown in figure 10 below.

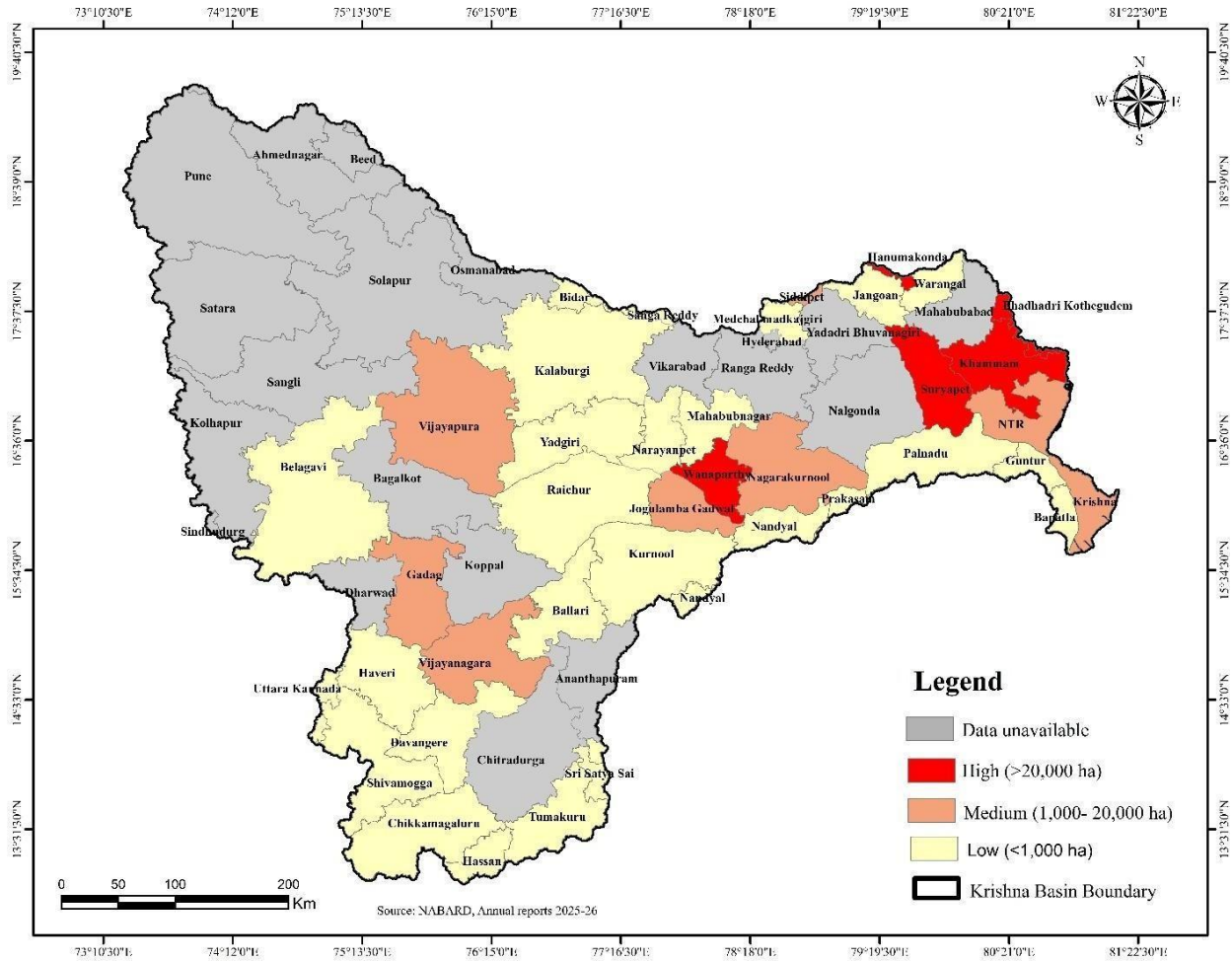


Figure 10: Tanks Irrigated area in the districts of Krishna River Basin

Other Sources: High agricultural concentration is prominently observed in districts such as Vijayapura, Bagalkot, Gadag, and Suryapet, indicating intensive cultivation and greater agricultural activity. Medium agricultural coverage is seen in districts like Khammam, NTR, Mahabubnagar, and Vijayanagara, while several districts across the basin exhibit low agricultural extent or unavailable data. The Other Sources Irrigated area in the districts of Krishna River Basin is shown in figure 11 below.

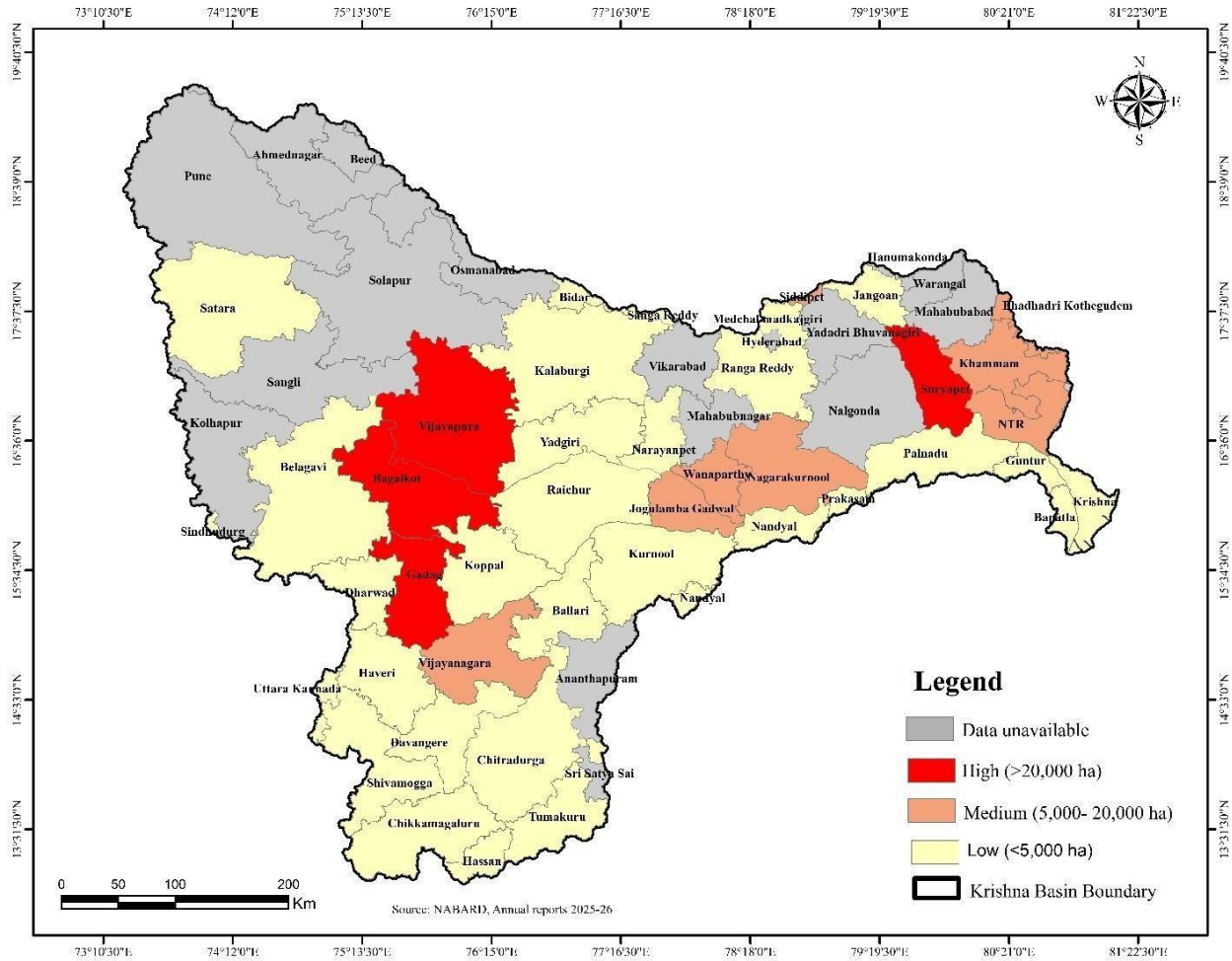


Figure 11: Other Sources Irrigated area in the districts of Krishna River Basin

5.2 Status of Groundwater Recharge

Groundwater recharge refers to the process through which rainfall, river seepage, surface runoff, and irrigation return flow infiltrate into the ground and replenish aquifers within the basin area. It plays a crucial role in maintaining the hydrological balance of the basin by supporting river base flow, sustaining groundwater availability, and meeting agricultural and domestic water demands. The extent of recharge in a river basin depends on factors such as rainfall distribution, soil type, geology, land use, and watershed management practices.

The Groundwater Recharge data used in this study has been obtained from the report of dynamic ground water resources of India, 2023. The Groundwater recharge is classified into Monsoon season and non-monsoon season for each district of the Krishna River Basin. District-wise tables are presented in the following sections.

5.2.1 Groundwater Recharge in Monsoon Period

The spatial distribution of groundwater recharge from monsoon rainfall across the Krishna River Basin districts. High recharge zones (>55,000 HAM) are concentrated in the northern and northwestern districts, particularly in parts of Maharashtra and northern Karnataka, while low recharge areas (<25,000 HAM) are mainly found in the southern districts of Karnataka and Andhra Pradesh. Most of the basin falls under the medium recharge category (25,000–55,000 HAM), indicating moderate groundwater replenishment during the monsoon season. The Groundwater Recharge in Monsoon season from Rainfall in the districts of Krishna River Basin is represented in figure 12 below.

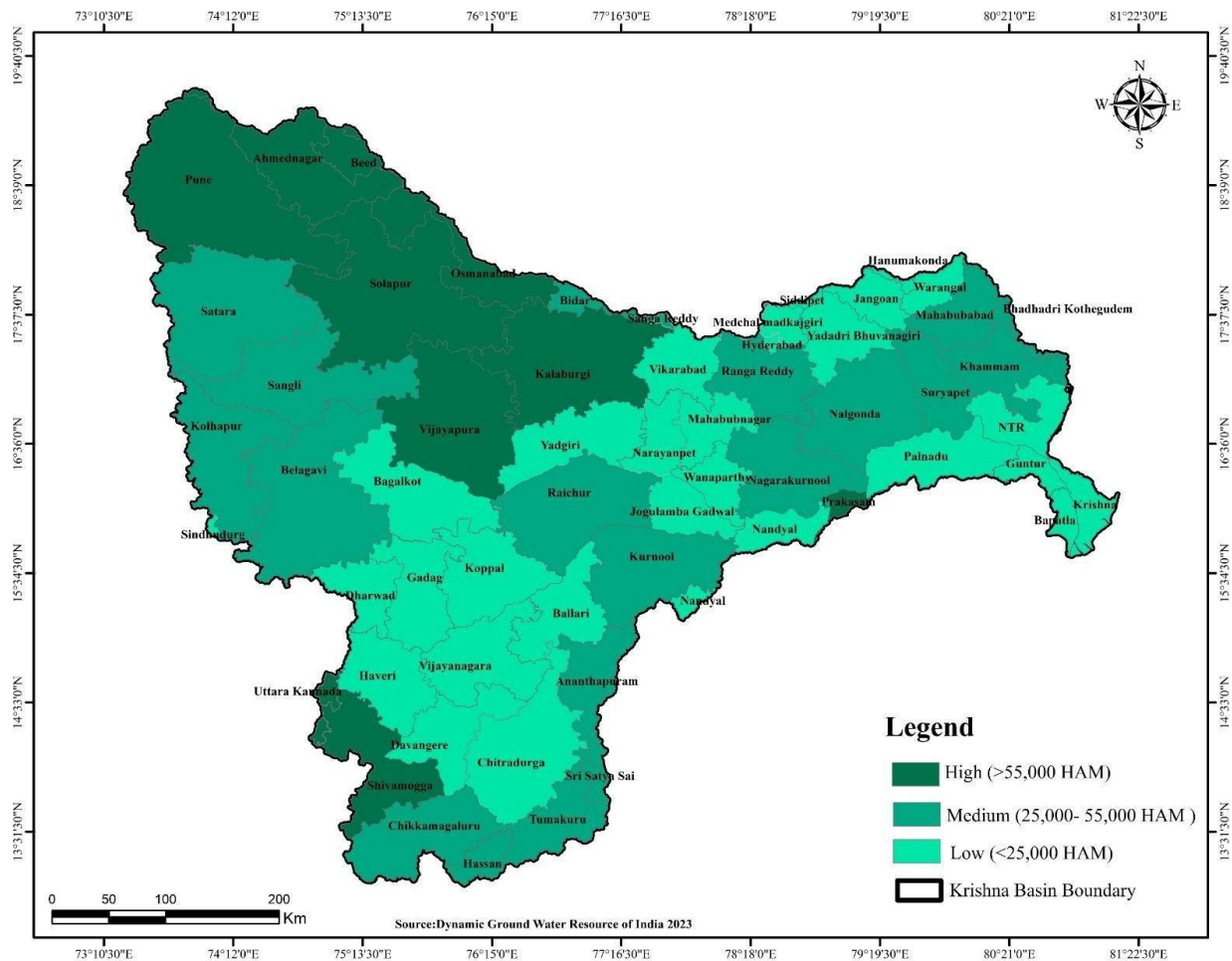


Figure 12: Groundwater Recharge in Monsoon season from Rainfall in the districts of Krishna River Basin

The spatial distribution of groundwater recharge during the monsoon season from other sources across Krishna River Basin districts. High recharge (>35,000 HAM) is concentrated in parts of eastern Telangana–Andhra Pradesh and some south-central districts, while low recharge (<15,000 HAM) occurs mainly in northern Maharashtra districts and parts of central/southern Karnataka, with much of the basin falling in the medium category. The Groundwater Recharge in Monsoon season from Other Sources in the districts of Krishna River Basin is represented in figure 13 below.

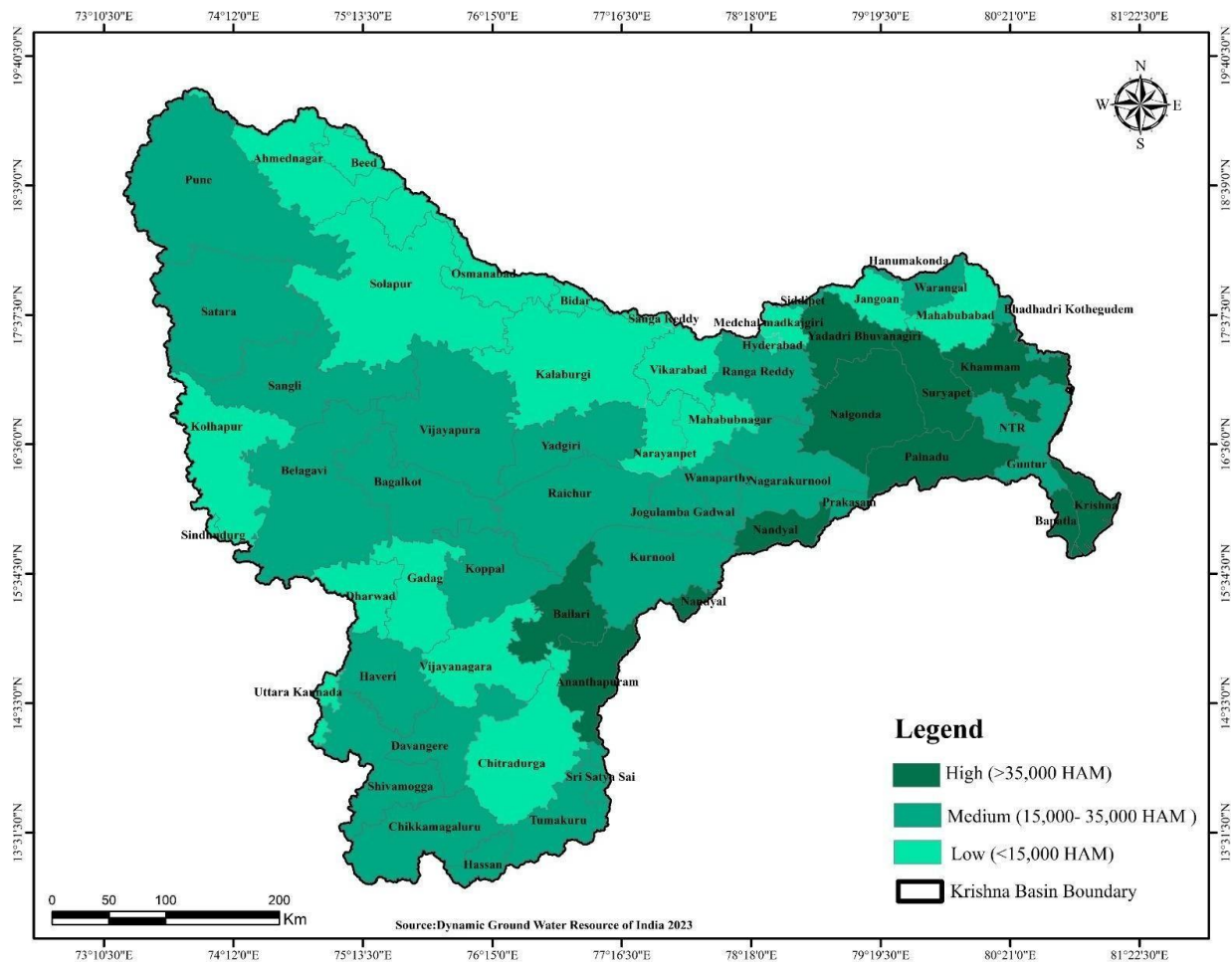


Figure 13: Groundwater Recharge in Monsoon season from Other Sources in the districts of Krishna River Basin

Table 14: Groundwater Recharge in Monsoon season in the districts of Krishna River Basin

Sl.No	Districts	Ground Water Recharge (Hectare - Metre)	
		Monsoon Season	
		Recharge from rainfall	Recharge from other sources
1	Bagalkot	21631.68	22330.06
2	Ballari	13976.06	40070.53
3	Belagavi	52574.7	24110.65
4	Bidar	31175.27	3568.32
5	Chikkamagaluru	32413.5	21149.89
6	Chitradurga	24985.26	9679.42
7	Davanagere	15438.88	32654.75
8	Dharwad	14918.27	6807.63
9	Gadag	11516.25	10500.7
10	Hassan	30019.39	25652.84
11	Haveri	15113.86	33945.76
12	Kalburgi	56575.11	6220.58
13	Koppal	17042.03	30438.45
14	Raichur	32447.04	33612.12
15	Shivamogga	61937.02	27058.57
16	Tumakuru	43088.23	15074.71
17	Uttara Kannada	80697.72	3676.62
18	Vijayanagara	21482.69	8350.51
19	Vijayapura	71998.06	21398.03
20	Yadgir	22412.41	20715.91
21	Ananthapur	41549.90	43716.95
22	Bapatla	23564.31	36845.21
23	Guntur	10346.15	22526.88
24	Krishna	23700.04	90011.45
25	Kurnool	37888.27	22869.19
26	NTR	20116.16	31641.94
27	Nandyal	22411.99	52414.99
28	Palnadu	17343.91	54608.72
29	Prakasam	60916.02	17698.69
30	Sri Sathya Sai	43246.69	31270.86
31	Ahmednagar	86,962.71	13,325.98
32	Beed	81,954.00	8,594.96
33	Osmanabad	61,164.17	6,447.24
34	Kolhapur	53,581.01	10,136.48
35	Sangli	53,003.49	21,603.95
36	Satara	52,487.27	19,022.28
37	Solapur	92,306.09	10,918.84
38	Sindhudurg	20,825.21	196.12
39	Pune	94222.19	19663.71
40	Bhadradi Kothagudem	52283.03	32305.56
41	Hanumakonda	13420.48	17806.36
42	Hyderabad	768.78	1817.17
43	Jangaon	14477.91	12649.88
44	Jogulamba Gadwal	8911.14	23026.77
45	Khammam	30687.21	64711.52
46	Mahabubabad	30722.16	14719.84
47	Mahabubnagar	13712.85	8493.58
48	Medchal Malkajgiri	4454.02	2487.01
49	Nagarkurnool	27796.73	24791.41
50	Nalgonda	33704.71	52040.10
51	Narayanpet	10462.68	10543.5
52	Rangareddy	26148.94	15117.16
53	Sangareddy	29188.85	5132.44
54	Siddipet	21790.34	21202.2
55	Suryapet	25497.25	66860.97
56	Vikarabad	21087.21	13574.71
57	Wanaparthy	8560.73	27413.84
58	Warangal	11947.08	22906.56
59	Yadadri Bhuvanagiri	19417.99	35063.48

5.2.2 Groundwater Recharge in Non-Monsoon Period

The spatial distribution of groundwater recharge from rainfall during the non-monsoon season across the Krishna River Basin. Most districts fall under the low to medium recharge categories (<10,000 HAM), while a few districts in western Maharashtra, Karnataka, and parts of Telangana exhibit relatively high recharge levels (>10,000 HAM), indicating localized groundwater replenishment outside the monsoon period. The Groundwater Recharge in Non-Monsoon season from Rainfall in the districts of Krishna River Basin is represented in figure 14 below.

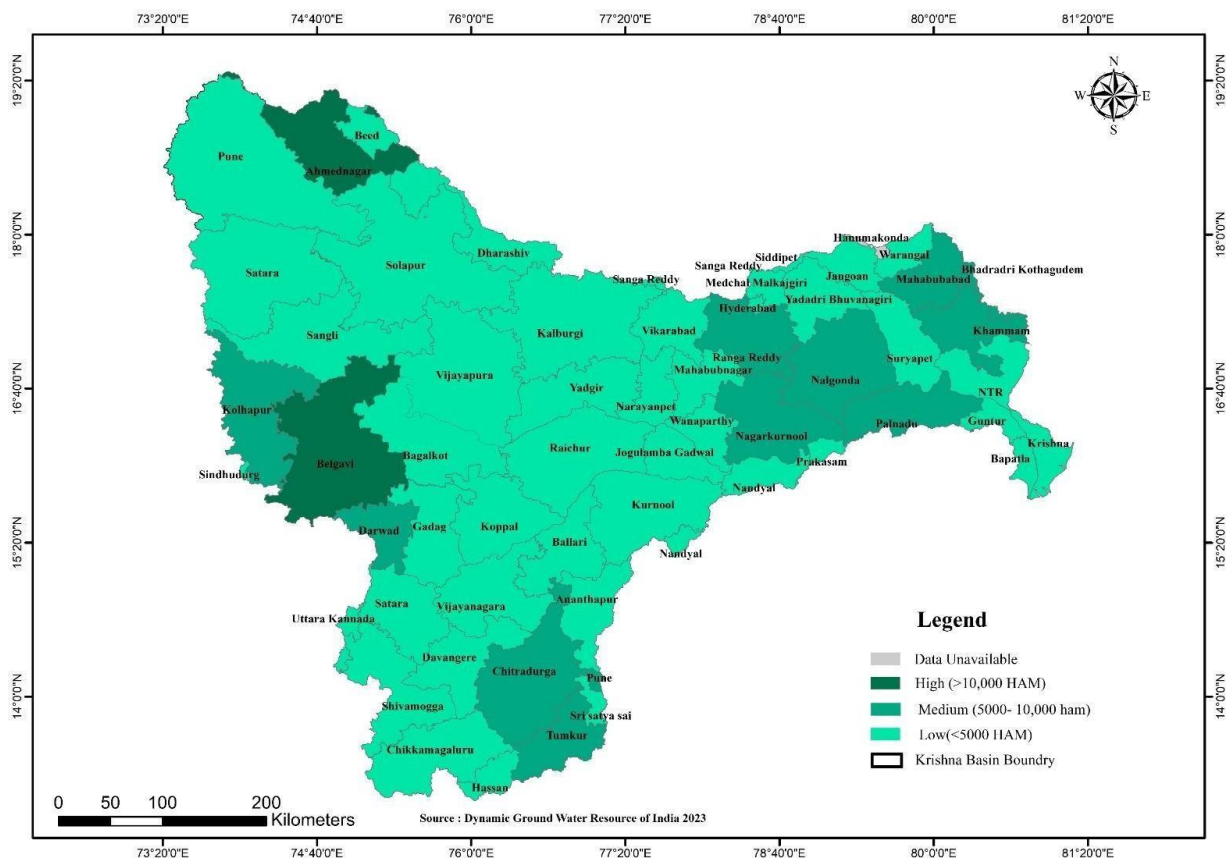


Figure 14: Groundwater Recharge in Non-Monsoon season from Rainfall in the districts of Krishna River Basin

The groundwater recharge from other sources during the non-monsoon season in the Krishna River Basin. High recharge areas (>35,000 HAM) are concentrated in several districts of Maharashtra, Telangana, and Andhra Pradesh, while central and southern districts of Karnataka generally exhibit low to medium recharge levels, highlighting spatial variations in groundwater replenishment outside the monsoon period. The Groundwater Recharge in Non-Monsoon season from Other Sources in the districts of Krishna River Basin is represented in figure 15 below.

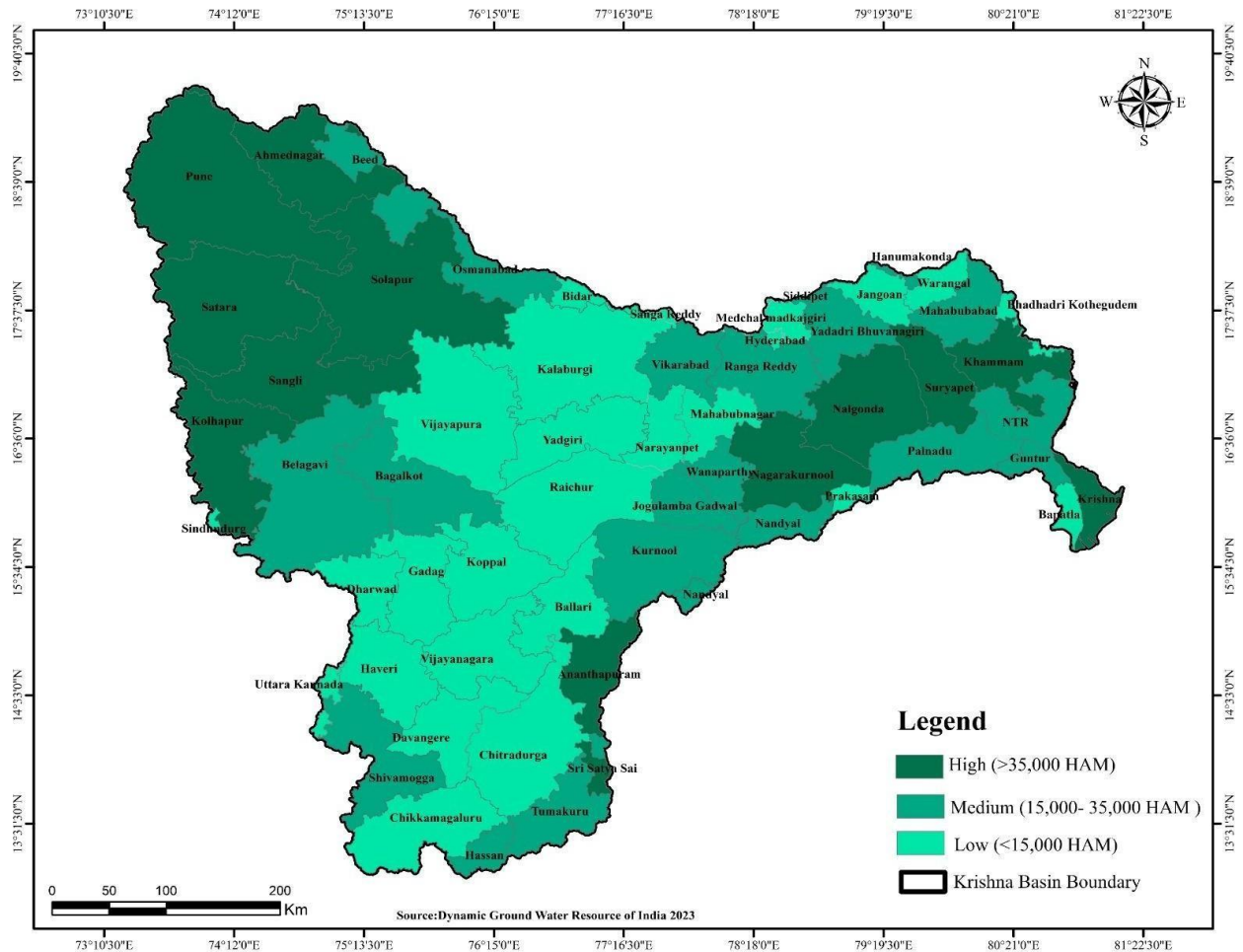


Figure 15: Groundwater Recharge in Non-Monsoon season from Other Sources in the districts of Krishna River Basin

Table 15: Groundwater Recharge in Non-Monsoon season in the districts of Krishna River Basin

Sl.No	District	Groun Water Recharge (Hectare - Metre)	
		Non-Monsoon Season	
		Recharge from rainfall	Recharge from other sources
1	Bagalkot	1748.07	26367.4
2	Ballari	2093.77	12640.77
3	Belagavi	15457.87	33788.16
4	Bidar	50.07	2832.98
5	Chikkamagaluru	2598.49	13667.56
6	Chitradurga	5314.75	6497.39
7	Davanagere	3087.02	11427.46
8	Dharwad	3638.49	6951.27
9	Gadag	4716.6	8654.66
10	Hassan	2036.48	21589.1
11	Haveri	6570.64	10173.55
12	Kalburgi	835.2	8358.98
13	Koppal	2300.28	15395.99
14	Raichur	2772.65	8476.79
15	Shivamogga	1291.5	16208.9
16	Tumakuru	9448.31	15406.17
17	Uttara Kannada	1196.29	7341.55
18	Vijayanagara	3441.07	7641.73
19	Vijayapura	561.19	12039.89
20	Yadgir	299.37	13160.11
21	Ananthapuramu	641.38	37402.50
22	Bapatla	1344.37	13371.33
23	Guntur	4321.07	20783.20
24	Krishna	4196.69	82260.96
25	Kurnool	566.53	15764.23
26	NTR	1211.81	19833.5
27	Nandyal	66.46	31552.10
28	Palnadu	9426.81	18922.04
29	Prakasam	994.24	11118.63
30	Sri Sathya Sai	595.26	42917.36
31	Ahmednagar	14,393.47	45,925.63
32	Beed	6,159.28	33,297.23
33	Osmanabad	2,583.65	15,718.09
34	Kolhapur	780.56	71,662.02
35	Sangli	128.4	65,489.45
36	Satara	3,734.05	37,067.04
37	Solapur	2,954.03	40,096.78
38	Sindhudurg	3.83	2,232.15
39	Pune	1192.62	68192.27
40	Bhadradi Kothagudem	8845.57	14229.78
41	Hanumakonda	0.00	18183.61
42	Hyderabad	285.34	3582.45
43	Jangaon	2547.61	9941.69
44	Jogulamba Gadwal	2662.1	17308.06
45	Khammam	6251.83	38988.87
46	Mahabubabad	411.68	17533.14
47	Mahabubnagar	2664.62	12331.38
48	Medchal Malkajgiri	956.46	1964.19
49	Nagarkurnool	7535.70	35887.15
50	Nalgonda	8784.34	59091.18
51	Narayanpet	2009.57	8880.32
52	Rangareddy	6465.24	24000.44
53	Sangareddy	4649.26	5872.17
54	Siddipet	3978.85	20351.74
55	Suryapet	3750.24	60306.77
56	Vikarabad	2654.99	16267.33
57	Wanaparthy	1976.72	32026.13
58	Warangal	1764.97	15895.28
59	Yadadi Bhuvanagiri	4444.56	33643.9

5.3 Status of Groundwater Extraction

Groundwater extraction is the process of removing water from underground aquifers through wells, borewells, tube wells, and pumps for various purposes such as irrigation, domestic use, and industrial activities. It plays a major role in supporting agriculture and water supply, especially in river basins where surface water availability is limited.

The Groundwater Extraction data used in this study has been obtained from the report of dynamic ground water resources of India, 2023.

5.3.1 Groundwater Extraction for Domestic Use

The spatial distribution of annual groundwater recharge within the Krishna River Basin, categorized into high (>4000 HAM), medium (2000–4000 HAM), and low (<2000 HAM) recharge zones. High recharge areas are predominantly found in western Maharashtra, parts of northern Karnataka, Telangana, and southern Andhra Pradesh, indicating satisfactory groundwater replenishment conditions. Medium recharge zones are widespread across the central part of the basin, while low recharge areas are concentrated in scattered districts of Karnataka, Telangana, and Andhra Pradesh. The Groundwater Extraction for Domestic Use in the districts of Krishna River Basin is shown in figure 16 below.

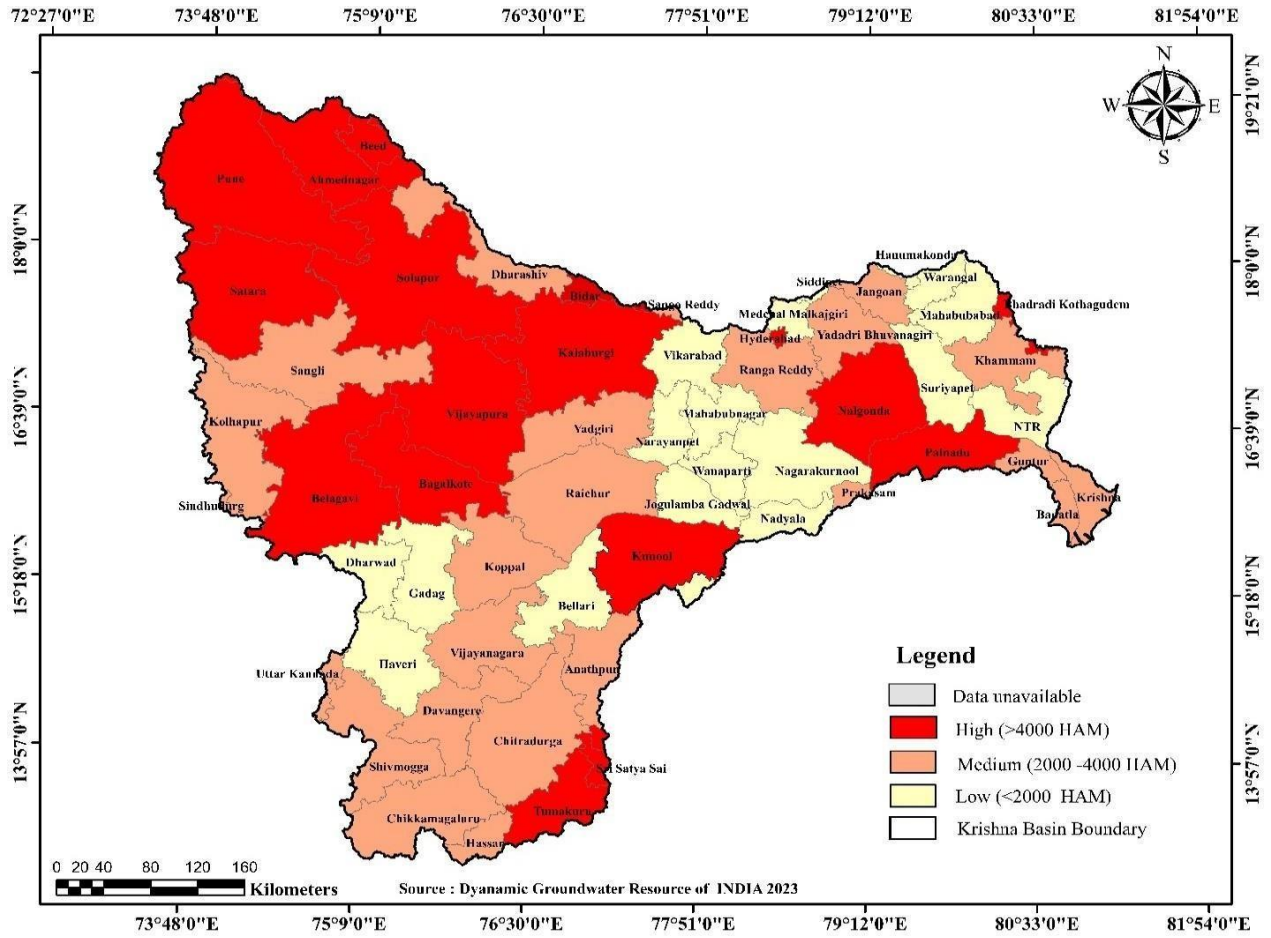


Figure 16: Groundwater Extraction for Domestic Use in the districts of Krishna River Basin

Table 16: Groundwater Extraction for Domestic Use in the districts of Krishna River Basin

SI No	Districts	Groundwater Extraction for Domestic Use (Hactare -Metre)
1	Bagalkot	4395.74
2	Ballari	1935.81
3	Belagavi	12363.56
4	Bidar	4264.98
5	Chikkamagaluru	2476.01
6	Chitradurga	3878.19
7	Davanagere	3621.8
8	Dharwad	1710.36
9	Gadag	660.82
10	Hassan	3038.26
11	Haveri	1947.17
12	Kalburgi	7142.53
13	Koppal	2753.44
14	Raichur	3240.05
15	Shivamogga	2678.67
16	Tumakuru	5722.89
17	Uttara Kannada	3126.83
18	Vijayanagara	2209.38
19	Vijayapura	5012.5
20	Yadgir	2857.96
21	Krishna	2061.21
22	Bapatla	2689.97
23	Guntur	2539.92
24	NTR	1551.26
25	Palnadu	4268.45
26	Kurnool	5277.86
27	Ananthapur	3588.93
28	SriSatyaSai	8856.86
29	Nandyal	503.11
30	Prakasam	3859.6
31	Beed	4774.52
32	Satara	4849.88
33	Sangli	3307.65
34	Sindhudurgh	2219.19
35	Ahmednagar	6196.74
36	Solhapur	4853.01
37	Kolhapur	2079.54
38	Osmanabad/Dharashiv	2315.87
39	Pune	8151.54
40	Bhadradi Kothagudem	4124.61
41	Hanumakonda	1345.6
42	Hyderabad	5247.28
43	Jangaon	2016.83
44	Jogulamba Gadwal	201.26
45	Khammam	3897.2
46	Mahabubabad	1223.38
47	Mahabubnagar	108
48	Mendhal Malkajgiri	673.54
49	Nagarkurnool	822.51
50	Nalgonda	5173.53
51	Narayanpet	127.63
52	Rangareddy	2895.99
53	Sangareddy	2162.71
54	Siddipet	328.07
55	Suryapet	1551.2
56	Vikarabad	511.02
57	Wanaparthy	1173.17
58	Warangal	901.17
59	Yadadi Bhuvanagiri	2560.83

5.3.2 Groundwater Extraction for Irrigation Use

The distribution of groundwater resources within the Krishna River Basin, categorized into high, medium, and low groundwater availability measured in HAM (Hectare-Meters). High groundwater resource zones (>50,000 HAM) are concentrated mainly in the western districts of Maharashtra and parts of southern Karnataka and Andhra Pradesh, indicating significant groundwater potential. Medium groundwater availability (25,000–50,000 HAM) is widespread across central and eastern parts of the basin, while low groundwater resource areas (<25,000 HAM) are scattered throughout Karnataka, Telangana, and Andhra Pradesh. The Groundwater Extraction for Irrigation Use in districts of Krishna River Basin is shown in figure 17 below.

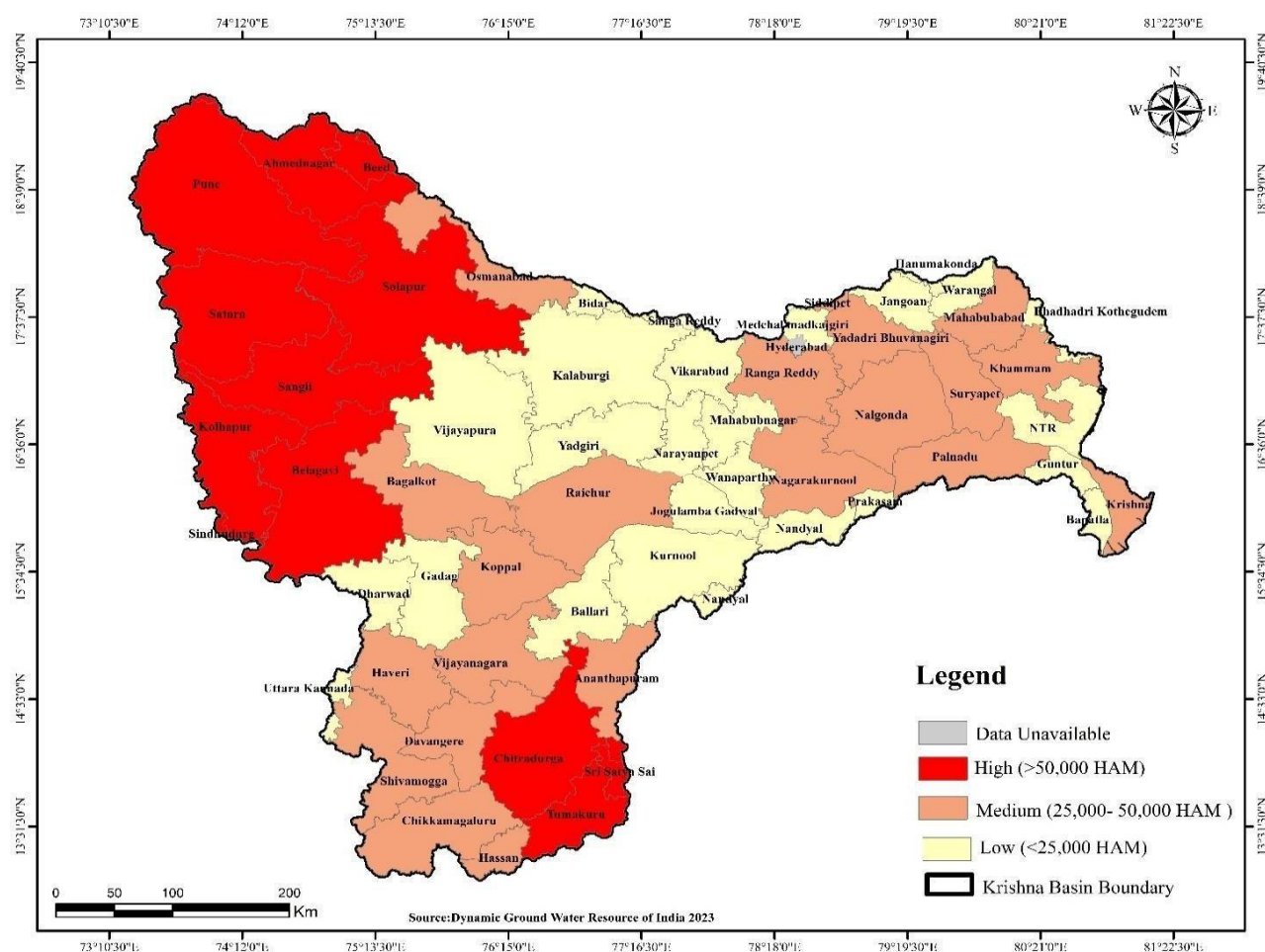


Figure 17: Groundwater Extraction for Irrigation Use in the districts of Krishna River Basin

Table 17: Groundwater Extraction for Irrigation Use in the districts of Krishna River Basin

SI No	Districts	Groundwater Extraction for Irrigation Use (Hactare -Metre)
1	Bagalkot	48589.44
2	Ballari	14686.1
3	Belagavi	64694.57
4	Bidar	15600.4
5	Chikkamagaluru	30960.21
6	Chitradurga	51343.5
7	Davanagere	46245.8
8	Dharwad	14569.69
9	Gadag	23405.27
10	Hassan	47882.71
11	Haveri	34099.16
12	Kalburgi	19615.07
13	Koppal	33746.09
14	Raichur	27814.45
15	Shivamogga	36300.2
16	Tumakuru	62774.52
17	Uttara Kannada	23813.65
18	Vijayanagara	28622.8
19	Vijayapura	33608.46
20	Yadgir	15705.35
21	Krishna	45685.31
22	Bapatla	10900.62
23	Guntur	7902.72
24	NTR	20579.11
25	Palnadu	24219.34
26	Kurnool	11879.53
27	Ananthapur	34880.78
28	SriSatyaSai	54079.04
29	Nandyal	13322.3
30	Prakasam	23626.02
31	Beed	68330.52
32	Satara	60640.59
33	Sangli	67823.88
34	Sindhudurgh	7351.3
35	Ahmednagar	114588.35
36	Solhapur	102898.49
37	Kolhapur	52167.22
38	Osmanabad/Dharashiv	48272.7
39	Pune	112093.74
40	Bhadradri Kothagudem	20583.68
41	Hanumakonda	24519.62
42	Hyderabad	0
43	Jangaon	17680.47
44	Jogulamba Gadwal	11053.98
45	Khammam	36020.75
46	Mahabubabad	26451.34
47	Mahabubnagar	18996.77
48	Mendhal Malkajgiri	20442.48
49	Nagarkurnool	35887.15
50	Nalgonda	48147.21
51	Narayanpet	10839.27
52	Rangareddy	30103.03
53	Sangareddy	24876.31
54	Siddipet	37104.88
55	Suryapet	22714.25
56	Vikarabad	17061.97
57	Wanaparthy	20830.7
58	Warangal	24876.31
59	Yadadri Bhuvanagiri	33236.21

5.3.3 Groundwater Extraction for Industrial Use

The distribution of groundwater extraction within the Krishna River Basin, classified into high (>1000 HAM), medium (200–1000 HAM), and low (<200 HAM) categories. High groundwater extraction is concentrated in several districts of Telangana, particularly Nalgonda, Khammam, and surrounding areas, as well as parts of Karnataka such as Vijayapura. Medium extraction levels are observed across portions of Karnataka and Andhra Pradesh, while most districts fall under the low extraction category. It shows that groundwater use is unevenly distributed across the basin, with certain regions experiencing significantly greater dependence on groundwater resources, highlighting the need for sustainable groundwater management in high-extraction zones. The Groundwater Extraction for Industrial Use in districts of Krishna River Basin is shown in figure 18 below.

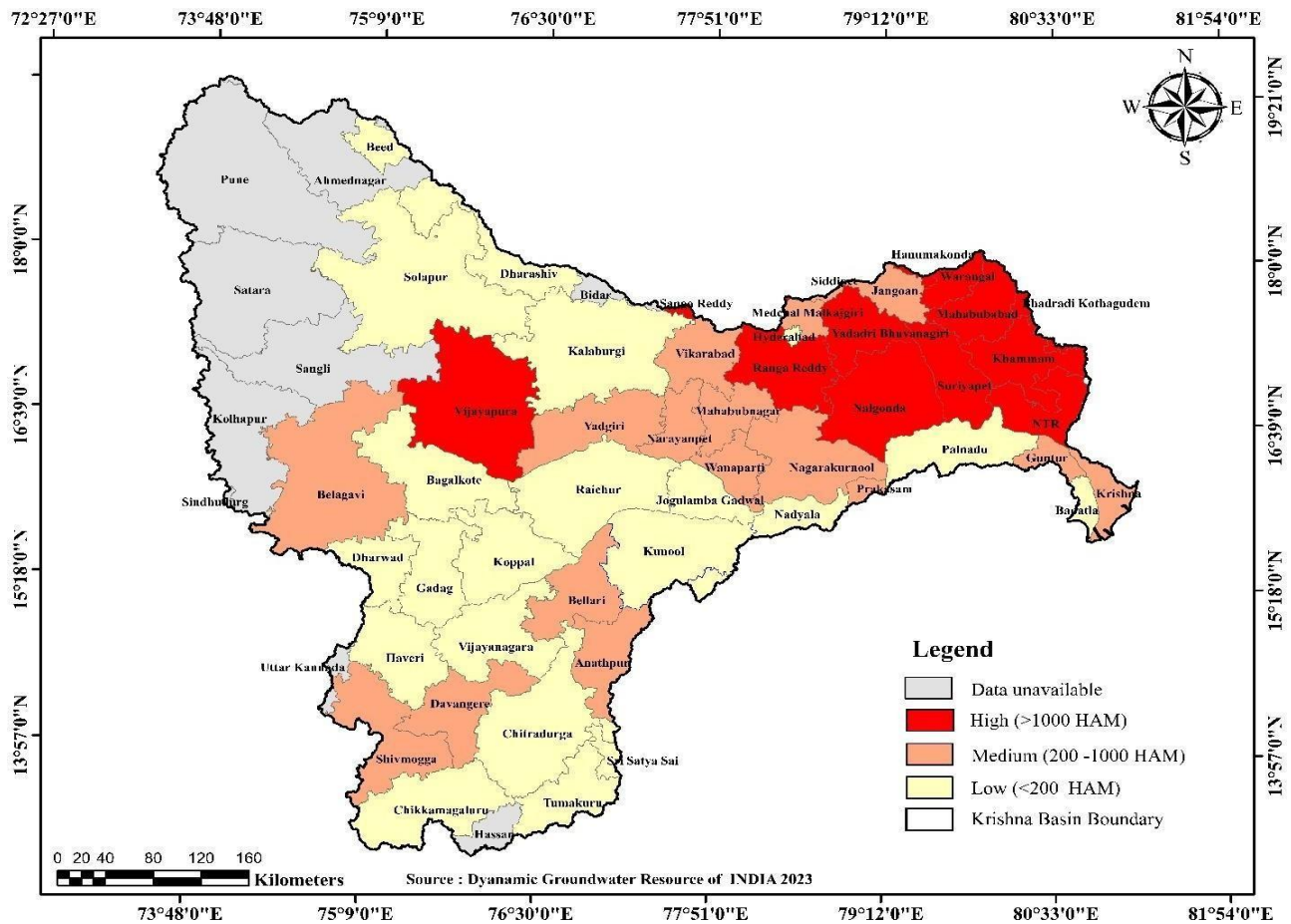


Figure 18: Groundwater Extraction for Industrial Use in the districts of Krishna River Basin

Table 18: Groundwater Extraction for Industrial Use in the districts of Krishna River Basin

SI No	Districts	Groundwater Extraction for Industrial Use (Hactare -Metre)
1	Bagalkot	28.29
2	Ballari	373.6
3	Belagavi	224.81
4	Bidar	0
5	Chikkamagaluru	0.15
6	Chitradurga	95.61
7	Davanagere	228.05
8	Dharwad	76.16
9	Gadag	27.68
10	Hassan	0
11	Haveri	73.02
12	Kalburgi	47.7
13	Koppal	50.76
14	Raichur	172.84
15	Shivamogga	253.83
16	Tumakuru	71.03
17	Uttara Kannada	0
18	Vijayanagara	30.96
19	Vijayapura	18.25
20	Yadgir	882.11
21	Krishna	994.54
22	Bapatla	55.24
23	Guntur	209.65
24	NTR	1137.84
25	Palnadu	81.63
26	Kurnool	59.85
27	Ananthapur	515.59
28	SriSatyaSai	121.32
29	Nandyal	128.4
30	Prakasam	469.79
31	Beed	39.65
32	Satara	0
33	Sangli	0
34	Sindhudurgh	0
35	Ahmednagar	0
36	Solhapur	2.65
37	Kolhapur	0
38	Osmanabad/Dharashiv	0.79
39	Pune	0
40	Bhadradi Kothagudem	3079.2
41	Hanumakonda	1054.28
42	Hyderabad	190.4
43	Jangaon	832.86
44	Jogulamba Gadwal	108.07
45	Khammam	1259.99
46	Mahabubabad	1480.9
47	Mahabubnagar	678.96
48	Mendhal Malkajgiri	950.44
49	Nagarkurnool	302.61
50	Nalgonda	4097.3
51	Narayanpet	376.47
52	Rangareddy	1008.11
53	Sangareddy	1483.19
54	Siddipet	823.3
55	Suryapet	1040
56	Vikarabad	339.24
57	Wanaparthi	256.75
58	Warangal	1231.74
59	Yadadi Bhuvanagiri	3924.58

6. Chemical Fertilizer and Plant Protectant Use

Chemical fertilizer and plant protectant use refers to the application of chemical substances in agriculture to improve crop growth, increase productivity, and protect plants from pests, diseases, and weeds. Chemical fertilizers supply essential nutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K) that enhance soil fertility and support healthy plant development. These fertilizers help farmers achieve higher crop yields and maintain agricultural production in intensive farming systems. Plant protectants include pesticides, herbicides, fungicides, and insecticides that are used to control harmful organisms affecting crops. Proper use of these chemicals reduces crop losses and improves the quality of agricultural produce.

6.1 Fertilizer and Pesticide application

Fertilizer and pesticide application refers to the use of nutrient substances and chemical compounds in agricultural fields to improve crop growth and protect crops from pests, diseases, and weeds. Fertilizers help in increasing soil fertility by supplying essential nutrients such as nitrogen, phosphorus, and potassium required for plant development. Pesticides are used to control harmful insects, fungi, and unwanted plants that affect crop productivity. In the Krishna River Basin, the application of fertilizers and pesticides has significantly contributed to higher agricultural production and cropping intensity.

The analysis of fertilizer consumption in the Krishna River Basin between 1970 and 2017 from ICRISAT reveals a pattern of massive agricultural intensification. The data indicates that the basin's productivity growth, particularly the record-breaking wheat and rice yields discussed previously, has been fueled by a multi-fold increase in chemical inputs.

6.1.1 Nitrogen Consumption:

Upper Krishna Basin: Nitrogen consumption showed steady growth across most districts over the study period. Raichur remained the highest consumer, indicating strong dependence on nitrogen fertilizers. Belgaum and Dharwad grew significantly but saw a slight decline in later years. Kolhapur, Vijayapura, Sangli, and Satara recorded consistent increases. Data for Bagalkot, Gadag, Haveri, Sindhudurg, Yadgir and Koppal was unavailable. Overall, nitrogen use increased notably before showing a mild decline in some districts toward the end. The Nitrogen (N) Consumption in districts of Upper Krishna Basin is represented in table 19 below.

Table 19: Nitrogen Consumption in the districts of Upper Krishna Basin

Nitrogen (N) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bagalkot	—	—	—	—	—	—
2	Belgaum	8126	19200	42069	76410	101487	92878
3	Dharwad	4337	11433	26026	56096	78970	62588
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Kolhapur	7189	25808	56406	53203	65271	70996
7	Koppal	—	—	—	—	—	—
8	Raichur	7517	22000	51302	101582	151135	115832
9	Sangli	5076	13815	37810	37495	74746	54620
10	Satara	4817	12570	32362	34842	50079	49264
11	Sindhudurg	—	—	—	—	—	—
12	Vijayapura	2745	7781	18447	43706	79505	73977
13	Yadgir	—	—	—	—	—	—

Middle Krishna Basin: Nitrogen(N) consumption in the Middle Krishna region shows a strong increase from 1970 to 2010 due to expansion of irrigation and intensive farming practices. Raichur and Nalgonda recorded the highest consumption, while Mahabubnagar showed comparatively moderate levels. The nitrogen consumption data for few districts like Jogulamba gadwal, Nandyal, Nagarkurnool, Narayanpet, Palnadu, Prakasam, Rangareddy, Vikarabad, Wanaparthi and Yadagir are not available. The Nitrogen (N) Consumption in districts of Middle Krishna Basin is represented in table 20 below.

Table 20: Nitrogen Consumption in districts of Middle Krishna Basin

Nitrogen (N) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Jogulamba Gadwal	—	—	—	—	—	—
2	Mahabubnagar	5967	13529	32255	47532	77259	74046
3	Nadyal	—	—	—	—	—	—
4	Nagarakurnool	—	—	—	—	—	—
5	Nalgonda	5295	13147	34661	83173	141668	33043
6	Narayanpet	—	—	—	—	—	—
7	Palnadu	—	—	—	—	—	—
8	Prakasam	—	—	—	—	—	—
9	Raichur	7517	22000	51302	101582	151135	115832

10	Rangareddy	—	—	—	—	—	—
11	Vikarabad	—	—	—	—	—	—
12	Wanaparthy	—	—	—	—	—	—
13	Yadgiri	—	—	—	—	—	—

Lower Krishna Basin: Nitrogen (N) consumption in Lower Krishna basin districts shows a strong rise from 1970 to 2010 due to intensive irrigation and fertilizer use. Guntur recorded the highest consumption, followed by Krishna and Warangal, while Hyderabad remained relatively lower. The increase is linked to commercial crops and modern agricultural practices. No data found for few districts like Bapatla, Bhadradi Kothagudem, Hanumakonda, Jagoan, Medchal Malkajgiri and NTR etc. The Nitrogen (N) Consumption in districts of Lower Krishna Basin districts is represented in table 21 below.

Table 21: Nitrogen Consumption in districts of Lower Krishna Basin

Nitrogen (N) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bapatla	—	—	—	—	—	—
2	Bhadradi Kothagudem	—	—	—	—	—	—
3	Gunturu	41123	62490	138583	135606	216731	173584
4	Hanumakonda	—	—	—	—	—	—
5	Hyderabad	5940	4353	28897	54623	51967	29965
6	Jagoan	—	—	—	—	—	—
7	Khammam	4727	5181	39093	53544	90586	15181
8	Krishna	16668	33940	88818	104451	136922	84529
9	Mahabubnagar	5967	13529	32255	47532	77259	74046
10	Medchal Malkajgiri	—	—	—	—	—	—
11	Nalgonda	5295	13147	34661	83173	141668	33043
12	NTR	—	—	—	—	—	—
13	Palnadu	—	—	—	—	—	—
14	Rangareddy	—	—	—	—	—	—
15	Siddipet	—	—	—	—	—	—
16	Suryapet	—	—	—	—	—	—
17	Vikarabad	—	—	—	—	—	—
18	Warangal	8286	21934	66283	87128	126371	122203
19	Yadadri Bhuvanagiri	—	—	—	—	—	—

Upper Bhima Basin: In the districts of Upper Bhima basin region nitrogen consumption increased steadily from 1970 to 2010 due to expansion of irrigation and use of chemical fertilizers. Ahmednagar shows the highest consumption throughout, while Beed and Vijayapura remain among the lowest. The rise is linked to adoption of high-yield crops and intensive farming practices. The Nitrogen (N) Consumption in districts of Upper Bhima Basin districts is represented in table 22 below.

Table 22: Nitrogen Consumption in districts of Upper Bhima Basin

Nitrogen (N) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Ahmednagar	9849	16991	55021	61860	99902	105164
2	Belgaum	8126	19200	42069	76410	101487	92878
3	Beed	2311	2481	16547	34176	61270	60321
4	Osmanabad	3517	5874	26118	41050	65704	57017
5	Pune	7094	10074	43112	53890	99667	97238
6	Sangli	5076	13815	37810	37495	74746	54620
7	Satara	4817	12570	32362	34842	50079	49264
8	Solapur	4714	11376	35590	51219	96340	101756
9	Vijayapura	2745	7781	18447	43706	79505	73977

Lower Bhima Basin: Nitrogen (N) consumption in Lower Bhima basin districts shows a steady increase from 1970 to 2010 due to expansion of irrigation and use of chemical fertilizers. Solapur and Kalaburgi recorded the highest consumption, while Bidar had lower levels and districts like sangareddy, vikarabad and Yadgir has no data available. The Nitrogen (N) Consumption in districts of Lower Bhima Basin districts is represented in table 23 below.

Table 23: Nitrogen Consumption in districts of Lower Bhima Basin

Nitrogen (N) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bidar	1481	3070	6836	11238	15799	10275
2	Kalaburgi	1050	1805	15609	27825	82629	70290
3	Osmanabad	3517	5874	26118	41050	65704	57017
4	Sangareddy	—	—	—	—	—	—
5	Solapur	4714	11376	35590	51219	96340	101756
6	Vijayapura	2745	7781	18447	43706	79505	73977
7	Vikarabad	—	—	—	—	—	—
8	Yadgiri	—	—	—	—	—	—

Upper Tungabhadra Basin: Nitrogen usage across these districts exhibits a gradual upward pattern, reflecting expanding agricultural practices. Chitradurga stands out with the highest level of consumption, followed by Shivamogga showing considerable usage. Chikkamagaluru maintains a moderate level, indicating balanced fertilizer application. Uttara Kannada records comparatively lower usage among the listed districts. A number of districts have missing data, suggesting limitations in data collection or reporting. The Nitrogen (N) Consumption in districts of Upper Tungabhadra Basin districts is represented in table 24 below.

Table 24: Nitrogen Consumption in districts of Upper Tungabhadra Basin

Nitrogen (N) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Chikkamagaluru	2062	4830	12940	21714	28664	28833
2	Chitradurga	8261	13697	26822	58986	76814	63447
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	4606	12033	21378	25369	39171	29018
8	Uttara Kannada	650	1196	2808	4305	7517	8781
9	Vijayanagar	—	—	—	—	—	—

Lower Tungabhadra Basin: Nitrogen consumption shows an overall increasing trend across the districts over time. Among the available data, Kurnool and Raichur show the highest consumption levels, followed by Ballari and Chitradurga. Moderate consumption is observed in Ananthapur, Hassan, Chikkamagaluru, and Tumkur. The lowest consumption levels are seen in Chikkamagaluru and Tumkur compared to other districts. Several districts have no available data, indicating gaps in reporting. The Nitrogen (N) Consumption in districts of Lower Tungabhadra Basin districts is represented in table 25 below.

Table 25: Nitrogen Consumption in districts of Lower Tungabhadra Basin

Nitrogen (N) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Ananthapur	3124	5789	24837	32955	60705	38288
2	Ballari	7165	19668	39325	63741	88074	70669
3	Chikkamagaluru	2062	4830	12940	21714	28664	28833
4	Chitradurga	8261	13697	26822	58986	76814	63447
5	Davangere	—	—	—	—	—	—
6	Hassan	3917	10425	18994	32056	35723	32894
7	Jogulamba Gadwal	—	—	—	—	—	—
8	Kurnool	17467	20129	46616	86752	127189	140564
9	Koppal	—	—	—	—	—	—
10	Nadyal	—	—	—	—	—	—
11	Raichur	7517	22000	51302	101582	151135	115832
12	Sri Satya Sai	—	—	—	—	—	—
13	Tumkur	3013	6850	12725	27927	27684	24548
14	Vijayanagara	—	—	—	—	—	—

6.1.2 Phosphate Consumption:

Upper Krishna Basin: Phosphate consumption increased significantly across districts of Upper Krishna Basin. Raichur recorded the highest usage, while Vijayapura and Belgaum showed steady growth from lower levels. Dharwad, Kolhapur, Sangli, and Satara maintained moderate consumption. Data for Bagalkot, Gadag, Haveri, and Koppal was unavailable. Overall, usage peaked around 2010 and declined by 2017. The phosphate (PO₄) Consumption in districts of Upper Krishna Basin districts is represented in table 26 below.

Table 26: Phosphate Consumption in districts of Upper Krishna Basin

Phosphate (PO ₄) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bagalkot	—	—	—	—	—	—

2	Belgaum	2446	5405	19478	27675	64120	39229
3	Dharwad	1221	7393	23591	41200	58408	31066
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Kolhapur	2892	13913	23812	21143	39649	31024
7	Koppal	—	—	—	—	—	—
8	Raichur	3111	8435	25809	49136	103845	62617
9	Sangli	2474	3488	18926	18170	47620	27950
10	Satara	2609	3123	14679	13639	33493	25804
11	Sindhudurg	—	—	—	—	—	—
12	Vijayapura	1330	2255	10740	20100	49953	37407
13	Yadgir	—	—	—	—	—	—

Middle Krishna Basin: Phosphate (PO₄) consumption in Middle Krishna increased steadily from 1970 to 2010 due to growing fertilizer use and expansion of irrigated farming. Raichur recorded the highest consumption, followed by Nalgonda, while Mahabubnagar remained moderate. The rise reflects adoption of improved crop varieties and commercial agriculture. Data for districts like Jogulamba Gadwal, Nandyal, Nagarkurnool, Palnadu, Prakasam, Rangareddy, Vikarabad, Wanaparthy, yadgiri are not available. The phosphate (PO₄) Consumption in districts of Middle Krishna Basin districts is represented in table 27 below.

Table 27: Phosphate Consumption in districts of Middle Krishna Basin

Phosphate (PO ₄) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Jogulamba Gadwal	—	—	—	—	—	—
2	Mahabubnagar	1049	4888	20365	26612	48593	35010
3	Nadyal	—	—	—	—	—	—
4	Nagarakurnool	—	—	—	—	—	—
5	Nalgonda	2434	5393	18759	37666	74875	14763
6	Narayanpet	—	—	—	—	—	—
7	Palnadu	—	—	—	—	—	—
8	Prakasam	—	—	—	—	—	—
9	Raichur	3111	8435	25809	49136	103845	62617
10	Rangareddy	—	—	—	—	—	—
11	Vikarabad	—	—	—	—	—	—
12	Wanaparthy	—	—	—	—	—	—
13	Yadgiri	—	—	—	—	—	—

Lower Krishna Basin: Phosphate (PO₄) consumption in Lower Krishna districts increased markedly from 1970 to 2010 due to expanding irrigation and greater reliance on chemical fertilizers. Guntur recorded the highest usage, followed by Krishna and Warangal, while Hyderabad remained lower. The growth reflects commercial agriculture and adoption of improved crop varieties. The phosphate (PO₄) Consumption in districts of Lower Krishna Basin districts is represented in table 28 below.

Table 28: Phosphate Consumption in districts of Lower Krishna Basin

Phosphate (PO ₄) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bapatla	—	—	—	—	—	—
2	Bhadradri Kothagudem	—	—	—	—	—	—
3	Gunturu	10911	19055	55156	63194	138440	89900
4	Hanumakonda	—	—	—	—	—	—
5	Hyderabad	1648	1523	14144	45923	32325	15280
6	Jagoan	—	—	—	—	—	—
7	Khammam	2072	1585	15969	22114	38922	8795
8	Krishna	7118	9322	37906	53168	70715	39105
9	Mahabubnagar	1049	4888	20365	26612	48593	35010
10	Medchal Malkajgiri	—	—	—	—	—	—
11	Nalgonda	2434	5393	18759	37666	74875	14763
12	NTR	—	—	—	—	—	—
13	Palnadu	—	—	—	—	—	—
14	Rangareddy	—	—	—	—	—	—
15	Siddipet	—	—	—	—	—	—
16	Suryapet	—	—	—	—	—	—
17	Vikarabad	—	—	—	—	—	—
18	Warangal	3031	5934	27297	26604	42748	31481
19	Yadadri Bhuvanagiri	—	—	—	—	—	—

Upper Bhima Basin: Phosphate (PO₄) consumption in the districts of Upper Bhima basin increased from 1970 to 2010 due to greater use of fertilizers and intensive farming. Ahmednagar and Solapur recorded the highest use, while Vijayapura and Beed had lower consumption. The growth is linked to high-yield crops and irrigation expansion. The phosphate (PO₄) Consumption in districts of Upper Bhima Basin districts is represented in table 29 below.

Table 29: Phosphate Consumption in districts of Upper Bhima Basin

Phosphate (PO ₄) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Ahmednagar	2364	6794	27574	29384	72618	66273
2	Belgaum	2446	5405	19478	27675	64120	39229
3	Beed	1964	1400	9819	15947	40248	41388
4	Osmanabad	2119	1970	17563	27180	55999	50445
5	Pune	2358	3545	18905	24369	63938	48290
6	Sangli	2474	3488	18926	18170	47620	27950
7	Satara	2609	3123	14679	13639	33493	25804
8	Solapur	2494	3757	16863	22057	76135	49267
9	Vijayapura	1330	2255	10740	20100	49953	37407

Lower Bhima Basin: Phosphate (PO₄) use in Lower Bhima basin districts shows a clear upward trend from 1970 to 2010 as farmers increasingly depended on fertilizers to improve crop productivity. Solapur and Kalaburagi emerge as major consumers, whereas Bidar remains relatively low. This pattern reflects the shift toward commercial farming and better access to agricultural inputs. The phosphate (PO₄) Consumption in districts of Lower Bhima Basin districts is represented in table 30 below.

Table 30: Phosphate Consumption in districts of Lower Bhima Basin

Phosphate (PO ₄) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bidar	371	838	4217	5840	16214	8497
2	Kalaburagi	174	1030	15634	25909	62315	46001
3	Osmanabad	2119	1970	17563	27180	55999	50445
4	Sangareddy	—	—	—	—	—	—
5	Solapur	2494	3757	16863	22057	76135	49267
6	Vijayapura	1330	2255	10740	20100	49953	37407
7	Vikarabad	—	—	—	—	—	—
8	Yadgiri	—	—	—	—	—	—

Upper Tungabhadra Basin: Phosphate consumption across the districts reflects a progressive rise, indicating increased use of fertilizers in agriculture. Chitradurga emerges as the leading district in terms of consumption, followed by Shivamogga with considerable

usage levels. Chikkamagaluru shows moderate consumption, suggesting balanced agricultural practices. Uttara Kannada records comparatively lower levels of usage. Several districts have no recorded data, highlighting gaps in data availability or reporting. The phosphate (PO₄) Consumption in districts of Upper Tungabhadra Basin districts is represented in table 31 below.

Table 31: Phosphate Consumption in districts of Upper Tungabhadra Basin

Phosphate (PO ₄) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Chikkamagaluru	764	2480	9281	12852	20846	17782
2	Chitradurga	3497	6385	18257	32375	54844	36388
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	2258	6020	15537	16138	25692	17441
8	Uttara Kannada	256	599	1433	3160	5084	4050
9	Vijayanagar	—	—	—	—	—	—

Lower Tungabhadra Basin: Phosphate consumption across the districts shows a gradual increasing trend, indicating growing reliance on fertilizers. Kurnool and Raichur record the highest consumption levels, followed by Ballari and Chitradurga. Ananthapur and Hassan display moderate usage, reflecting stable agricultural activity. Lower levels of consumption are seen in Chikkamagaluru and Tumkur compared to other districts. A few districts have no available data, suggesting gaps in data collection or reporting. The phosphate (PO₄) Consumption in districts of Lower Tungabhadra Basin districts is represented in table 32 below.

Table 32: Phosphate Consumption in districts of Lower Tungabhadra Basin

Phosphate (PO ₄) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Ananthapur	910	2640	16766	19773	42480	26127
2	Ballari	2410	7821	28884	29021	54774	37463
3	Chikkamagaluru	764	2480	9281	12852	20846	17782
4	Chitradurga	3497	6385	18257	32375	54844	36388
5	Davangere	—	—	—	—	—	—
6	Hassan	1604	6018	12303	16540	25271	19091
7	Jogulamba Gadwal	—	—	—	—	—	—

8	Kurnool	8756	9899	29717	53880	101451	80498
9	Koppal	—	—	—	—	—	—
10	Nandyal	—	—	—	—	—	—
11	Raichur	3111	8435	25809	49136	103845	62617
12	Sri Satya Sai	—	—	—	—	—	—
13	Tumkur	1056	3094	10781	14352	18593	13290
14	Vijayanagara	—	—	—	—	—	—

6.1.3 Potash Consumption:

Upper Krishna Basin: Potash consumption showed strong growth across districts over the Upper Krishna basin. Belgaum and Raichur recorded the highest usage, while Kolhapur and Sangli showed moderate growth. Dharwad, Satara, and Vijayapura remained at lower levels with gradual increases. Data for Bagalkot, Gadag, Haveri, Koppal, Sindhudurg and Yadgir was unavailable. The potash (K₂₀) Consumption in districts of Upper Krishna Basin districts is represented in table 33 below.

Table 33: Potash Consumption in districts of Upper Krishna Basin

Potash (K ₂₀) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bagalkot	—	—	—	—	—	—
2	Belgaum	431	4243	9156	18337	46713	33264
3	Dharwad	545	5132	14448	15945	24660	12903
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Kolhapur	1614	10038	22897	20447	35657	30580
7	Koppal	—	—	—	—	—	—
8	Raichur	1044	5758	14747	29088	46026	22756
9	Sangli	1589	2767	17955	16644	32254	24678
10	Satara	1479	2997	9480	11724	24774	19926
11	Sindhudurg	—	—	—	—	—	—
12	Vijayapura	232	1360	4868	10462	29966	23520
13	Yadgir	—	—	—	—	—	—

Middle Krishna Basin: Potash (K₂₀) consumption in Middle Krishna increased from 1970 to 2010, showing growing use of balanced fertilizers in agriculture. Raichur recorded the highest consumption, while Mahabubnagar and Nalgonda showed moderate levels. The rise is linked to improved farming practices and crop diversification. The potash (K₂₀) Consumption in districts of Middle Krishna Basin districts is represented in table 34 below

Table 34: Potash Consumption in districts of Middle Krishna Basin

Potash (K ₂₀) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Jogulamba Gadwal	—	—	—	—	—	—
2	Mahabubnagar	418	1345	4988	6289	17739	8556
3	Nadyal	—	—	—	—	—	—
4	Nagarakurnool	—	—	—	—	—	—
5	Nalgonda	502	1171	3584	8636	22918	5605
6	Narayanpet	—	—	—	—	—	—
7	Palnadu	—	—	—	—	—	—
8	Prakasam	—	—	—	—	—	—
9	Raichur	1044	5758	14747	29088	46026	22756
10	Rangareddy	—	—	—	—	—	—
11	Vikarabad	—	—	—	—	—	—
12	Wanaparthy	—	—	—	—	—	—
13	Yadgiri	—	—	—	—	—	—

Lower Krishna Basin: Potash (K₂₀) consumption in Lower Krishna basin districts, Guntur recorded the highest consumption, followed by Krishna and Warangal, while Hyderabad and Khammam remained lower. The increase reflects crop diversification and improved agricultural inputs. The potash (K₂₀) Consumption in districts of Lower Krishna Basin districts is represented in table 35 below.

Table 35: Potash Consumption in districts of Lower Krishna Basin

Potash (K ₂₀) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bapatla	—	—	—	—	—	—
2	Bhadradi Kothagudem	—	—	—	—	—	—
3	Gunturu	4550	6930	22456	19317	48170	25004
4	Hanumakonda	—	—	—	—	—	—
5	Hyderabad	1115	509	3302	15797	22820	10357
6	Jagoan	—	—	—	—	—	—
7	Khammam	546	415	3338	6885	21131	3643
8	Krishna	1879	4679	13052	34417	37400	20768
9	Mahabubnagar	418	1345	4988	6289	17739	8556
10	Medchal Malkajgiri	—	—	—	—	—	—

11	Nalgonda	502	1171	3584	8636	22918	5605
12	NTR	—	—	—	—	—	—
13	Palnadu	—	—	—	—	—	—
14	Rangareddy	—	—	—	—	—	—
15	Siddipet	—	—	—	—	—	—
16	Suryapet	—	—	—	—	—	—
17	Vikarabad	—	—	—	—	—	—
18	Warangal	311	1434	3501	7048	25698	16202
19	Yadadri Bhuvanagiri	—	—	—	—	—	—

Upper Bhima Basin: Potash (K₂₀) consumption in Upper Bhima shows a steady increase from 1970 to 2010 due to rising fertilizer use and intensive agriculture. Ahmednagar and Solapur recorded the highest consumption, while Vijayapura and Beed had lower levels. The growth is linked to adoption of high-yield crops and irrigation expansion. The potash (K₂₀) Consumption in districts of Upper Bhima Basin districts is represented in table 36 below.

Table 36: Potash Consumption in districts of Upper Bhima Basin

Potash (K ₂₀) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Ahmednagar	1784	4929	15001	16277	51638	41883
2	Belgaum	431	4243	9156	18337	46713	33264
3	Beed	1110	977	3127	6566	26118	21125
4	Osmanabad	1093	1272	6531	13225	25817	19119
5	Pune	1704	2274	11912	14665	43864	34456
6	Sangli	1589	2767	17955	16644	32254	24678
7	Satara	1479	2997	9480	11724	24774	19926
8	Solapur	1668	2691	10492	15918	53373	38343
9	Vijayapura	232	1360	4868	10462	29966	23520

Lower Bhima Basin: Potash (K₂₀) consumption in Lower Bhima basin districts shows gradual growth from 1970 to 2010, indicating increasing awareness of balanced fertilization in agriculture. Solapur and Kalaburagi recorded higher consumption, while Bidar remained comparatively low. The rise reflects diversification of crops and improved farming inputs over time. The potash (K₂₀) Consumption in districts of Lower Bhima Basin districts is represented in table 37 below

Table 37: Potash Consumption in districts of Lower Bhima Basin

Potash (K ₂ O) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Bidar	117	340	812	2383	3717	2388
2	Kalaburgi	142	226	2164	4720	18499	12551
3	Osmanabad	1093	1272	6531	13225	25817	19119
4	Sangareddy	—	—	—	—	—	—
5	Solapur	1668	2691	10492	15918	53373	38343
6	Vijayapura	232	1360	4868	10462	29966	23520
7	Vikarabad	—	—	—	—	—	—
8	Yadgiri	—	—	—	—	—	—

Upper Tungabhadra Basin: Potash consumption across Karnataka's districts in Upper Tungabhadra basin has shown a general rising trend over the decades. Chikkamagalur emerged as the highest consumer, reflecting its intensive agricultural practices. Chitradurga and Shivamogga also grew significantly but experienced a slight decline in later years. Uttara Kannada maintained comparatively lower consumption throughout the entire period. Several districts lack recorded data, likely due to administrative reorganization or inadequate records. The potash (K₂O) Consumption in districts of Upper Tungabhadra Basin districts is represented in table 38 below.

Table 38: Potash Consumption in districts of Upper Tungabhadra Basin

Potash (K ₂ O) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Chikkamangaluru	841	1863	8076	14785	20613	20329
2	Chitradurga	1994	2850	10427	12736	27091	13890
3	Davangere	—	—	—	—	—	—
4	Gadag	—	—	—	—	—	—
5	Haveri	—	—	—	—	—	—
6	Koppal	—	—	—	—	—	—
7	Shivamogga	2464	4819	10895	12519	18804	14377
8	Uttara Kannada	325	848	2248	2338	4506	3845
9	Vijayanagar	—	—	—	—	—	—

Lower Tungabhadra Basin: Potash consumption across the districts shows a steady upward trend, indicating increasing dependence on fertilizers in agriculture. Kurnool and Raichur record the highest levels of consumption among the districts. Ballari and Chitradurga also demonstrate relatively higher usage patterns. Anantapur and Hassan reflect moderate consumption, suggesting stable agricultural practices. Lower consumption is observed in Chikkamagaluru and Tumkur, while several districts have no available data, indicating possible gaps in reporting. The potash (K₂O) Consumption in districts of Lower Tungabhadra Basin districts is represented in table 39 below.

Table 39: Potash Consumption in districts of Lower Tungabhadra Basin

Potash (K ₂ O) Consumption in tons							
SL NO	District	1970	1980	1990	2000	2010	2017
1	Anantapur	154	1732	6734	8562	25911	12070
2	Ballari	818	7644	19787	16483	26674	13491
3	Chikkamagaluru	841	1863	8076	14785	20613	20329
4	Chitradurga	1994	2850	10427	12736	27091	13890
5	Davangere	—	—	—	—	—	—
6	Hassan	1191	3196	9579	13407	22081	15439
7	Jogulamba Gadwal	—	—	—	—	—	—
8	Kurnool	1730	3320	8886	15850	34935	24777
9	Koppal	—	—	—	—	—	—
10	Nandyal	—	—	—	—	—	—
11	Raichur	1044	5758	14747	29088	46026	22756
12	Sri Satya Sai	—	—	—	—	—	—
13	Tumkur	638	1759	3252	6225	8175	6346
14	Vijayanagara	—	—	—	—	—	—

6.2 Environmental and Health Concern

The Krishna River Basin is experiencing increasing environmental and public health concerns due to rapid urbanization, industrialization, agricultural intensification, and population growth across the basin. Various anthropogenic activities have significantly affected the quality of water, soil, and air resources, leading to ecological degradation and adverse impacts on human health. Untreated domestic sewage, industrial effluent discharge, agricultural runoff containing fertilizers and pesticides, solid waste disposal, and encroachment of natural water bodies have contributed to the deterioration of environmental conditions within the basin. In addition, overexploitation of water resources, groundwater depletion, deforestation, and loss of wetlands have further intensified environmental stress in several regions of the basin.

6.2.1 Water Pollution:

The deterioration of water quality in the Krishna River Basin is strongly linked to intensive agricultural activities and excessive fertilizer use. Studies by **Prasad and Rao (2014)** reported nitrate concentrations of 45–110 mg/L in several tributaries, exceeding the safe limit of 45 mg/L due to synthetic nitrogen fertilizer runoff. **Kumar et al. (2016)** observed phosphorus levels between 0.35–0.75 mg/L, far above the eutrophication threshold of 0.02 mg/L, leading to algal blooms in reservoir waters. **Reddy and Venkateswarlu (2012)** recorded dissolved oxygen levels as low as 2.1–3.5 mg/L in irrigation command areas, indicating severe oxygen depletion. Groundwater studies by **Sonkamble et al. (2018)** found that 68% of sampled wells exceeded the WHO nitrate limit of 50 mg/L. Furthermore, remote sensing analysis study by **Sridhar. (2021)** confirmed increasing chlorophyll-a concentrations and progressive eutrophication in Krishna River reservoirs.

6.2.2 Soil Degradation:

Soil degradation in the Krishna River Basin has become a major environmental issue due to excessive fertilizer use and intensive irrigation practices. **Srinivasa Rao et al. (2015)** reported that about 38% of agricultural soils recorded pH values below 5.5, indicating severe soil acidification caused by continuous nitrogen fertilizer application. **Venkatesh et al. (2017)** observed a 28–42% reduction in soil organic carbon in continuously fertilized paddy fields, which reduced soil fertility and water retention capacity. **Nagaraju et al. (2014)** identified salinity problems in irrigated command areas where electrical conductivity exceeded 4 D.S/m in nearly 22% of surveyed fields due to fertilizer residue accumulation and poor drainage. **Bhatt and Mahesh (2018)** also found a 35–52% decline in soil microbial biomass in long-term fertilizer-treated soils, affecting nutrient cycling and soil biological activity. **Reddy and Sharma (2016)** reported that nearly 75% of applied phosphate fertilizers became fixed in soils, causing phosphorus accumulation and nutrient imbalance. **Prasad et al. (2019)** estimated soil erosion rates of 15–25 tonnes/ha/year in highly fertilized regions, exceeding the national tolerable limit of 10–12 tonnes/ha/year. **Sunitha et al. (2020)** detected cadmium concentrations up to 3.9 mg/kg in agricultural soils, indicating heavy metal contamination from phosphate fertilizers. Continuous fertilizer use also increased soil compaction, reduced porosity, and weakened soil structure, thereby affecting long-term agricultural productivity in the Krishna River Basin.

6.2.3 Health Risks:

The increasing contamination of water and soil resources due to excessive fertilizer application has become a serious public health concern in the Krishna River Basin, particularly affecting rural populations dependent on the river for drinking water, agriculture, and domestic use. **Rao and Srinivas (2014)** reported nitrate concentrations above 100 mg/L in groundwater and documented 47 cases of infant methemoglobinemia (blue baby syndrome) in Guntur and Krishna districts. **Swami et al. (2018)** found that long-

term exposure to drinking water containing more than 50 mg/L nitrate increased colorectal cancer risk by 2.47 times. **Reddy et al.** (2015) observed that combined exposure to fluoride (>1.5 mg/L) and nitrate (>50 mg/L) intensified skeletal fluorosis severity in affected villages. **Naidu and Venkata Ramaiah** (2019) reported a 23% higher prevalence of low birth weight and increased preterm births in nitrate-contaminated agricultural communities. **Murthy et al.** (2020) linked harmful algal blooms in Nagarjuna Sagar Reservoir to gastroenteritis outbreaks affecting nearly 28% of households during bloom periods. **Sharma and Kumar** (2021) also identified reduced cognitive performance and elevated blood methaemoglobin levels among children exposed to nitrate-rich drinking water. **Patel and Singh** (2022) found hypothyroidism prevalence of 32.6% in high-nitrate areas compared to 11.4% in normal populations. Studies further reported respiratory illness, skin disorders, kidney dysfunction, and water-borne diseases among farming communities exposed to fertilizer-contaminated water and soils in the Krishna River Basin.

7. Agricultural Manpower, Land and Livestock Holdings

Agricultural manpower, land holdings, and livestock holdings are the three major components that support the rural economy and agricultural development of a region. Agricultural manpower refers to the human workforce engaged in farming, irrigation management, livestock rearing, and allied agricultural activities. It includes farmers, agricultural laborers, machine operators, and seasonal workers who contribute to crop production and farm management. Land holdings indicate the size and ownership pattern of agricultural land possessed by farmers, which may be classified as marginal, small, medium, or large holdings. Smaller land holdings are common in many parts of India and often influence crop productivity, irrigation practices, and income levels. Livestock holdings represent the number and type of animals such as cattle, buffaloes, sheep, goats, pigs, and poultry maintained by farming households. In case of river basins i.e Krishna River Basin, integrated management of manpower, land, and livestock is essential for improving agricultural productivity and ensuring food security.

7.1. Farmer Demographics

Farmer demographics refer to the characteristics and composition of the farming population in a particular area or region. It includes information such as age, gender, education level, family size, farming experience, and occupation of farmers. Farmer demographics also provide insights into labor availability, adoption of modern farming techniques, and decision-making patterns in agriculture. Studying farmer demographics is important for designing effective agricultural policies, training programs, and rural development initiatives.

The Farmer Demographics data used in this study has been obtained from Secondary data like District at a Glance Reports and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) 2011. District-wise tables for individual sub-basins are presented **in**

the following sections to illustrate the spatial distribution of farmer demographics pattern across the Krishna River basin. The farmer demographics in below tables are calculated as Agricultural Cultivator population ratio per 1000 persons and total Agricultural Labours ratio per 1000 persons.

Upper Krishna Basin: The Upper Krishna basin's farmer demographics reveals a varied distribution of agricultural and non-agricultural labour across 12 districts. Belagavi leads in total agricultural cultivators, followed closely by Kolhapur and Dharwad, reflecting their strong farming base. In terms of agricultural labourers, Dharwad records the highest with Belagavi and Vijayapura also showing substantial labour presence. Non-agricultural labour is most prominent in Belagavi, Dharwad and Kolhapur, indicating a relatively diversified rural economy in these districts. Notably, several districts including Sindhudurg, Bagalkot, Yadgiri, Gadag and Koppal report zero values across all categories, likely due to incomplete data records or administrative boundary considerations. The farmer demographics data of the Upper Krishna basin districts is represented in the table 40 below.

Table 40: Farmer Demographics in the districts of Upper Krishna Basin

Sl.No	Districts	Total Agricultural Cultivators /1000 numbers	Total Agricultural Labours /1000 numbers	Non-Agricultural Labours
1	Satara	585.88	297.24	1648.79
2	Sangli	480.55	290.69	1607.04
3	Sindhudurg	0	0	0
4	Kolhapur	660.87	266.03	2171.95
5	Dharwad	494.78	719.21	2498.64
6	Belagavi	711.98	649.52	2673.99
7	Bagalkot	0	0	0
8	Raichur	408.71	656.55	1760.55
9	Vijayapura	458.42	654.84	0
10	Yadgiri	0	0	0
11	Gadag	0	0	0
12	Koppal	0	0	0

Middle Krishna Basin: The Middle Krishna basin's farmer demographics presents a sparse distribution of agricultural activity across its 13 districts. Mahabubnagar stands out as the dominant district with the highest total agricultural cultivators and the largest agricultural labour force, indicating a strong agrarian economy within the basin. Nalagonda follows as the second most active district, reflecting considerable farming engagement. The remaining districts like Raichur, Yadgir, Vikarabad, Rangareddy, Palnadu, Prakasam, Nagarkurnool, Nandyal, Wanaparthy, Jogulamba Gadwal and Narayanpet report either zero or no recorded values across all categories, suggesting either data unavailability or minimal agricultural activity within the basin boundary. The farmer demographics in the districts of Middle Krishna basin is represented in the table 41 below.

Table 41: Farmer Demographics in the districts of Middle Krishna Basin

Sl.No	Districts	Total Agricultural Cultivators/1000 numbers	Total Agricultural Labours /1000 numbers
1	Raichur	-	-
2	Yadgir	0	0
3	Vikarabad	0	0
4	Rangareddy	0	0
5	Nalagonda	325.22	863.13
6	Palnadu	0	0
7	Prakasam	0	0
8	Nagarkurnool	0	0
9	Nandyal	0	0
10	Wanaparthy	0	0
11	Mahabubnagar	569.14	931.08
12	Jogulamba Gadwal	0	0
13	Narayanpet	0	0

Lower Krishna Basin: The Lower Krishna basin's farmer demographics reflects a highly uneven distribution of agricultural workforce across the districts. Guntur emerges as the most agriculturally active district, recording the highest agricultural cultivators and the largest agricultural labour force, signifying its pivotal role in the basin's farming economy. Krishna district follows with a notably high agricultural labour despite a relatively modest cultivator, suggesting a labour-intensive farming structure. Warangal, Nalagonda, Hyderabad and Khammam also contribute meaningfully to the basin's agricultural workforce. The remaining districts like Bapatla, NTR, Palnadu, Badradri Kothagudem, Mahabubabad, Hanumakonda, Jangoan, Siddipet, Medchal Malkajgiri, Yadadri Bhuvanagiri, Vikarabad and Suryapet report zero values, likely attributable to data gaps or partial inclusion within the basin boundary. The farmer demographics in the districts of Lower Krishna basin is represented in the table 42 below.

Table 42: Farmer Demographics in the districts of Lower Krishna Basin

Sl.No	Districts	Total Agricultural Cultivators/1000 numbers	Total Agricultural Labours/1000 numbers
1	Krishna	150.17	1006.98
2	Bapatla	0	0
3	Guntur	431.15	1637
4	NTR	0	0
5	Palnadu	0	0
6	Khammam	224.97	804.54
7	Badradi kothagudem	0	0
8	Mahabubabad	0	0
9	Warangal	401.65	758.09
10	Hanumakonda	0	0
11	Jangoan	0	0
12	Siddipet	0	0
13	Medchal Malkajgiri	0	0
14	Hyderabad	299.24	372.06
15	Yadadri Bhuvanagiri	0	0
16	Vikarabad	0	0
17	Nalagonda	325.22	863.13
18	Suryapet	0	0

Upper Bhima Basin: The Upper Bhima basin's farmer demographics reveals a relatively well-distributed agricultural workforce across the districts. Ahmednagar leads with the highest cultivators, followed by Pune, reflecting their dominant agrarian presence in the basin. Solapur, Beed and Dharashiv also record substantial cultivator and labour figures, with Dharashiv notably exhibiting a higher labour count relative to its cultivator base, indicating greater dependence on hired agricultural labour. Vijayapura contributes meaningfully with 458.42 cultivators and 654.84 labourers, further reinforcing its agricultural significance within the basin. Sangli and Satara report no recorded data, likely due to partial inclusion within the basin boundary or administrative data gaps. The farmer demographics in the districts of Upper Bhima basin is represented in the table 43 below.

Table 43: Farmer Demographics in the districts of Upper Bhima Basin

Sl. No	Districts	Total Agricultural Cultivators/1000 numbers	Total Agricultural Labours/1000 numbers
1	Ahmednagar	1013.05	559.01
2	Pune	886.53	414.46
3	Solapur	637.25	558.33
4	Beed	606.28	373.57
5	Dharashiv	629.14	716.11
6	Sangli	-	-
7	Vijayapura	458.42	654.84
8	Satara	-	-

Lower Bhima Basin: The Lower Bhima basin's farmer demographics highlights a moderate but unevenly distributed agricultural workforce across the districts. Solapur leads with the highest cultivator, closely followed by Dharashiv, both reflecting a strong cultivator presence in the basin. In terms of agricultural labourers, Kalaburagi records the highest, followed by Vijayapura and Dharashiv indicating considerable labour dependency in these districts. Bidar contributes moderately, while Sangreddy, Vikarabad and Yadgir report zero values across all categories, likely due to data unavailability or minimal inclusion within the basin boundary. The farmer demographics in the districts of Lower Bhima basin is represented in the table 44 below.

Table 44: Farmer Demographics in the districts of Lower Bhima Basin

Sl.No	Districts	Total Agricultural Cultivators /1000 numbers	Total Agricultural Labours/1000 numbers
1	Dharashiv	629.14	716.11
2	Sangareddy	0	0
3	Vikarabad	0	0
4	Solapur	637.25	558.33
5	Bidar	141.3	280.09
6	Kalaburagi	379.53	649.93
7	Yadgir	0	0
8	Vijayapura	458.42	654.84

Upper Tungabhadra Basin: The Upper Tungabhadra basin's farmer demographics reveals a stark contrast in agricultural activity across its 11 districts. Dharwad leads with the highest cultivator count at 494.78 and a substantial agricultural labour force of 719.21, alongside the second highest non-agricultural workforce, reflecting a well-diversified rural economy.

Chitradurga follows with 517.10 cultivators and 590.21 labourers, recording the highest non-agricultural workforce at 1873.16, indicating a growing non-farm employment base. Ballari and Shivamogga also contribute meaningfully with moderate cultivator and labour figures, supported by considerable non-agricultural worker counts of 1335.72 and 972.16 respectively. In contrast, Koppal, Gadag, Vijayanagara, Haveri and Davangere report zero values across all categories, likely due to data unavailability or their minimal spatial inclusion within the basin boundary. The farmer demographics in the districts of Upper Tungabhadra basin is represented in the table 45 below.

Table 45: Farmer Demographics in the districts of Upper Tungabhadra Basin

Sl.No	District	Total Agricultural Cultivators /1000 numbers	Total Agricultural Labours /1000 numbers	Non-Agricultural Workers
1	Koppal	0	0	0
2	Gadag	0	0	0
3	Vijayanagara	0	0	0
4	Haveri	0	0	0
5	Davangere	0	0	0
6	Uttar Kannada	111.58	116.34	828.64
7	Ballari	258.08	406.09	1335.72
8	Shivamogga	204.49	246.46	972.16
9	Dharwad	494.78	719.21	2498.64
10	Chikkamagaluru	155.39	126.6	572.19
11	Chitradurga	517.1	590.21	1873.16

Lower Tungabhadra Basin: The Lower Tungabhadra basin's farmer demographics displays a diverse and unevenly distributed agricultural workforce across its 14 districts. Kurnool stands out with the highest agricultural labour force and the largest non-agricultural workforce, despite a moderate cultivator indicating a highly labour-intensive farming structure. Chitradurga leads in cultivator count at 517.10 with 590.21 labourers and a significant non-agricultural workforce of 1873.16, followed closely by Tumakuru and Ananthapur, reflecting strong agrarian and diversified economies. Raichur and Hassan also contribute notably, with Raichur recording 408.71 cultivators and a substantial non-agricultural workforce of 1760.55, while Hassan maintains moderate figures across all categories. Bagalkot, Koppal, Vijayanagara, Davangere, SriSatyaSai and Jogulamba Gadwal report zero values across all categories, likely attributable to data gaps or minimal spatial inclusion within the basin boundary. The farmer demographics in the districts of Lower Tungabhadra basin is represented in the table 46 below.

Table 46: Farmer Demographics in the districts of Lower Tungabhadra Basin

Sl.No	Districts	Total Agricultural Cultivators/1000 numbers	Total Agricultural Labours/1000 numbers
1	Raichur	408.71	656.55
2	Ballari	258.08	406.09
3	Chitradurga	517.1	590.21
4	Tumakuru	505.91	352.29
5	Hassan	437.03	165.91
6	Chikkamagaluru	155.39	126.6
7	Bagalkot	0	0
8	Koppal	0	0
9	Vijayanagara	0	0
10	Davangere	0	0
11	Kurnool	355.75	1179.58
12	Ananthapur	413.25	879.54
13	SriSatyaSai	0	0
14	Jogulamba Gadwal	0	0

7.2. Land Holdings

Landholding patterns within the Krishna River Basin exhibit considerable variation across districts and sub-basins, reflecting differences in agricultural practices, population pressure, and resource availability. The region is predominantly characterized by marginal and small landholdings, resulting in fragmented agricultural landscapes in many areas. Landholding size plays an important role in influencing cropping choices, irrigation practices, mechanization, and investment capacity of farmers. Smaller holdings often limit the adoption of advanced irrigation systems and efficient farm management practices, whereas medium and large landholders generally possess better access to financial resources and irrigation infrastructure.

The agricultural land holding data used in this study has been obtained from secondary sources, primarily the National Bank for Agriculture and Rural Development (NABARD) Rural Infrastructure and Agricultural Reports (2025–2026). The landholdings are classified into marginal, small, medium, and large farmer categories for each district within the respective sub-basins of the Krishna River Basin. District-wise tables for individual sub-basins are presented in the following sections to illustrate the spatial distribution of agricultural landholding patterns across the basin.

Upper Krishna Basin: The pattern of land holdings in the Upper Krishna Basin reflects significant regional disparities in farm size distribution across districts. Among marginal land holdings, Satara has the highest concentration while Haveri records the lowest. In small

land holdings, Belgaum stands out as the highest, whereas Haveri again shows the lowest presence. For medium land holdings, Koppal has the highest share, while Haveri records the least. In large land holdings, Kolhapur has the highest dominance, whereas Haveri shows the lowest. Overall, the pattern indicates that most districts are dominated by smaller and marginal farmers, while large holdings are limited and concentrated in a few districts. The agricultural land holdings in the districts of Upper Krishna basin are represented below in Table 47.

Table 47: Agricultural land holdings in the districts of Upper Krishna basin

Sl.no	District	Marginal <=1 ha		Small >1 to <= 2ha		Medium >4 to <= 10ha		Large > 10ha	
		Nos	Area	Nos	Area	Nos	Area	Nos	Area
1	Bagalkot	89615	51318	84788	122532	21541	123116	2149	31822
2	Belgaum	294982	141465	170553	243289	44991	256264	5196	87227
3	Dharwad	49097	29237	57524	83798	17705	103133	2204	30231
4	Gadag	46349	28444	68571	99393	-	-	-	-
5	Haveri	39	39	37	37	6	6	1	1
6	Kolhapur	504117	168114	105492	128903	1634	38260	39416	96908
7	Koppal	83131	47101	79083	112565	212486	295809	-	-
8	Raichur	110208	62743	92290	130884	29695	172499	4848	81258
9	Sangli	335037	144203	121394	160337	24913	142922	3114	50940
10	Satara	674344	241696	127574	175638	-	-	-	-
11	Sindhudurg	244765	58945	39692	48244	3100	52522	30228	87854
12	Vijayapura	63100	40237	132545	192390	53714	314346	7461	101620
13	Yadgir	80151	44849	81160	117839	18753	106712	1971	26453

Middle Krishna Basin: The agricultural landholding pattern in the Middle Krishna sub-basin indicates a dominance of marginal and small farmers, reflecting fragmented land ownership and dependence on agriculture. In the marginal category, Palnadu has the highest number of holdings, while Nalgonda has the highest area, and Narayanpet records the lowest number and area. In small holdings, Prakasam has the highest number, whereas Nalgonda has the highest area, with the lowest values observed in Wanaparathi and Narayanpet respectively. For medium holdings, Raichur has the highest number and area, while Vikarabad has the lowest number and lowest area and data is not available for Jogulamba Gadwal, Nagarakurnool, and Wanaparathi. In large holdings, Nalgonda ranks highest in both number and area, while Narayanpet has the lowest number and lowest area, data is not available for Jogulamba Gadwal, Nagarakurnool, and Wanaparathi. Overall, some districts have more large farms, while others have many small and divided farms, showing differences in land distribution. The agricultural land holdings in the districts of Middle Krishna basin are represented below in Table 48.

Table 48: Agricultural land holdings in the districts of Middle Krishna basin

SL NO	Districts	Marginal <= 1ha		Small >1 to <=2 ha		Medium >4 to <=10 ha		Large >10 ha	
		Number	Area	Number	Area	Number	Area	Number	Area
1	Jogulamba Gadwal	89074	76414	44601	39038	—	—	—	—
2	Mahabubnagar	114266	53385	45050	63204	3251	17818	308	4522
3	Nandyal	178063	90704	95328	135134	13725	77546	858	16299
4	Nagarakurnool	166294	32363	82463	47035	—	—	—	—
5	Nalgonda	231153	277947	115289	402968	755	24957	46711	298837
6	Narayanpet	70554	15431	45756	26515	4628	10191	300	1617
7	Palnadu	281559	129180	82569	115693	7747	40375	310	8270
8	Prakasam	262344	124824	128584	184336	18776	103291	1327	18988
9	Raichur	110208	62743	92290	130884	29695	172499	4848	81258
10	Rangareddy	156355	177131	56853	196537	5585	19051	25888	168448
11	Vikarabad	126007	154538	59245	206763	733	24670	28162	183219
12	Wanaparathi	98083	41485	38399	54570	—	—	—	—
13	Yadgiri	80151	44849	81160	117839	18753	106712	1971	26453

Lower Krishna Basin: The Lower Krishna region shows a clear dominance of marginal and small farmers, indicating widespread land fragmentation and dependence on small-scale agriculture. In marginal holdings, Palnadu has the highest number, while Nalgonda has the highest area, Medchal Malkajgiri records the lowest values, and data is not available for Hyderabad. In small holdings, Nalgonda has the highest area and number of holdings, Medchal Malkajgiri shows the lowest values and data is not available for Hyderabad and NTR. For medium holdings, Suryapet has the highest medium holdings, and data is not available for Krishna, NTR, Hyderabad, Khammam and Siddipet in this category. In large holdings, Nalgonda shows the highest area and number of holdings, while Rangareddy also has a significant number of large holdings, and the lowest values are observed in districts Warangal, data is not available for Siddipet Hyderabad, Krishna and NTR. This reflects

differences in agricultural development and land use patterns across the districts. The agricultural land holdings in the districts of Lower Krishna basin are represented below in Table 49.

Table 49: Agricultural land holdings in the districts of Lower Krishna basin

SL.NO	Districts	Marginal <= 1ha		Small >1 to <=2 ha		Medium >4 to <=10 ha		Large >10 ha	
		Number	Area	Number	Area	Number	Area	Number	Area
1	Bapatla	269252	110372	58616	82889	4830	25232	197	3093
2	Bhadradi Kothagudem	54568	34671	37349	52263	4695	24854	189	2431
3	Gunturu	210545	81894	33221	46885	2027	10610	89	1738
4	Hanumakonda	104340	101798	25380	82908	2115	20534	705	4112
5	Hyderabad	0	0	0	0	0	0	0	0
6	Jagoan	88035	36444	29407	41391	224	3085	11838	31427
7	Khammam	207983	91817	58254	79966			31491	106390
8	Krishna	248315	93205	44278	61877	0	0	0	0
9	Mahabubnagar	114266	53385	45050	63204	3251	17818	308	4522
10	Medchal Malkajgiri	15070	13505	3369	11571	662	9338	78	3242
11	Nalgonda	231153	277947	115289	402968	755	24957	46711	298837
12	NTR	193202	107752	0	0	0	0	0	0
13	Palnadu	281559	129180	82569	115693	7747	40375	310	8270
14	Rangareddy	156355	177131	56853	196537	5585	19051	25888	168448
15	Siddipet	203697	90480	64909	90316	—	—	—	—
16	Suryapet	153300	171355	54957	190441	14387	220562	1165	1328
17	Vikarabad	126007	154538	59245	206763	733	24670	28162	183219
18	Warangal	192000	70636	32000	43932	250	2514	50	988
19	Yadadri Bhuvanagiri	101825	210618	47424	96135	310	3220	27500	55067

Upper Bhima Basin: The Lower Krishna region shows a clear dominance of marginal and small farmers, The agricultural landholding pattern in the Upper Bhima sub-basin is mainly characterized by a large number of marginal and small farmers, showing that land is highly fragmented and agriculture is largely practiced on a small scale. In marginal holdings, Satara has the highest number and area, while Vijayapura records the lowest values. In small holdings, Pune has the highest number, whereas Solapur has the highest area, and Ahmednagar shows the lowest values. For medium holdings, Vijayapura has the highest holdings, Solapur is the lowest holdings, and data is not available for Ahmednagar, Osmanabad and Satara. In large holdings, Solapur stands out with the highest number and area, while very low values are observed in district Beed, data is not available for Ahmednagar, Osmanabad and Satara. Overall, this reflects variations in agricultural development and landholding structure across the districts within the Upper Bhima sub-basin. The agricultural land holdings in the districts of Upper bhima basin are represented below in Table 50.

Table 50: Agricultural land holdings in the districts of Upper Bhima basin

SL NO	Districts	Marginal <= 1ha		Small >1 to <=2 ha		Medium >4 to <=10 ha		Large >10 ha	
		Number	Area	Number	Area	Number	Area	Number	Area
1	Ahmednagar	171170	62168	53947	77031	—	—	—	—
2	Beed	433643	176789	196151	266219	27295	151275	1555	24651
3	Belgaum	294982	141465	170553	243289	44991	256264	5196	87227
4	Osmanabad	158261	77622	141393	192218	—	—	—	—
5	Pune	485204	195639	289578	249303	40787	228596	5828	97077
6	Sangli	335037	144203	121394	160337	24913	142922	3114	50940
7	Satara	674344	241696	127574	175638	—	—	—	—
8	Solapur	3,25,387	1,43,158	2,26,400	3,00,786	5,015	80,496	1,64,427	4,36,185
9	Vijayapura	63100	40237	132545	192390	53714	314346	7461	101620

Lower Bhima Basin: The Lower Bhima basin is largely characterized by the dominance of marginal and small farmers, indicating fragmented land distribution and dependence on small-scale farming. In marginal holdings, Solapur has the highest number and Vikarabad highest area, while Sangareddy records the lowest values. In small holdings, Solapur again has the highest number and area, whereas Sangareddy shows the lowest. For medium holdings, Vijayapura has the highest Holdings. while Vikarabad records the lowest values, data is not available for Osmanabad and Sangareddy. In large holdings, Solapur stands out with the highest number and area, while Sangareddy has the lowest values, data is not available for Osmanabad. The agricultural land holdings in the districts of Lower bhima basin are represented below in Table 51.

Table 51: Agricultural land holdings in the districts of Lower Bhima basin

SL NO	Districts	Marginal <= 1ha		Small >1 to <=2 ha		Medium >4 to <=10 ha		Large >10 ha	
		Number	Area	Number	Area	Number	Area	Number	Area
1	Bidar	94038	51939	99037	139551	15720	89054	1629	21969
2	Kalaburgi	106374	60699	154013	223449	43871	250641	5681	78424
3	Osmanabad	158261	77622	141393	192218	—	—	—	—
4	Sangareddy	180	81	74	103	—	—	35	121
5	Solapur	3,25,387	1,43,158	2,26,400	3,00,786	5,015	80,496	1,64,427	4,36,185
6	Vijayapura	63100	40237	132545	192390	53714	314346	7461	101620
7	Vikarabad	126007	154538	59245	206763	733	24670	28162	183219
8	Yadgiri	80151	44849	81160	117839	18753	106712	1971	26453

Upper Tungabhadra Basin: The pattern of agricultural land in districts of Upper Tungabhadra Basin shows a varied distribution from marginal to large categories, reflecting differences in land ownership. Shivamogga has the highest marginal holdings, while Haveri has the lowest. Chitradurga leads in small holdings, whereas Haveri is the lowest. Koppal has the highest medium holdings, with Haveri the lowest. Chitradurga records the highest large holdings, while Haveri has the least. The agricultural land holdings in the districts of Upper Tungabhadra basin are represented below in Table 52.

Table 52: Agricultural land holdings in the districts of Upper Tungabhadra basin

Sl.no	District	Marginal <=1 ha		Small >1 to <= 2ha		Medium >4 to <= 10ha		Large > 10ha	
		Nos	Area	Nos	Area	Nos	Area	Nos	Area
1	Chikkamagaluru	134046	62582	55867	76814	123	53780	1804	46261
2	Chitradurga	119385	65090	97044	137698	24632	141109	3651	54831
3	Davangere	120564	59388	65375	90353	9848	54156	758	10946
4	Gadag	46349	28444	68571	99393	-	-	-	-
5	Haveri	39	39	37	37	6	6	1	1
6	Koppal	83131	47101	79083	112565	212486	295809	-	-
7	Shivamogga	146306	71256	57199	78865	6906	38688	736	10787
8	Uttara Kannada	151335	46715	31351	43319	3560	19497	234	3144
9	Vijayanagara	95450	46241	64881	89997	14836	82925	1505	21581

Lower Tungabhadra Basin: Land holdings in the Lower Tungabhadra Basin vary across districts, showing a mixed agrarian structure. Marginal holdings are highest in Hassan and lowest in Ballari. Small holdings are highest in Tumkur and lowest in Jogulamba Gadwal. Medium holdings are highest in Koppal and lowest in Chikkamagaluru, while large holdings are highest in Raichur and minimal in Sri satya sai, where only the number of holdings is given and area is not mentioned. The agricultural land holdings in the districts of Lower Tungabhadra basin are represented below in Table 53.

Table 53: Agricultural land holdings in the districts of Lower Tungabhadra basin

Sl.no	District	Marginal <=1 ha		Small >1 to < = 2ha		Medium >4 to < = 10ha		Large > 10ha	
		Nos	Area	Nos	Area	Nos	Area	Nos	Area
1	Ananthapur	136299	136111	58002	57941	-	-	-	-
2	Ballari	69825	33881	44046	59976	13787	77267	1581	21979
3	Chikkamagaluru	134046	62582	55867	76814	123	53780	1804	46261
4	Chitradurga	119385	65090	97044	137698	24632	141109	3651	54831
5	Davanagere	120564	59388	65375	90353	9848	54156	758	10946
6	Hassan	393407	149419	103184	143325	8382	46550	986	22255
7	Jogulamba Gadwal	89074	76414	44601	39038	-	-	-	-
8	Koppal	83131	47101	79083	112565	212486	295809	-	-
9	Kurnool	188189	102496	118104	168196	21337	118255	1443	23346
10	Nandyal	178063	90704	95328	135134	13725	77546	858	16299
11	Raichur	110208	62743	92290	130884	29695	172499	4848	81258
12	Sri satya sai	158870	-	120008	-	11802	-	952	-
13	Tumkur	301432	133908	123216	172508	22926	128408	2725	40772
14	Vijayanagara	95450	46241	64881	89997	14836	82925	1505	21581

7.3 Livestock holdings

Livestock holdings constitute an important component of the rural economy in the Krishna River Basin and significantly contribute to livelihood security, nutritional support, and supplementary income generation for farming communities. Livestock rearing activities such as dairy farming, poultry, sheep rearing, goat farming, and cattle husbandry are widely practiced across the basin due to their close integration with agricultural systems. In the present study, livestock assessment has been carried out for major livestock categories including cattle, buffalo, sheep, goat, and pig populations. The distribution and density of livestock holdings vary across different regions depending on availability of fodder resources, water availability, grazing land, climatic conditions, and socio-economic characteristics of the population. Assessment of livestock holdings is essential for understanding rural economic dependency, resource utilization patterns, and the role of allied agricultural activities in supporting sustainable development within the basin.

The livestock holdings data for the Krishna River Basin has been compiled using secondary information collected from Districts at Glance reports and District Statistical Reports (DSR) of all districts falling within the four states of the basin. The district-wise data has been consolidated and analyzed to prepare a comprehensive livestock holdings profile for the entire Krishna River basin.

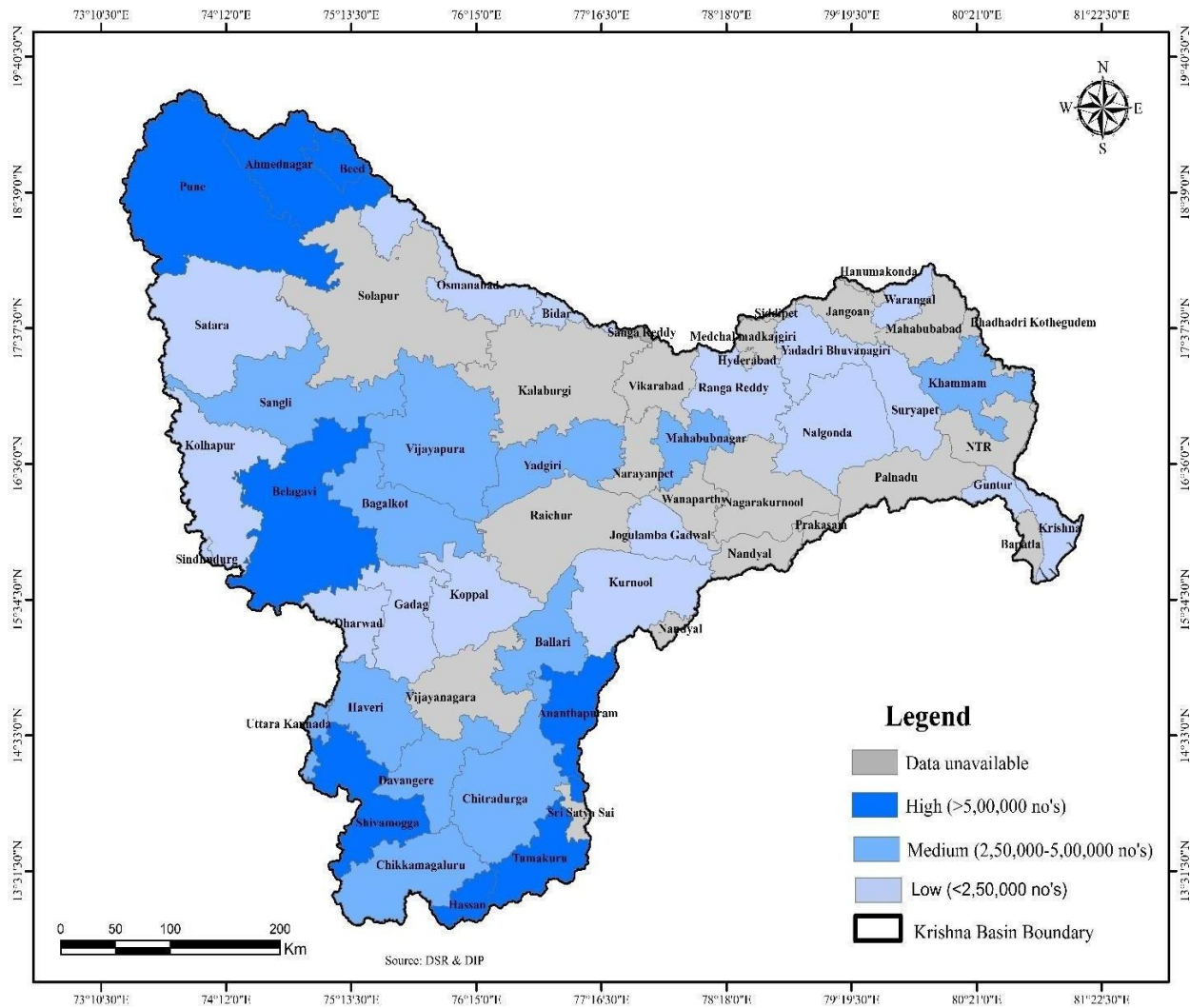


Figure 90: Cattles in the districts of Krishna River Basin

Goats: The distribution of Goats population across districts of the Krishna River Basin is categorized into high, medium, and low population zones. High goat populations are mainly concentrated in the western and southern districts such as Pune, Satara, Sangli, Belagavi, Vijayapura, and Tumakuru, indicating strong livestock activity in these regions. Medium and low populations are observed in the eastern districts, while some central districts have unavailable data. Goats in dictricts of krishna River Basin is represented in figure 21 below.

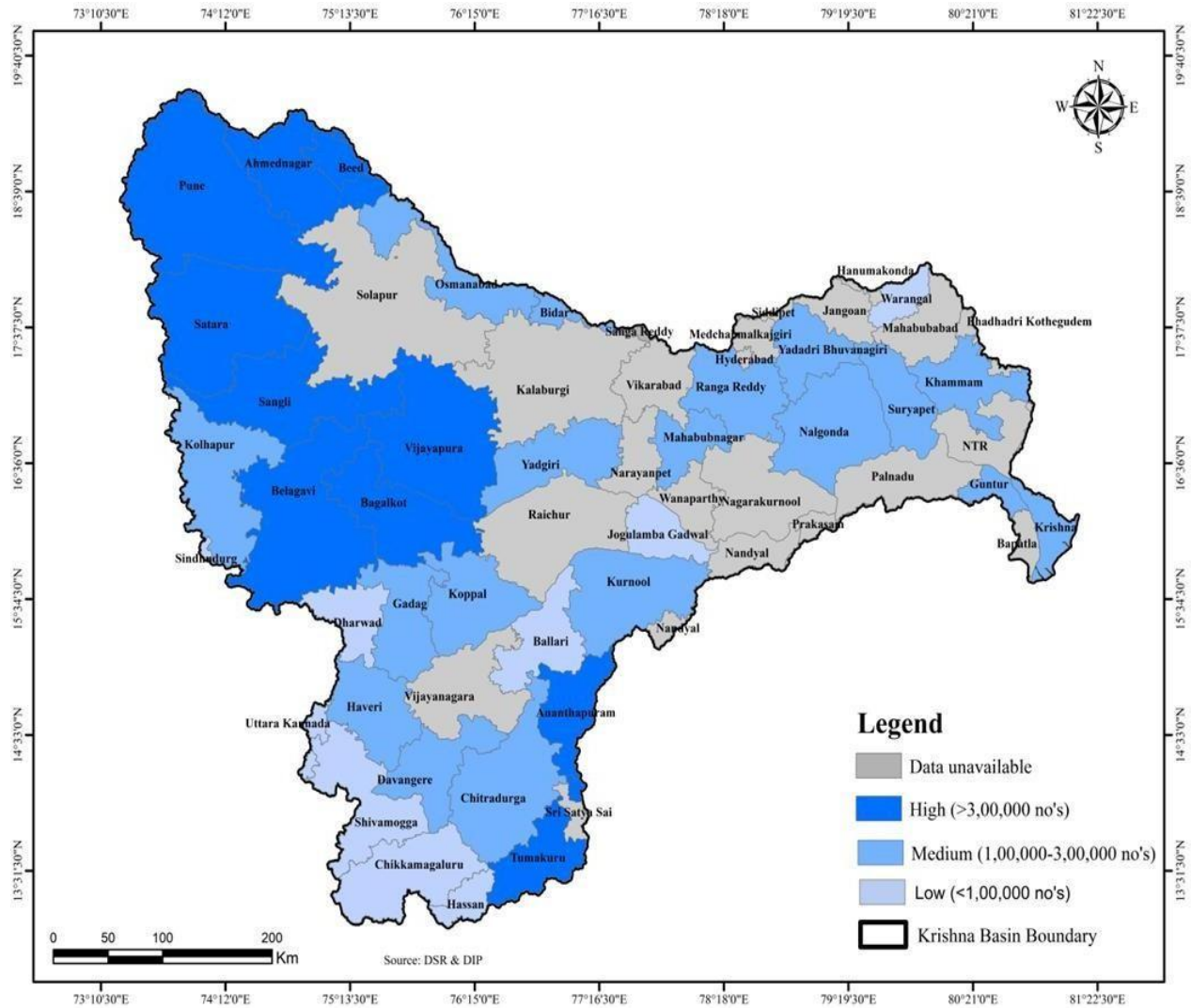


Figure 10: Goats in the districts of Krishna River Basin

Pigs: Pig populations are mainly concentrated in districts such as Belagavi, Bagalkot, Vijayapura, and Anantapur, indicating greater pig-rearing activity in these regions. Most other districts show low to medium populations, while several central and eastern districts have unavailable data. Pigs in districts of Krishna River Basin is represented in figure 22 below.

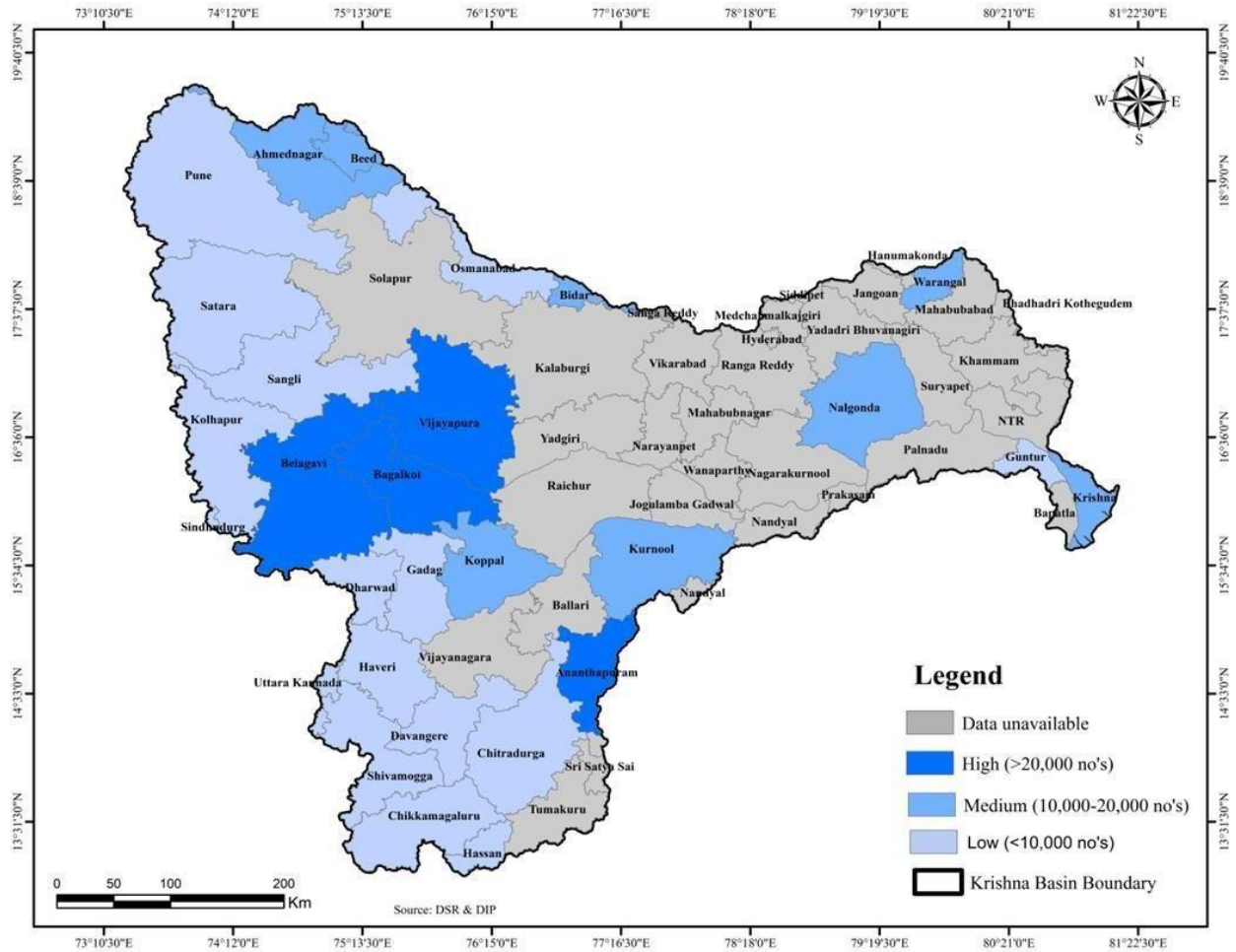


Figure 22: Pigs in the districts of Krishna River Basin

Sheeps: High sheep populations are concentrated in districts such as Bagalkot, Belagavi, Koppal, Kurnool, Nalgonda, and Tumakuru, showing the importance of sheep rearing in these semi-arid regions. Medium populations are spread across several neighbouring districts, while some districts have low populations or unavailable data. Sheeps in districts of krishna River Basin is represented in figure 23 below.

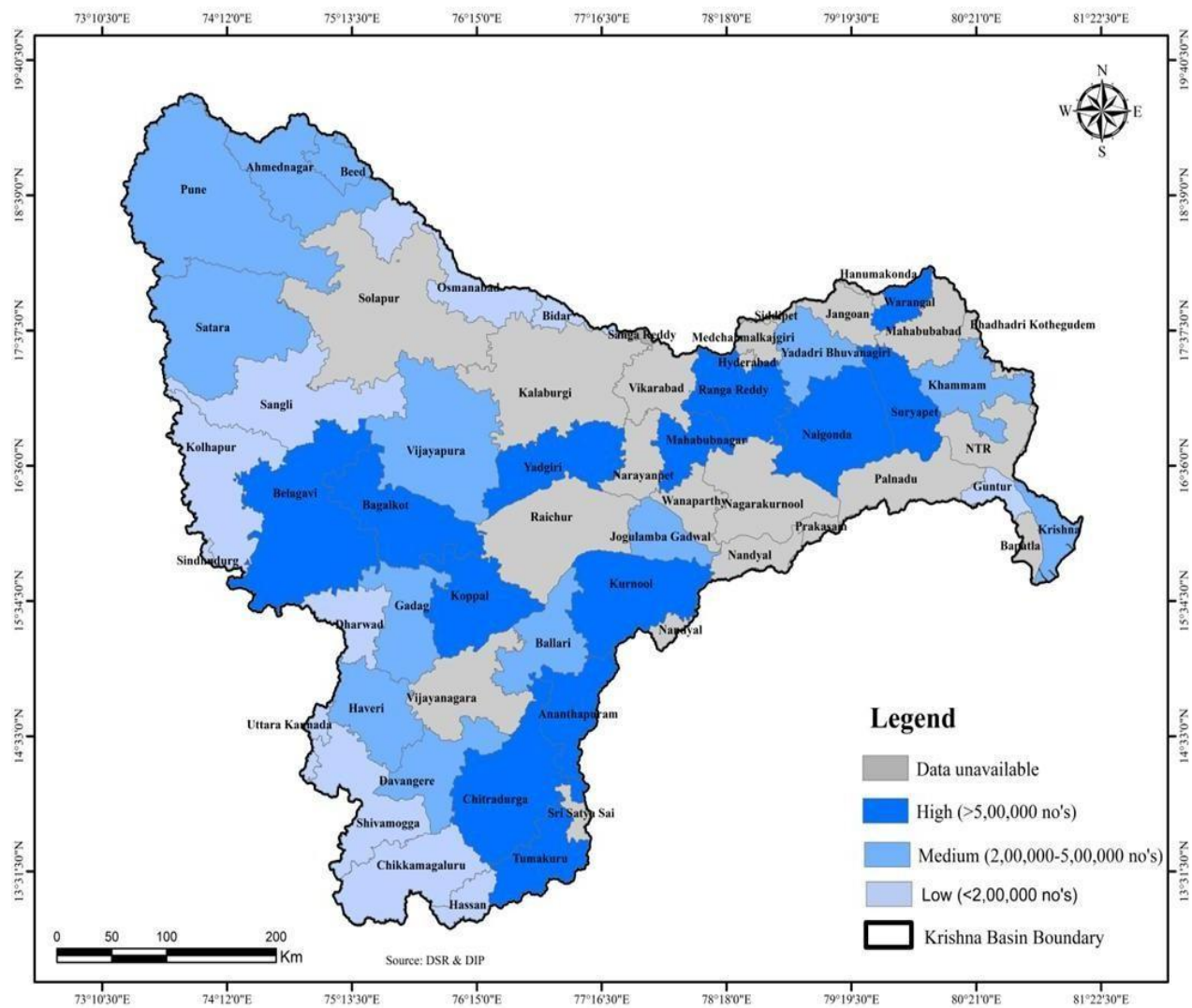


Figure 11: Sheeps in the districts of Krishna River Basin

8. Government Schemes and Institutional Support in Krishna River Basin

The Government of India has implemented, with the cooperation of states, multiple flagship schemes to support sustainable agriculture, many of which have been operational across the Krishna River Basin in varying degrees. Since these portals related to these schemes do not provide basin wise data, this report discusses the major government schemes with respect to states in which Krishna River Basin falls.

8.1. Overview of Major agriculture related Government Schemes

8.1.1 PM-KISAN (Pradhan Mantri Kisan Samman Nidhi)

- **Primary purpose:** An important objective of Pradhan Mantri Kisan Samman Nidhi in the Krishna River Basin is to provide ₹6,000 annual financial assistance to eligible farmer families for supporting agricultural input costs and improving farmer livelihoods.
- **Study coverage within the basin:** The scope of Pradhan Mantri Kisan Samman Nidhi extends across the eligible agricultural districts located within the Krishna River Basin.

Table 54: PM-KISAN Beneficiaries (State-wise) – 2023-2024

Sl. No	State/UT	Initial Beneficiaries (Dec-Mar) 16 th Installment	Middle Phase Beneficiaries (Apr-Jul) 17 th Installment	Final Beneficiaries (Aug-Nov) 18 th Installment
1	Andhra Pradesh	40,76,229	41,40,569	41,22,252
2	Karnataka	44,34,025	43,04,818	43,47,737
3	Maharashtra	89,61,525	91,43,017	91,41,983
4	Telangana	30,64,579	30,98,116	30,77,274

Source: www.data.gov.in

The PM-KISAN scheme data presents beneficiary distribution across four states during the 16th to 18th installment cycle (Dec–Nov period). Overall, the figures remain relatively stable with minor fluctuations across phases. Maharashtra accounts for the maximum share of beneficiaries, ranging around 89–91 lakh, followed by Karnataka with about 43–44 lakh beneficiaries. Andhra Pradesh maintains a consistent level of nearly 41 lakh beneficiaries, while Telangana reflects the minimum share among the states, with around 30–31 lakh beneficiaries. Overall, Maharashtra shows the strongest beneficiary base among the states of Krishna River Basin, while Telangana records the lowest coverage in comparison. In the Krishna Basin region, PM-KISAN plays a key role in strengthening farm household income support and improving rural financial stability, thereby contributing to agricultural sustainability.

8.1.2 PMKSY (Pradhan Mantri Krishi Sinchayee Yojana)

- **Aim:** PMKSY is a government scheme aimed at expanding irrigation coverage, improving water use efficiency, promoting drip and sprinkler irrigation, developing water conservation structures, and reducing dependence on rainfall in agriculture.
- **Major components within the basin:**
 - **Accelerated Irrigation Benefits Programme (AIBP)** – completion of major and medium irrigation projects
 - **Har Khet Ko Pani (HKKP)** – ensuring water supply to every farm through new sources, distribution systems, and restoration of water bodies
 - **Per Drop More Crop** – promoting micro-irrigation (drip and sprinkler) for efficient water use
 - **Watershed Development Component** – rainwater harvesting, soil conservation, and land development in rainfed areas.

Table 55: Central Assistance Released PMKSY in Krishna Basin States (₹ in Crore) 2021-22

Sl.NO	State/UT	Accelerated Irrigation Benefits Programme(AIBP)	Har Khet Ko Pani(HKKP)	Watershed Development Component(WDC)	Per Drop More Crop(PDMC)
1	Andhra Pradesh	91.81	2.7	746.32	2284.16
2	Karnataka	1268.29	30	792.19	2509.15
3	Maharashtra	2514.73	NA	1141.12	1960.46
4	Telangana	1017.82	104.56	335.87	679.32

Source: www.data.gov.in

8.1.3 Krishi Vigyan Kendras (KVKs) in the Krishna Basin

A Krishi Vigyan Kendra (KVK) is a district-level farm science centre established by ICAR that helps farmers by transferring agricultural research into practical field-level technologies through training, demonstrations, and advisory services. In the Krishna River basin, Krishi Vigyan Kendras support farmers by promoting improved water management and sustainable farming practices. They also help in adopting modern agricultural technologies to increase productivity. Table shows extension programmes and number of participants in the basin states of the Krishna River Basin.

Table 56: Extension Programmes and No. of Participants in the Krishna Basin States (2021-22)

Category	Andhra Pradesh	Karnataka	Maharashtra	Telangana
No. of KVKs	24	33	50	16
Extension Programmes	12901	66856	18869	4992
Total Participants	1283923	994588	1110768	1015653

Source: ICAR, data.gov.in

8.1.4. The Soil Health Card (SHC) Scheme

The Soil Health Card (SHC) Scheme was launched by the Government of India to assess soil quality and provide farmers with recommendations on proper nutrient and fertilizer use. The main aim of the scheme is to improve soil fertility, promote balanced fertilizer application, and support sustainable agricultural production. Soil Health Cards help farmers understand the nutrient status of their soil and guide them in selecting suitable crops and fertilizers. In the Krishna basin states, a large number of Soil Health Cards were distributed during different phases of the programme from 2015 to 2021. Among these states, Maharashtra recorded the highest number of SHCs issued with 2.62 crore cards, followed by Karnataka with 1.70 crore cards. Andhra Pradesh and Telangana also showed significant coverage under the scheme. Most cards were distributed during Cycle-I (2015–17) and Cycle-II (2017–19), indicating the major implementation phase of the programme. The scheme aims to improve agricultural productivity, reduce excessive fertilizer use, maintain soil health, and encourage sustainable farming practices in the Krishna River basin region.

Table 57: Number of Soil Health Cards Issued to Farmers in Krishna Basin States

Sl. No	State/UT	Cycle-I (2015-17)	Cycle-II (2017-19)	Model Village Programme(2019-20)	2020-21	Total SHCs Issued
1	Andhra Pradesh	7455204	6927733	226487	NA	14609424
2	Karnataka	7832189	9073145	73221	40404	17018659
3	Maharashtra	12977232	13067735	201837	NA	26246804
4	Telangana	5720737	4842509	110664	165527	10839437

9. Conclusion

Agriculture in the Krishna River Basin plays a vital role in supporting regional livelihoods, economic development, and food security across the basin states. The study shows that agriculture is widely practiced across the basin due to favourable climatic conditions, fertile soils, and extensive irrigation facilities available in different sub-basins including Upper

Krishna, Middle Krishna, Lower Krishna, Upper Bhima, Lower Bhima, Upper Tungabhadra and Lower Tungabhadra. Major crops such as rice, sugarcane, cotton, maize, groundnut, and chickpea contribute substantially to regional agricultural production and rural livelihoods. The analysis also indicates considerable variation in agricultural land use, cropping intensity, and irrigation practices among districts due to differences in topography, water availability, and farming conditions. Surface water and groundwater resources play a crucial role in sustaining agricultural productivity, although increasing dependence on groundwater extraction has created pressure on water resources and environmental sustainability. The extensive use of fertilizers and pesticides has further raised concerns regarding soil degradation, water pollution, and ecological imbalance within the basin. Government schemes and institutional support have improved irrigation infrastructure, agricultural productivity, and farmer welfare in many regions. However, challenges such as climate variability, declining groundwater levels, land degradation, and inefficient water use continue to affect sustainable agricultural development. Therefore, adoption of efficient irrigation methods, groundwater recharge measures, crop diversification, and sustainable farming practices is essential for ensuring long-term agricultural productivity and environmental conservation in the Krishna River Basin.

10. Recommendations and Role of Stakeholders

Recommendations: The Krishna River Basin requires sustainable and integrated agricultural management practices to ensure long-term productivity and water security. Efficient irrigation techniques such as drip and sprinkler irrigation should be promoted to reduce excessive water consumption and improve irrigation efficiency. Groundwater recharge measures including rainwater harvesting, check dams, percolation tanks, and watershed development should be strengthened to address declining groundwater levels. Crop diversification towards less water-intensive and climate-resilient crops can help reduce pressure on water resources and improve farm sustainability. Balanced application of fertilizers and pesticides along with the adoption of organic and integrated nutrient management practices should be encouraged to minimize soil degradation and water pollution. Modern agricultural technologies, precision farming, and climate-smart agricultural practices should be promoted to enhance productivity and resource-use efficiency. Strengthening agricultural extension services and farmer awareness programs is essential for improving knowledge regarding sustainable farming practices and efficient resource management. Improved data monitoring, basin-level planning, and inter-state coordination are also necessary for effective agricultural and water resource management within the Krishna River Basin.

Role of Stakeholders: Stakeholders play a crucial role in ensuring sustainable agricultural development and water resource management. Government agencies are responsible for implementing irrigation projects, groundwater management policies, farmer welfare schemes, and sustainable agricultural programs. Agricultural departments and research

institutions should provide technical guidance, climate-resilient crop strategies, and modern farming technologies to farmers. Farmers play a major role in adopting efficient irrigation methods, balanced fertilizer use, crop diversification, and sustainable farming practices at the field level. Local communities and water user associations should actively participate in watershed management, groundwater recharge activities, and maintenance of irrigation infrastructure. Financial institutions and organizations such as NABARD can support farmers through agricultural credit, subsidies, and capacity-building programs. Non-governmental organizations and environmental agencies can contribute by creating awareness regarding water conservation, soil health, and ecological sustainability. Effective coordination among all stakeholders is essential for achieving sustainable agriculture, efficient water utilization, and long-term environmental conservation in the Krishna River Basin.

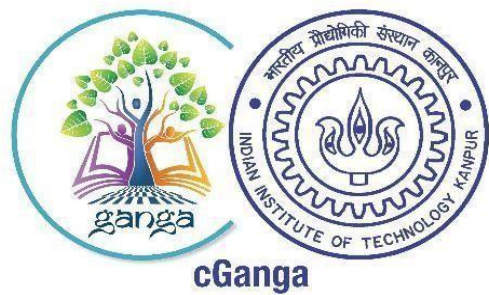
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