

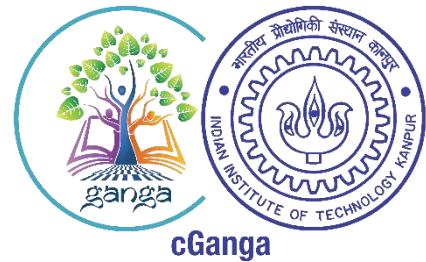


National River Conservation Directorate
Ministry of Jal Shakti,
Department of Water Resources,
River Development & Ganga Rejuvenation
Government of India

Godavari River Basin Land and Vegetation Dynamics: A Revenue Map-Driven Assessment



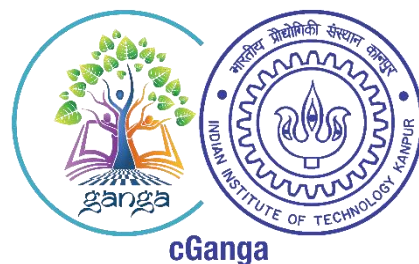
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National River Conservation Directorate (NRCD)

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.

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

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Acknowledgment

This report is a comprehensive outcome of the project jointly executed by CSIR-NEERI (Lead Institute) and IIT Hyderabad (Fellow Institute) under the supervision of cGanga at IIT Kanpur. It is submitted to the National River Conservation Directorate (NRCD) in 2025. We gratefully acknowledge the individuals who provided information for this report.

Disclaimer

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

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Preface

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

Throughout the following pages, you will find detailed insights into infrastructure related to water resource management, along with development plans focused on urban areas, sanitation systems, and riverfront management, all of which directly impact the health, safety, and resilience of communities across the basin.

This document is not merely a technical assessment; it is a call to action. We urge decision-makers, planners, community leaders, and citizens alike to recognize the vital role of infrastructure in shaping a more equitable and resilient future. Whether you are involved in policy, engineering, environmental planning, or community development, this report is designed to support informed decision-making and collaborative action across sectors.

We extend our heartfelt gratitude to the many stakeholders, experts, and institutions who have contributed their insights, data to this report. 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 act as a catalyst for integrated and inclusive development, fostering long-term resilience, public health, and environmental sustainability for both present and future generations.

As you delve into the following sections, we invite you to consider both the challenges and the opportunities presented by the evolving needs of the basin. Together, through informed planning and collective responsibility, we can create a future where infrastructure serves not only human needs but also the long-term health of our environment.

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Management Studies (cGodavari)
CSIR-NEERI, IIT Hyderabad

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ABBERVATIONS

AICRP-IFS – All India Coordinated Research Project on Integrated Farming Systems
APCNF – Andhra Pradesh Community-Managed Natural Farming
APSAC – Andhra Pradesh State Remote Sensing Applications Centre
CWC – Central Water Commission
GIMMS3g – Global Inventory Modelling and Mapping Studies – 3rd Generation
Ha – Hectare
ISRO – Indian Space Research Organisation
LDN – Land Degradation Neutrality
MODIS – Moderate Resolution Imaging Spectroradiometer
MoEF & CC – Ministry of Environment, Forest and Climate Change
MSAAPCC – Maharashtra State Adaptation Action Plan on Climate Change
NAP – National Action Plan (India's plan to combat desertification & land degradation)
NDVI – Normalized Difference Vegetation Index
NICRA – National Innovations on Climate Resilient Agriculture
NRSC – National Remote Sensing Centre
OFSDP-II – Odisha Forestry Sector Development Project – Phase II
PMKSY – Pradhan Mantri Krishi Sinchai Yojana
PM-RKVY – Pradhan Mantri Rashtriya Krishi Vikas Yojana
QGIS – Quantum Geographic Information System
SAC – Space Applications Centre
SDGs – Sustainable Development Goals
Sq Km – Square Kilometre
UNCCD – United Nations Convention to Combat Desertification
VCI – Vegetation Condition Index
WRIS – Water Resources Information System (India-WRIS WebGIS)

Executive Summary

This report presents a spatially integrated analysis of land use transformation, land degradation, and vegetation health across the Godavari River Basin between 2000 and 2022. Spanning over 3,12,000 square kilometres across eight Indian states, the basin plays a vital role in India's ecological balance and economic productivity. Using district-level revenue data, satellite-derived vegetation indices (NDVI), and QGIS-based spatial analysis, the study provides a comprehensive understanding of how land use patterns, degradation processes, and vegetative dynamics have evolved over the last two decades. The findings highlight the simultaneous pressures of urbanization, agricultural decline, and ecological stress raising critical concerns for long term sustainability and regional planning.

Key observations show that forest cover has improved in parts of the basin, notably in Andhra Pradesh and Maharashtra, largely due to afforestation and conservation programs. However, these gains are offset by declines in categories like permanent pasture, tree groves, and culturable wastelands, with fallow lands increasing sharply especially in Andhra Pradesh and Telangana, suggesting stress on rainfed agriculture and a gradual retreat from cultivation. Net sown area remains stable in absolute terms but is declining as a share of total land, reflecting the growing prominence of non-agricultural land uses. Vegetation health, as measured by NDVI, displays strong seasonal resilience but no long-term upward trend, with persistent stress in pre-monsoon months across most districts. The degradation analysis further reveals that water erosion and vegetation degradation are the most widespread threats, concentrated particularly in semi-arid districts of Telangana, Maharashtra, and parts of Chhattisgarh and Odisha.

These trends point to the urgent need for tailored, district-level policy responses. Restoring long-fallow and culturable wastelands through regenerative agriculture, promoting afforestation in high-stress zones, and protecting remaining pasture and tree-based systems are critical. Sustainable land management must move beyond expanding cultivation to improving land productivity through practices like natural farming and soil conservation. Policy efforts should also focus on creating basin-level vegetation and degradation monitoring systems to guide adaptive responses. Ultimately, aligning spatial diagnostics with climate-resilient land use planning will be central to achieving long-term ecological sustainability and fulfilling India's Land Degradation Neutrality (LDN) commitments.

1. INTRODUCTION

The Godavari River Basin, India's second-longest river system and the largest in southern India, is a vital ecological and economic region. Originating at an elevation of approximately 1,067 meters in the Sahyadri Hills near Trimbakeshwar, Maharashtra, the river flows approximately 1,465 km in a generally southeast direction through Maharashtra, Telangana, and Andhra Pradesh, before emptying into the Bay of Bengal roughly 97 kilometres south of Rajahmundry in Andhra Pradesh. The basin covers an area of 312,813 square kilometres, accounting for nearly 10% of India's total geographical area, and extends across parts of Maharashtra, Karnataka, Madhya Pradesh, Chhattisgarh, Odisha, Telangana, Andhra Pradesh, and a small part of Puducherry. Key tributaries include the Pravara, Purna, Manjra, Maner, Pranhita, Penganga, Wardha, Indravati, and Sabari rivers (Central Water Commission, 2014).

1.1. Geography and Ecology

The basin is bounded by the Satmala Hills, Ajanta Range, and Mahadeo Hills in the north, the Western Ghats in the west, and the Eastern Ghats in the east and south. It is triangular, with the main river channel forming the base. The Godavari Basin spans five Agro Climatic zones and six Agro Ecological zones, reflecting its environmental diversity. Land cover is dominated by agriculture (59.57%), followed by forests (29.78%) and water bodies (2.06%) (Central Water Commission, 2009). The region supports varied soil types including black, red, lateritic, alluvial, mixed, saline, and alkaline soils, each influencing local agricultural patterns.

1.2. Natural and Economic Resources

The basin's forests, though only partially utilised, contribute to timber production and the manufacturing of paper and other wood-based products. It is rich in minerals such as bauxite, manganese, iron ore, and coal, with smaller deposits of lead, zinc, corundum, refractory minerals, and kaolin (CWC, 2014). Mining—particularly for coal and manganese—plays a significant role in mineral-rich districts, with a substantial portion of output being exported. The region also supports a range of Agro based industries including rice milling, cotton ginning, sugar production, textiles, and oil extraction from groundnut and other oilseeds. Small-scale engineering industries are distributed across the basin, contributing to local industrial growth.

1.3. Rationale for the Study

The Godavari Basin faces rapid land use changes driven by urbanisation, industrial expansion, and climate variability. These pressures have direct implications for ecological stability, agricultural productivity, and rural livelihoods. Understanding spatial and temporal trends in land use, environmental degradation, and vegetation health is critical for formulating policies that balance economic development with environmental conservation.

1.4. Scope and Structure of the Report

This report focuses exclusively on the Godavari River Basin, covering districts that fall either fully or partially within the basin boundary. The analysis is based on revenue maps, district-level statistics, and satellite-derived vegetation indices. The scope is limited to understanding land use dynamics, degradation patterns, and vegetation health, with an emphasis on sustainable management of natural resources in the basin.

The report is organised into five sections. Section 1 introduces the Godavari River Basin by outlining its geography, ecology, natural and economic resources, and the motivation for undertaking the present study. Section 2 presents the revenue maps of the basin, identifying the state-wise distribution of fully and partially covered districts, and analyses the statistical trends in land use categories over two points of time. Further, it explores district-level variations to highlight differences in land use change across the basin. Section 3 examines patterns of land degradation, providing a consolidated view for the entire Godavari Basin as well as a state-wise analysis. Within this section, subsections are dedicated to the district-level variations that explain the heterogeneity in degradation across the basin. Section 4 evaluates vegetation health using the NDVI index by calculating the average NDVI values at the state level, which are derived by compressing and aggregating the district-level data. This enables a comparative assessment of vegetation stress and recovery across the states within the basin. Finally, Section 5 provides the conclusion, bringing together the major findings of the study and proposing policy directions for sustainable land and resource management in the Godavari River Basin.

This report uses the Revenue Map and district-level data to:

1. Analyse land use patterns and their evolution from 2000-01 to 2022-23.
2. Assess the extent and drivers of environmental degradation.
3. Evaluate vegetation health using NDVI satellite data.
4. Recommend strategies for sustainable land and resource management.

2. REVENUE MAP AND LAND USE TRENDS

2.1. Introduction

Land use patterns are a key indicator of a region's environmental setting, infrastructure development, and prevailing climatic conditions. They emerge from the interaction of diverse physical, ecological, and socio-economic factors. Beyond simply depicting land cover, land use analysis provides valuable insights into the extent and nature of environmental change, including degradation within the catchment areas of river basins. For this reason, land use studies are integral to environmental assessments (Central Water Commission, 2009).

In India, land use statistics are generally compiled at administrative unit levels—such as blocks, tehsils, or districts—by the respective government departments. As such, data are rarely available in formats aligned with natural river basin boundaries. To address this limitation, the present study aggregates district-level land use data to match the geographical extent of the Godavari River Basin. This has been carried out on a state-wise basis, identifying all districts falling wholly or partially within the basin in each state. The compiled data were then restructured to enable a basin-level assessment, allowing for a more integrated understanding of spatial patterns and temporal changes in land utilization.

The following section details the methodology, including spatial delineation of basin boundaries, identification of relevant districts, data sources, and the classification framework used for analysis.

2.2. Data and Methodology

The Godavari River Basin spans multiple states and encompasses numerous administrative districts. In this study, basin boundaries were delineated using QGIS (Quantum Geographic Information System) software, and all districts falling wholly or partially within these boundaries were identified at the state level. This spatial delineation formed the basis for compiling district-wise land use data relevant to the basin.

Since official land use statistics in India are maintained at the district level rather than for natural river basins, basin-level figures were generated by aggregating district data according to the proportion of each district lying within the basin. Land utilization for the basin was computed as the sum of each land use category within the relevant districts.

The districts included in this analysis span the states of Maharashtra, Andhra Pradesh, Telangana, Chhattisgarh, Madhya Pradesh, Odisha, Karnataka, and the Union Territory of Puducherry (Yanam region). A detailed list of districts, organized by state, is provided in *Appendix 1*.

The primary data source is the Directorate of Economics and Statistics (DES), Department of Agriculture and Farmers Welfare, Government of India. District-level statistics for each state were obtained from the DES District Dashboard ¹which follows the Nine-Fold Classification of Land Use prescribed by the Ministry of Statistics and Programme Implementation (MoSPI).

NINE-FOLD CLASSIFICATION:

1. **Forest Area:** This includes all land classified as forest under any legal enactment or administered as forest, whether State-owned or private, and whether wooded or maintained as potential forest land. The area of crops raised in the forest and grazing lands, or areas open for grazing within the forests, remains included under the “forest area.”
2. **Area under Non-agricultural Uses:** This includes all land occupied by buildings, roads, and railways or under water, e.g., rivers and canals, and other land put to uses other than agriculture.
3. **Barren and Unculturable Land:** This includes all land covered by mountains, deserts, etc. Land, which cannot be brought under cultivation except at an exorbitant cost, is classified as unculturable, whether such land is in isolated blocks or within cultivated holdings.
4. **Permanent Pasture and other Grazing Land:** This includes all grazing land, whether it is permanent pasture/meadows or not. Village common grazing land is included under this category.
5. **Culturable Waste Land:** This includes land available for cultivation, whether taken up or not taken up once but not cultivated during the last five years or more in succession, including the current year for some reason or the other. Such land may be either fallowed or covered with shrubs and jungles, which are not put to any use. They may be accessible or inaccessible and may lie in isolated blocks or within cultivated holdings.

¹ <https://data.desagri.gov.in/weblus/classification-of-area-report-web>.

6. **Fallow Lands other than Current Fallows:** This includes all land that was taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years.
7. **Current Fallows:** This represents the cropped area, which is kept fallow during the current year.
8. **Net Area Sown:** This represents the total area shown with crops and orchards. Area sown more than once in the same year is counted only once.
9. **Land under Miscellaneous Tree Crops, etc.:** This includes all cultivable land, which is not included in 'Net area sown' but is put to some agricultural use. Land under casuarina trees, thatching grasses, bamboo bushes, and other groves for fuel, etc., which are not included under 'Orchards,' are classified under this category.

The initial step involves constructing a Revenue Map to represent the revenue divisions of each state within the Godavari River basin. In the next step, we will provide detailed insights into the distribution and utilization of land across various districts within the Godavari River basin. This subsequent step will present the statistical data for each land-use category.

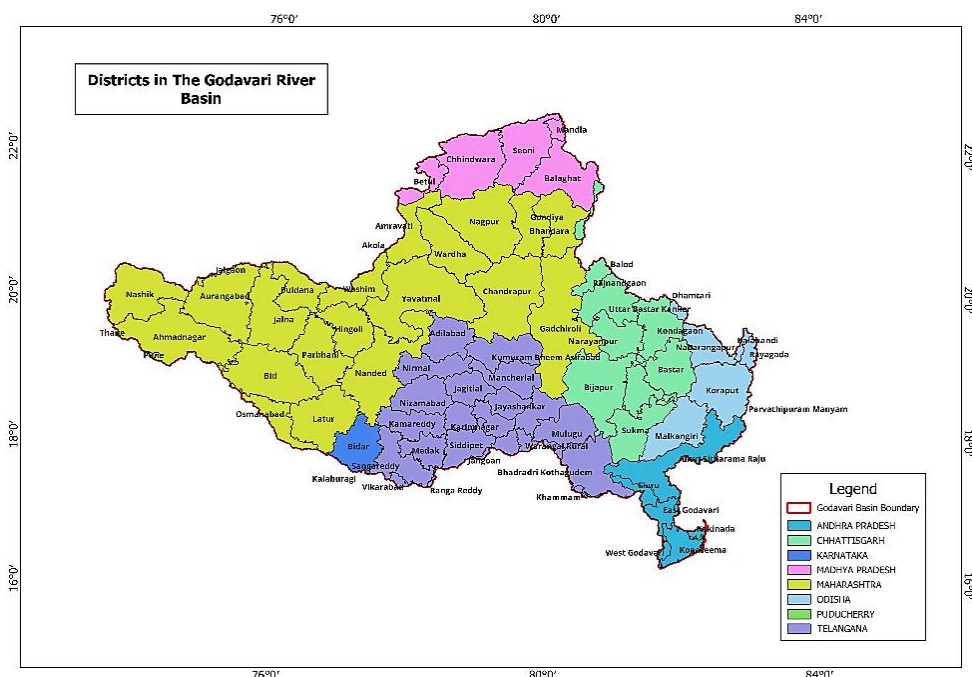
2.3. Revenue Map of Godavari River Basin

We have presented the land use trends for the Godavari River Basin at the state level, covering the districts that fall within the basin across Andhra Pradesh, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, and Telangana. The Union Territory of Puducherry has not been analysed separately, as only a small portion of the Yanam region lies within the Godavari Basin. In the subsequent section, we will present a consolidated overview of land utilization trends across the entire Godavari River Basin, aggregating the patterns observed across the covered states to provide a comprehensive understanding of land use dynamics in the region.

The districts covered in the Godavari River Basin span multiple states (Figure 1), with their inclusion based on different census years. In Andhra Pradesh, the districts included Alluri Sitharama Raju, East Godavari, Kakinada, Konaseema, Eluru, West Godavari, and Parvathipuram Manyam. In Telangana, based on the 2016 Census, the districts forming part of the basin are Adilabad, Karimnagar, Bhadrachalam, Siddipet, Nizamabad, Ranga Reddy, Kumuram Bheem Asifabad, Mancherial, Nirmal, Kamareddy, Sangareddy,

Vikarabad, Medchal Malkajgiri, Khammam, Mahabubabad, Jangoan, Warangal Urban, Warangal Rural, Jayashankar, Peddapalli, Jagitial, Rajanna Sircilla, and Medak, while Mulugu is included as per the 2019 records.

Figure 1: Godavari Basin Districts



Source: Revenue Map of the Godavari River Basin developed using QGIS.

Note: The figure illustrates the districts within the Godavari River Basin, spanning eight Indian states. Each state is distinguished using a specific colour for easy identification. Andhra Pradesh is shown in sky blue, Chhattisgarh in green, Karnataka in dark blue, Madhya Pradesh in teal green, Maharashtra in yellow, Odisha in light aqua blue, and Telangana in purple.

In Maharashtra, the districts forming part of the Godavari Basin as per the 2011 Census include Ahmadnagar, Akola, Amravati, Aurangabad, Bhandara, Bid, Buldana, Chandrapur, Gadchiroli, Gondiya, Hingoli, Jalgaon, Jalna, Latur, Nagpur, Nanded, Nashik, Osmanabad, Parbhani, Pune, Thane, Wardha, Washim, and Yavatmal.

In Madhya Pradesh, the covered districts, as per the 2011 Census, are Balaghat, Betul, Chhindwara, Mandla, and Seoni. In Chhattisgarh, the districts forming part of the basin based on the 2011 Census include Bastar, Bijapur, Dakshin Bastar Dantewada, Dhamtari, Uttar Bastar Kanker, Narayanpur, and Rajnandgaon, while Balod, Kondagaon, and Sukma were updated in 2014. In Odisha, the basin covers the districts of Kalahandi, Koraput, Malkangiri, Nabarangapur, and Rayagada as per the 2011 Census, while Yanam in Puducherry is also part of the basin according to the 2011 Census. Additionally, in Karnataka, the districts included in the Godavari River Basin, based on the 2011 Census, are Bidar and Kalaburagi (Figure 1).

These districts collectively contribute to the diverse land utilization, water resources, and environmental dynamics of the Godavari River Basin, impacting agriculture, forestry, and urbanization trends across the region.

2.4. Land Use of Godavari River Basin

Between 2000 and 2022, the Godavari River Basin experienced measurable changes in land use patterns. Forest area expanded significantly, non-agricultural uses grew steadily, and certain agricultural and ecological categories showed marked declines.

Table 1: Land Use Trends Summary – Godavari River Basin (2000-01 & 2022-23)

Land Use Category	(Value in Hectare)		% Change (2000-01 to 2022-23)
	2000-01	2022-23	
Forests	25,88,526	31,25,418	+20.74
Area under Non-Agricultural Uses	20,11,910	22,98,469	+14.24
Barren and Unculturable Land	12,33,847	11,11,793	-9.89
Permanent Pasture and Other Grazing Land	24,35,320	19,04,583	-21.79
Misc. Tree Crops and Groves	16,26,728	12,43,626	-23.55
Culturable waste Land	1,35,11,191	1,27,19,282	-5.86
Fallow Lands (Other than current Fallows)	3,78,687	3,67,919	-2.84
Current Fallow	2,33,92,174	2,32,53,809	-0.59
Net Area Sown	17,20,434	17,67,673	+2.75
Total Area	4,88,98,817	4,77,92,572	-2.26

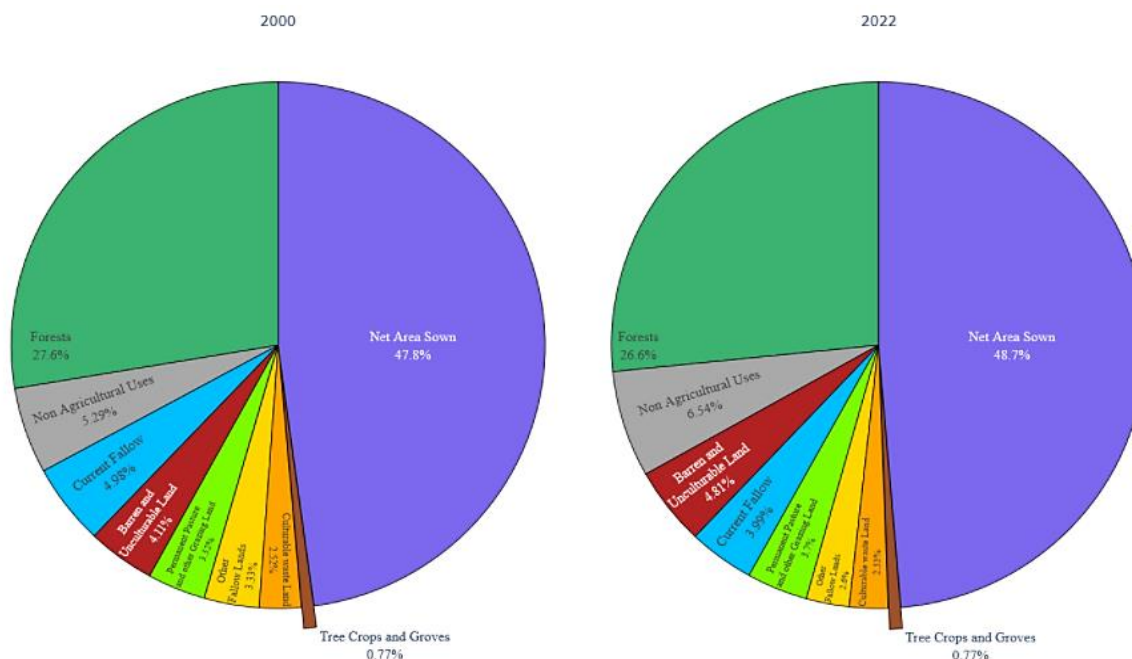
Source: Compiled from Directorate of Economics and Statistics Data.

Note: The observed discrepancies in the total reported land area for the Godavari River Basin may be attributed to differences in data sources and estimation methodologies used in compiling land use statistics. According to *Land Use Statistics briefly: 2013–14 to 2022–23*, in cases where current year data has not been received from State/UT Governments, the figures have been estimated using the most recent data available from earlier years, the Agriculture Census, or advance estimates provided by the respective States (Directorate of Economics and Statistics, 2022).

2.4.1. Discussion & Implications

From an absolute change perspective (Table - 1), forest area grew by over 20% in hectares, likely reflecting afforestation programs, natural regeneration, and improved protection measures. Non-agricultural land uses expanded by 14%, consistent with urban, industrial, and infrastructure growth, suggesting rising competition for agricultural and ecological land. Permanent pasture and miscellaneous tree crops saw declines exceeding 20%, which may indicate conversion to cropland or built-up areas, with potential consequences for biodiversity, rangeland health, and livestock-based livelihoods. Net area sown increased slightly (+2.75%), showing agriculture remains a stable land use but with limited spatial expansion potential.

Figure 2: Land Use Composition as % of Total Geographical Area – Godavari River Basin



Source: Compiled from Directorate of Economics and Statistics Data.

Note: The land use category names in this visual representation have been shortened for clarity and readability. For instance, "Area under Non-Agricultural Uses" is presented as "Non-Agricultural Uses", and "Land under Misc. Tree Crops and Groves not included in Net Area Sown" is shown as "Tree Crops and Groves". These categories are based on the classification provided by the Ministry of Statistics and Programme Implementation (MoSPI). The data represents the share of each land use category as a percentage of the total geographical area in the Godavari River Basin for the years 2000-01 and 2022-23.

From a composition perspective (Figure - 2), net area sown remains the dominant category, increasing from 47.84% to 48.66% of the basin's total area, reinforcing the region's continued dependence on agriculture. Forests, despite substantial absolute gains, fell slightly in proportional share (27.63% → 26.61%), indicating that other land uses—especially non-agricultural—expanded more rapidly. The proportional rise in non-agricultural uses (+1.25 percentage points) highlights ongoing urbanization pressures. Meanwhile, barren land's slight proportional increase (+0.70 percentage points) may reflect localized land degradation or reclassification.

Overall, the trends point to both opportunities and challenges. Gains in forest cover are positive for ecological stability, watershed health, and climate resilience. However, the loss of pasture and agroforestry areas alongside expanding urban land underscores the need for integrated, cross-state land use planning. Such planning should balance conservation, agricultural productivity, and economic development to ensure long-term ecological and livelihood security in the Godavari River Basin.

Key Land Use Trends in the Godavari River Basin (2000-01 & 2022-23)

Land Use Category	Trend	% Change	Basin Share (2000-01 → 2022-23)	What This Indicates
Forest	● Increasing	+20.74%	27.63% → 26.61%	Significant absolute gain. Slight shares drop due to faster growth in other categories. Likely due to afforestation and protection efforts.
Non-Agricultural Uses	● Increasing	+14.24%	5.29% → 6.54%	Urbanisation and infrastructure expansion; strong growth in built-up areas.
Permanent Pastures & Grazing	● Decreasing	-21.79%	3.52% → 3.70%	Fall in area; grazing pressure and biodiversity concerns emerge.
Misc. Tree Crops & Groves	● Decreasing	-23.55%	0.77% → 0.77%	Decline in agroforestry practices; no change in share reflects minor role.
Net Area Sown	● Slight Increase	+2.75%	47.84% → 48.66%	Core agricultural base remains steady with marginal expansion.

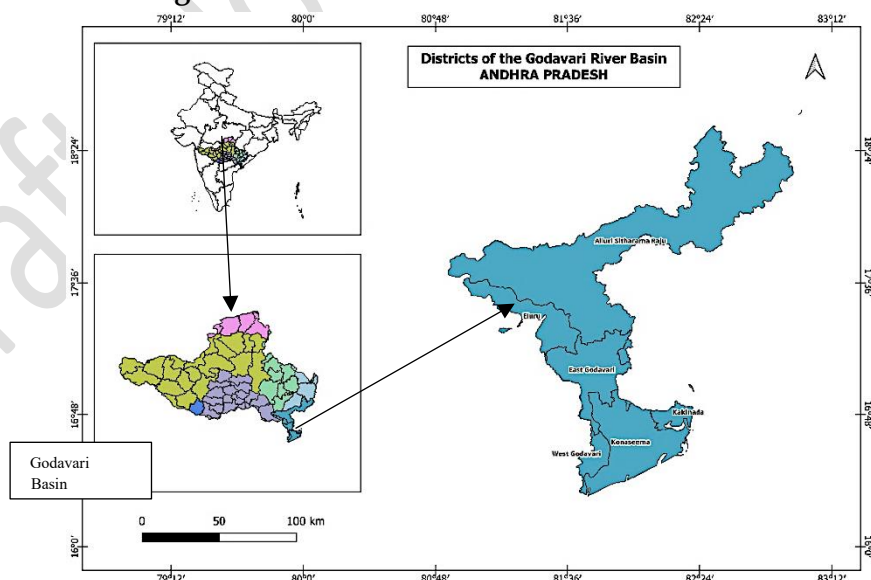
2.5. Land Use Patterns - State Level Overview

While the overall land use changes across the Godavari River Basin indicate broad trends, it is important to note that significant variation exists at the district level. These intra-basin differences reflect the diverse geographical, ecological, and socio-economic conditions prevailing across the basin. Therefore, to capture these differences more accurately, the subsequent section presents a state-wise analysis, wherein the data has been aggregated based on the districts falling within the Godavari River Basin in each respective state. This disaggregated approach allows for a more precise understanding of spatial trends and policy implications across states. The complete list of districts included under the basin in each state is provided in Appendix 1.

2.5.1. Andhra Pradesh

Andhra Pradesh accounts the nearly 5% of Godavari River Basin (4.5%), with seven districts—Alluri Sitharama Raju, East Godavari, Kakinada, Kona Seema, Eluru, West Godavari, and Parvathi puram Manyam—falling wholly or partially within the basin. Land use changes between 2000 and 2022 show a combination of ecological gains, shifts in agricultural practices, and increases in fallow land, shaped by afforestation programs, cropping decisions, and climate variability.

Figure 3: Godavari Basin Districts in Andhra Pradesh



Source: Revenue Map of the Godavari River Basin – Andhra Pradesh, developed using QGIS.

Note: The inset map at the top left shows the Godavari River Basin within India. The middle-left map highlights the basin's spread across states. The primary map on the right shows the Andhra Pradesh districts within the basin, shaded in blue.

Forests experienced the most substantial positive transformation, with a 48.26% increase in area (Table – 2) and a 6.40 percentage in total geographical area share (Table – 3). This reflects the effectiveness of afforestation programs, improved forest management strategies, and potential land reclassification. Fallow lands, excluding those currently fallow, expanded by 176.20% in area and 2.32 percentage in share, while current fallow lands increased by 51.90% in area and 1.13 percentage in share. These patterns may suggest agricultural challenges, interruptions in seasonal cultivation, or evolving economic incentives for farming. The net area sown saw a reduction of 1.18% in area but a notable decrease of 6.42 percentage in share, indicating a contraction of agricultural land within the total geographical area.

Culturable wasteland, permanent pasture, and land under miscellaneous tree crops exhibited declines in both absolute area and share, suggesting a gradual reduction in grazing resources, non-conventional agriculture, and agroforestry practices. The area allocated for non-agricultural uses increased by 6.20% in absolute values but experienced a slight decrease in share by 1.05 percentage. This indicates that although urban and infrastructural development continued, other land use categories, particularly forests, expanded.

Table 2: Change in Land Use Categories – Andhra Pradesh (2000-01 & 2022-23)

Land Use Category	2000-01(ha)	2022-23(ha)	% Change
Forests	4,04,293	5,99,396	+48.26
Non-Agricultural Uses	2,70,349	2,87,099	+6.20
Barren & Unculturable Land	1,24,234	1,23,165	-0.86
Permanent Pasture & Grazing Land	38,833	32,870	-15.36
Misc. Tree Crops & Groves	15,914	12,695	-20.23
Culturable Waste Land	40,116	31,258	-22.08
Fallow Lands (Other than the current Fallows)	30,661	84,686	+176.20
Current Fallow	64,286	97,651	+51.90
Net Area Sown	8,72,695	8,62,370	-1.18
Total Area	18,61,381	21,31,190	+14.50

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The observed discrepancies in the total reported land area for Andhra Pradesh may be attributed to differences in data sources and estimation methodologies used in compiling land use statistics. According to *Land Use Statistics briefly: 2013–14 to 2022–23*, in cases where current year data has not been received from State/UT Governments, the figures have been estimated using the most recent data available from earlier years, the Agriculture Census, or advance estimates provided by the respective States (Directorate of Economics and Statistics, 2022).

**Table 3: Land Use Composition as % of Total Geographical Area in Andhra Pradesh
(2000-01 & 2022-23)**

Land Use Category	2000-01(%)	2022-23(%)	Change (%)
Forests	21.72%	28.12%	+6.40
Non-Agricultural Uses	14.52%	13.47%	-1.05
Barren & Unculturable Land	6.67%	5.78%	-0.89
Permanent Pasture & Grazing Land	2.09%	1.54%	-0.55
Misc. Tree Crops & Groves	0.85%	0.60%	-0.25
Culturable Waste Land	2.16%	1.47%	-0.69
Fallow Lands (Other than the current Fallows)	1.65%	3.97%	+2.32
Current Fallow	3.45%	4.58%	+1.13
Net Area Sown	46.88%	40.46%	-6.42

Source: Compiled from Directorate of Economics and Statistics Data. The data represent the share of each land use category as a percentage of the total geographical area in Andhra Pradesh for the years 2000-01 and 2022-23.

2.5.1.1. District-Level Land Use Analysis

The administrative reorganization effective from 4 April 2022² led to the creation of several new districts within the Godavari River Basin, including Alluri Sitharama Raju, Kakinada, Kona Seema, Eluru, and Parvathi Puram Manyam. However, the present analysis considers only the East Godavari and West Godavari district boundaries. This approach aligns with the original classification used in the source data ((Directorate of Economics and Statistics,)), based on which the land use parameters have been calculated. At the disaggregated level, East Godavari and West Godavari exhibit broadly similar land use change patterns between 2000 and 2022, with variations in magnitude for certain categories. Forest area expanded in both districts, increasing by 44.38% in East Godavari and 63.70% in West Godavari, reflecting strong afforestation and conservation efforts (Table – 4). The most dramatic growth occurred in fallow lands, with Fallow Lands other than Current Fallows rising by 172.71% in East Godavari and 184.29% in West Godavari, and Current Fallow increasing by 37.16% and 78.19% respectively, indicating a shared regional shift towards more uncultivated agricultural land.

² <https://ahd.aptonline.in/AHMS/Views/DownLoads/All26Districts.pdf>.

Table 4 : Land Use Area Change by Districts, Andhra Pradesh (2000-01 & 2022-23)

Land Use Category	East Godavari (%)	West Godavari (%)
Forests	+44.38	+63.70
Non-Agricultural Uses	+27.19	-11.52
Barren & Unculturable Land	-0.12	-2.37
Permanent Pasture & Grazing Land	-13.27	-19.05
Misc. Tree Crops & Groves	-34.53	-5.33
Culturable Waste Land	-5.79	-33.53
Fallow Lands (Other than the current Fallows)	+172.71	+184.29
Current Fallow	+37.16	+78.19
Net Area Sown	-5.34	+3.04

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The above table represents the %= percentage change in hectares from 2000-01 to 2022-23 in selected districts of Andhra Pradesh.

When we observed the change in percentage share of total geographical area between 2000 and 2022, both East and West Godavari show similar trends, with forests and fallow lands gaining, while agricultural and grazing areas decline. Forests recorded the largest share increases, rising by 6.56 percentage in East Godavari and 5.21 percentage points in West Godavari (Table – 5), reflecting sustained afforestation and protection measures. Fallow lands, particularly those other than current fallows, also expanded their share, suggesting a shift towards longer-term idle land. In contrast, the net area sown saw notable share reductions, indicating a contraction of agriculture within the land use mix. Non-agricultural uses increased slightly in East (+0.85) but declined in West (-3.56), pointing to differing development pressures. Other categories, including barren land, permanent pasture, miscellaneous tree crops, and culturable waste, saw marginal decreases in share in both districts.

Table 5 : Share of Total Geographical Area Change by Districts, Andhra Pradesh (2000-01 & 2022-23)

Land Use Category	East Godavari (Change in Share (%))	West Godavari (Change in Share (%))
Forests	+6.56	+5.21
Non-Agricultural Uses	+0.85	-3.56
Barren & Unculturable Land	-1.20	-0.56
Permanent Pasture & Grazing Land	-0.61	-0.47
Misc. Tree Crops & Groves	-0.33	-0.13
Culturable Waste Land	-0.31	-1.18
Fallow Lands (Other than the current Fallows)	+2.58	+1.90
Current Fallow	+0.60	+1.88
Net Area Sown	-8.14	-3.09

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The table shows the change in the share of each land use category as a percentage of the total geographical area between 2000-01 and 2022-23.

Key Highlights State-Level Trends (Andhra Pradesh)

Land Use Category	Area Change (%)	Change in Share (%)	Significance
Forests	+48.26	+6.4	Major ecological gain, likely due to afforestation, regeneration.
Non-Agricultural Uses	+6.2	-1.05	Expansion of built-up and infrastructure areas, supporting urban and economic activities.
Barren & Unculturable Land	-0.86	-0.89	marginal reclamation of unproductive land for potential alternative uses.
Permanent Pasture & Grazing Land	-15.36	-0.55	Reflects reduced grazing land availability, which could affect livestock-based livelihoods.
Misc. Tree Crops & Groves	-20.23	-0.25	Reducing agroforestry output.
Culturable Waste Land	-22.08	-0.69	Conversion of previously unused cultivable land into productive use.
Fallow Lands (Other than the current Fallows)	+176.2	+2.32	Suggests a substantial increase in long-term idle agricultural land, indicating shifts in farming viability.
Current Fallow	+51.9	+1.13	More land left uncultivated within a season, possibly due to water or labour shortages.
Net Area Sown	-1.18	-6.42	Reduced proportion of cultivated land, a gradual shift away from agriculture.

Note: *Area Change (%)*: Percent change in total area under each category (in hectares) between 2000-01 and 2022-23. *Change in Share (%)*: Difference in that category's proportion of total geographical area (in percentage points) between 2000-01 and 2022-23.

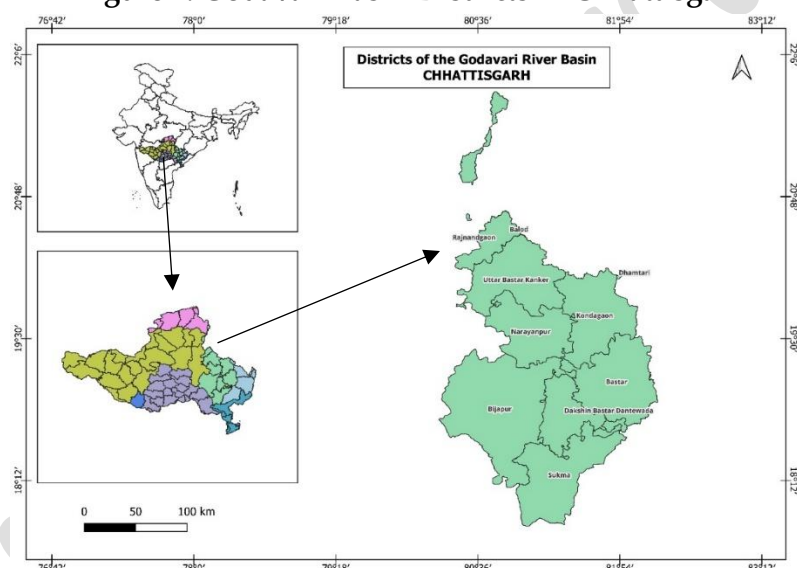
District-Level Highlights

Category	District(s)	Trend	Significance
Major Gains			
● Forests	East Godavari, West Godavari	Large increases in both area and share	Driven by afforestation and conservation efforts.
● Fallow Lands other than Current Fallows	East Godavari, West Godavari	Strong expansion in both absolute and share	Reflects shifts in cultivation viability and longer-term land idling.
Major Losses			
● Net Area Sown	East Godavari	Sharpest drop in share.	Indicates agricultural contraction in the eastern part of the basin.
● Culturable Waste Land	East Godavari, West Godavari	Significant declines in both area and share	Suggests conversion of unused cultivable land to other uses.

2.5.2. Chhattisgarh

Chhattisgarh accounts for nearly 13%³ of the Godavari River Basin, encompassing 10 districts. These include Balod, Bastar, Bijapur, Dantewada, Dhamtari, Kanker, Kondagaon, Narayanpur, Rajnandgaon, and Sukma, which fall wholly or partially within the basin. Between 2000 and 2022, land use changes in Chhattisgarh reflect modest forest gains, notable expansion of non-agricultural uses, and increases in fallow land, particularly in categories other than current fallows. Rising culturable waste land in some district's points to underutilisation of cultivable resources, while reductions in net sown area highlight a gradual shift away from active cultivation towards alternative land uses.

Figure 4: Godavari Basin Districts in Chhattisgarh



Source: Revenue Map of the Godavari River Basin – Chhattisgarh, developed using QGIS.

Note: The insert map at the top left highlights the overall geographical extent of the Godavari River Basin within India, providing a national context for the basin's reach. The middle-left map provides a more focused view of the basin's distribution across various states, emphasizing the intricate network of river systems. The primary map on the right specifically highlights the districts within Chhattisgarh that form part of the Godavari River Basin, shaded in green colour.

Forests in Chhattisgarh recorded positive change, with a 3.22% increase in absolute area (Table 6) and a 1.32 percentage point rise in their share of the total geographical area (Table 7). This suggests incremental gains from afforestation initiatives, sustained forest protection, and potential improvements in forest boundary delineation.

³ Government of India, *Godavari Basin Report*, India-WRIS (2014). Accessed at <https://indiawris.gov.in/downloads/Godavari%20Basin.pdf>.

Table 6: Change in Land Use Categories – Chhattisgarh (2000-01 & 2022-23)

Land Use Category	2000-01(ha)	2022-23(ha)	% Change
Forests	28,92,802	29,86,045	+3.22
Non-Agricultural Uses	1,76,088	2,08,972	+18.67
Barren & Unculturable Land	1,25,817	1,14,938	-8.65
Permanent Pasture & Grazing Land	1,95,482	2,01,919	+3.29
Misc. Tree Crops & Groves	360	1,255	+248.61
Culturable Waste Land	2,19,699	2,47,223	+12.53
Fallow Lands (Other than the current Fallows)	71,237	82,865	+16.32
Current Fallow	81,433	76,489	-6.07
Net Area Sown	13,53,533	12,92,677	-4.50
Total Area	51,16,451	52,12,383	

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The observed discrepancies in the total reported land area for Chhattisgarh may be attributed to differences in data sources and estimation methodologies used in compiling land use statistics. According to *Land Use Statistics briefly: 2013–14 to 2022–23*, in cases where current year data has not been received from State/UT Governments, the figures have been estimated using the most recent data available from earlier years, the Agriculture Census, or advance estimates provided by the respective States (Directorate of Economics and Statistics, 2022).

Non-agricultural uses registered a notable 18.67% rise in area and a 0.57 percentage increase in share, reflecting steady growth in infrastructure, settlement expansion, and other non-farming land uses. Similarly, culturable wasteland expanded by 12.53% in absolute terms and by 0.45 percentage point share, indicating either land degradation or the persistence of underutilized agricultural resources.

Among the most striking changes, land under miscellaneous tree crops and groves increased by 248.61% in area and doubled its share, though this category remains very small in absolute terms. Fallow lands other than current fallows also expanded, increasing by 16.32% in area and 0.20 percentage points in share, which may point to seasonal cultivation challenges or shifts in cropping intensity.

Conversely, barren and unculturable land declined by 8.65% in area and 0.25 percentage in share, which could indicate reclamation for other uses. Current fallows decreased by 6.07% in area and 0.12 percentage in share, while the net area sown contracted by 4.50% in absolute terms and by 1.65 percentage points in share. These patterns reflect a gradual reduction in cultivated land as percentage of state's total geographical area, possibly due to land diversion, resource constraints, or evolving land use priorities.

**Table 7: Land Use Composition as % of Total Geographical Area in Chhattisgarh
(2000-01 & 2022-23)**

Land Use Category	2000-01(%)	2022-23(%)	Change (%)
Forests	56.54	57.29	+1.32
Non-Agricultural Uses	3.44	4.01	+16.56
Barren & Unculturable Land	2.46	2.21	-10.16
Permanent Pasture & Grazing Land	3.82	3.87	+1.30
Misc. Tree Crops & Groves	0.01	0.02	+100
Culturable Waste Land	4.29	4.74	+10.48
Fallow Lands (Other than the current Fallows)	1.39	1.59	+14.38
Current Fallow	1.59	1.47	-7.54
Net Area Sown	26.45	24.80	-6.23

Source: Compiled from Directorate of Economics and Statistics Data. The data represent the share of each land use category as a percentage of the total geographical area Chhattisgarh for the years 2000-01 and 2022-23.

2.5.2.1. District-Level Land Use Analysis

Although the Godavari River Basin in Chhattisgarh comprises 10 districts as per the 2011 Census and subsequent administrative reorganization⁴, the present analysis is based on combined data for four districts—Bastar, Dantewada, Dhamtari, and Kanker—due to the availability and compatibility of data in the Directorate of Economics and Statistics datasets for 2000 and 2022. The land use patterns across the selected districts of Chhattisgarh show mixed trends between 2000 and 2022. Forest areas generally remained stable or increased in some districts, while others saw declines, reflecting local variations in land management. For example, Bastar recorded the largest positive change (+21.33%), while Dhamtari experienced a substantial decline (Table – 8). Non-agricultural uses expanded across all districts, pointing to growing infrastructure and settlement development. highest growth shown in Bastar. Barren and unculturable land showed minimal change, with slight increases in Dantewada (+1.61%) and declines in Dhamtari (–4.65%) and Kanker (–1.38%), possibly reflecting minor reclamation or degradation.

Grazing land and culturable waste land increased notably in a few districts, suggesting shifts in land utilisation and persistence of unused agricultural land. Fallow lands—both current and other than current—grew in most areas, indicating seasonal cultivation gaps or reduced cropping intensity, while net sown area declined in three districts, hinting at a gradual contraction of agricultural land in favour of other uses. The net area sown contracted in all

⁴ <https://cgstate.gov.in/en>.

districts except Dhamtari (+5.66%), reflecting an overall reduction in cultivated land percentage to total area.

In terms of share to the total geographical area, increases occurred in fallow land both other than current and current fallows particularly in Dantewada, Dhamtari, and Bastar, indicating reduced cropping intensity and possible agricultural disruptions. Culturable waste land also expanded sharply in Kanker and Dantewada, suggesting highest portions of land remaining unused for cultivation.

Table 8: Land Use Area Change by Districts, Chhattisgarh (2000-01 & 2022-23)

Land Use Category	Bastar (%)	Dantewada (%)	Dhamtari (%)	Kanker (%)
Forests	+21.33	-0.81	-25.84	-1.51
Non-Agricultural Uses	+29.91	+8.87	+5.98	+4.87
Barren & Unculturable Land	+0.33	+1.61	-4.65	-1.38
Permanent Pasture & Grazing Land	+2.56	+12.68	+0.09	+34.15
Misc. Tree Crops & Groves	NA	+1400	-78.72	NA
Culturable Waste Land	-5.50	+20.92	-23.52	+45.48
Fallow Lands (Other than the current Fallows)	+33.76	+51.27	+29.89	+39.89
Current Fallow	+43.76	+49.40	+51.12	-53.90
Net Area Sown	-6.14	-10.00	+5.66	-9.82

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The above table represents the %= percentage change in hectares from 2000-01 to 2022-23 in selected districts of Chhattisgarh.

Permanent pasture and grazing land grew most prominently in Kanker, highlighting its importance for livestock-based activities in the district. Non-agricultural uses increased across all districts, with the largest gains in Bastar and Dhamtari, reflecting rising infrastructure and settlement expansion. By contrast, forest share declined in three districts—most steeply in Dhamtari—while Bastar saw a moderate gain. Net sown area contracted in most districts except Dhamtari, underscoring a gradual shift away from cultivation in much of the region. Barren and unculturable land generally reduced or remained stable, indicating some reclamation or conversion to other uses.

**Table 9: Share of Total Geographical Area Change by Districts, Chhattisgarh
(2000-01 & 2022-23)**

Land Use Category	Bastar (Change in Share (%))	Dantewada (Change in Share (%))	Dhamtari (Change in Share (%))	Kanker (Change in Share (%))
Forests	+6.29	-1.70	-16.07	-1.51
Non-Agricultural Uses	+13.74	+7.87	+19.91	+4.86
Barren & Unculturable Land	-12.45	+0.69	+7.89	-1.32
Permanent Pasture & Grazing Land	-10.08	+11.74	+13.23	+34.22
Culturable Waste Land	-17.14	+19.74	-13.33	+45.66
Fallow Lands (Other than the current Fallows)	+16.47	+50.41	+46.67	+39.91
Current Fallow	+25.51	+48.53	+73.68	-53.91
Net Area Sown	-17.75	-10.83	+19.57	-9.82

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The table shows the change in the share of each land use category as a percentage of the total geographical area between 2000-01 and 2022-23. Misc. Tree Crops and Groves are excluded due to their negligible contribution to the total geographical area.

Key Highlights
State-Level Trends (Chhattisgarh)

Land Use Category	Area Change (%)	Change in Share (%)	Significance
Forests	+3.22	+1.32	Minor increase indicating stable forest cover with slight gains from afforestation or protection efforts.
Non-Agricultural Uses	+18.67	+16.56	Highest growth driven by infrastructure, urban expansion, and land diversion from agriculture.
Barren & Unculturable Land	-8.65	-10.16	Decline suggests reclamation for other uses or improved land management.
Permanent Pasture & Grazing Land	+3.29	+1.30	Modest emphasis on livestock-based land use.
Misc. Tree Crops & Groves	+248.61	+100	Sharp rise but negligible in total share; may reflect small-scale diversification or reclassification.
Culturable Waste Land	+12.53	+10.48	underutilised cultivable land or degradation.
Fallow Lands (Other than the current Fallows)	+16.32	+14.38	Strong increase indicating reduced cropping frequency and longer-term land idling.
Current Fallow	-6.07	-7.54	Re-entry of seasonally idle land into cultivation.
Net Area Sown	-4.50	-6.23	Gradual contraction of cultivated land to total area.

Note: *Area Change (%)*: Percent change in total area under each category (in hectares) between 2000-01 and 2022-23.
Change in Share (%): Difference in that category's proportion of total geographical area (in percentage points) between 2000-01 and 2022-23.

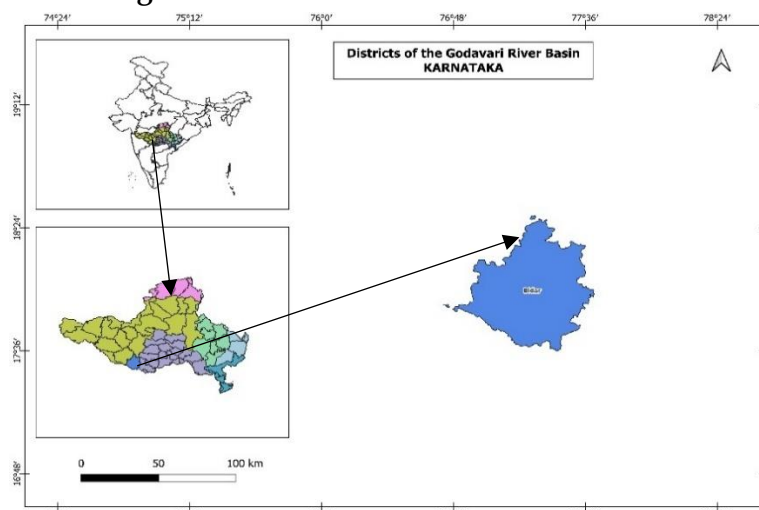
District Level Highlights

Category	District(s)	Trend	Significance
Major Gains			
● Fallow Lands other than Current Fallows	Dantewada, Dhamtari, Kanker	Large increases in share across districts	Indicates reduced cropping intensity and seasonal cultivation gaps.
● Current Fallow	Bastar, Dantewada, Dhamtari	Substantial rise in share	Points to agricultural interruptions and short-term land idling.
● Culturable Waste Land	Kanker, Dantewada	Strong expansion in share	Suggests persistence of underutilised agricultural land.
Major Losses			
● Forests	Dhamtari	Steep decline in share	May reflect deforestation, land diversion, or reclassification.
● Net Area Sown	Bastar, Dantewada, Kanker	Decline in share	Indicates gradual contraction of cultivated land.
● Barren & Unculturable Land	Bastar	Noticeable reduction in share	Could be due to reclamation or conversion to other uses.

2.5.3. Karnataka

Within Karnataka, the Godavari River Basin encompasses the district of Bidar and a small portion of Kalaburagi (formerly Gulbarga), with most of the the basin's area located in Bidar and only a minor segment extending into Kalaburagi. Between 2000 and 2022, Karnataka's portion of the Godavari River Basin experienced a mix of marginal forest gains, notable agricultural shifts, and changes in land utilisation patterns.

Figure 5: Godavari Basin Districts in Karnataka



Source: Revenue Map of the Godavari River Basin – Karnataka, developed using QGIS.

Note: The inset map at the top left highlights the overall geographical extent of the Godavari River Basin within India, providing a national context for the basin's reach. The middle-left map provides a more focused view of the basin's distribution across various states, emphasizing the intricate network of river systems. The main map on the right specifically focuses on Karnataka. The areas falling under the basin are shaded in blue.

Forest area recorded an increase in both absolute terms (+1.93%) (Table – 10) and share (+2.04%) (Table – 11), reflecting stable coverage with minor improvements in afforestation or conservation. Non-agricultural uses expanded by over 10% in both measures, indicating steady growth in infrastructure, settlements, and other non-farm activities. Whereas Barren and unculturable land declined slightly (–3.32%), suggesting limited reclamation or conversion to other uses. Permanent pasture and grazing land remained stable, showing only a marginal increase. Culturable waste land decreased substantially (–62.90%), pointing to either reclamation for cultivation or conversion to other purposes. Fallow lands showed divergent trends: current fallows grew markedly (+23.31%), possibly due to seasonal cultivation gaps or changes in cropping intensity, whereas fallow lands other than current fallows fell sharply (–39.22%), suggesting some re-entry into active cultivation. The net area sown, however, shown a reduction (–59.79%), representing a substantial reduction in

cultivated land within the basin, likely driven by land diversion, reduced irrigation, or shifts towards less land-intensive livelihoods.

Table 10: Change in Land Use Categories – Karnataka (2000-01 & 2022-23)

Land Use Category	2000-01(ha)	2022-23(ha)	% Change
Forests	94,959	96,796	+1.93
Non-Agricultural Uses	88,937	98,218	+10.44
Barren & Unculturable Land	84,847	82,028	-3.32
Permanent Pasture & Grazing Land	51,323	51,574	+0.49
Misc. Tree Crops & Groves	12,766	4,736	-62.90
Culturable Waste Land	31,066	18,883	-39.22
Fallow Lands (Other than the current Fallows)	43,077	53,120	+23.31
Current Fallow	2,20,384	88,626	-59.79
Net Area Sown	15,24,614	16,57,992	+8.75
Total Area	21,51,973	21,51,973	

Source: Compiled from Directorate of Economics and Statistics Data.

Table 11: Land Use Composition as % of Total Geographical Area in Karnataka (2000-01 & 2022-23)

Land Use Category	2000-01(%)	2022-23(%)	Change (%)
Forests	4.41	4.50	+2.04
Non-Agricultural Uses	4.13	4.56	+10.44
Barren & Unculturable Land	3.94	3.81	-3.29
Permanent Pasture & Grazing Land	2.38	2.40	+0.84
Misc. Tree Crops & Groves	0.59	0.22	-62.71
Culturable Waste Land	1.44	0.88	-38.88
Fallow Lands (Other than the current Fallows)	2.00	2.47	+23.50
Current Fallow	10.24	4.12	-59.76
Net Area Sown	70.85	77.05	+8.75

Source: Compiled from Directorate of Economics and Statistics Data. The data represent the share of each land use category as a percentage of the total geographical area of Karnataka for the years 2000-01 and 2022-23.

2.5.3.1. District-Level Land Use Analysis

The land use patterns in these districts show constant trends over the two decades. Forest area increased moderately in Bidar (+7.10%) (Table – 12), indicating modest gains from conservation or afforestation initiatives, while remaining unchanged in Gulbarga. Non-agricultural uses expanded in both districts, with the highest growth in Bidar (+15.54%), reflecting infrastructure development and settlement expansion. Barren and unculturable land declined in Bidar (-11.11%) but remained almost stable in Gulbarga, suggesting minor land reclamation or changes in land classification. Permanent pasture and grazing land were stable in Bidar, with only a marginal increase in Gulbarga, indicating limited expansion in livestock-related land use.

Table 12: Land Use Area Change by Districts, Karnataka (2000-01 & 2022-23)

Land Use Category	Bidar (%)	Gulbarga (%)
Forests	+7.10	0.00
Non-Agricultural Uses	+15.54	+8.76
Barren & Unculturable Land	-11.11	-0.68
Permanent Pasture & Grazing Land	0.00	+0.67
Misc. Tree Crops & Groves	-74.18	+6.19
Culturable Waste Land	-47.67	-25.42
Fallow Lands (Other than the current Fallows)	-65.19	+123.45
Current Fallow	-69.87	-58.07
Net Area Sown	+13.88	+7.08

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The above table represents the %= percentage change in hectares from 2000-01 to 2022-23 in selected districts of Karnataka.

Land under miscellaneous tree crops fell sharply in Bidar (–74.18%), while Gulbarga recorded a small gain, though this category remains negligible in overall share. Culturable waste land contracted in both districts, more sharply in Bidar, pointing to conversion of unused cultivable land to other uses. Fallow lands other than current fallows increased substantially in Gulbarga (+123.50%) but dropped sharply in Bidar (–65.20%), indicating divergent cultivation practices. Current fallow land fell steeply in both districts, with a larger decline in Bidar (–69.87%), suggesting a reduction in seasonally idle land. Net sown area expanded notably in Bidar (+13.87%) and moderately in Gulbarga (+7.08%), showing increase in cultivated land within the basin’s Karnataka portion—contrasting with the declines observed in some other basin states. In terms of share of total geographical area, there is increase in the non-agricultural uses (both districts) and net sown area (particularly Bidar).

Table 13: Share of Total Geographical Area Change by Districts, Karnataka (2000-01 & 2022-23)

Land Use Category	Bidar (Change in Share (%))	Gulbarga (Change in Share (%))
Forests	+7.10	0.00
Non-Agricultural Uses	+15.54	+8.76
Barren & Unculturable Land	-11.11	-0.68
Permanent Pasture & Grazing Land	0.00	+0.67
Misc. Tree Crops & Groves	-74.18	+6.19
Culturable Waste Land	-47.67	-25.42
Fallow Lands (Other than the current Fallows)	-65.19	+123.45
Current Fallow	-69.87	-58.07
Net Area Sown	+13.88	7.08

Source: Compiled from Directorate of Economics and Statistics Data. **Note:** The table shows the change in the share of each land use category as a percentage of the total geographical area between 2000–01 and 2022–23.

Key Highlights
State – Level Trends (Karnataka)

Land Use Category	Area Change (%)	Change in Share (%)	Significance
Forests	+1.93	+2.04	Stable forest cover with modest gains from afforestation or protection efforts.
Non-Agricultural Uses	+10.44	+10.41	Infrastructure, urban expansion, and land diversion from agriculture.
Barren & Unculturable Land	-3.32	-3.3	Reclamation for other uses or improved land management.
Permanent Pasture & Grazing Land	+0.49	+0.84	Stable share with minimal emphasis on livestock-based land use.
Misc. Tree Crops & Groves	-62.9	-62.71	Sharp decline but negligible in total share; may indicate reduction in agroforestry or reclassification.
Culturable Waste Land	-39.22	-38.89	Significant reduction, suggesting reclamation or conversion of unused cultivable land to other uses.
Fallow Lands (Other than the current Fallows)	+23.31	+23.5	Strong increase indicating reduced cropping frequency and longer-term land idling.
Current Fallow	-59.79	-59.75	Sharp decline pointing to re-entry of seasonally idle land into cultivation or change in seasonal cropping patterns.
Net Area Sown	+8.75	+8.75	Expansion of cultivated land within the basin.

Note: *Area Change (%)*: Percent change in total area under each category (in hectares) between 2000-01 and 2022/23.
Change in Share (%): Difference in that category's proportion of total geographical area (in percentage points) between 2000-01 and 2022-23.

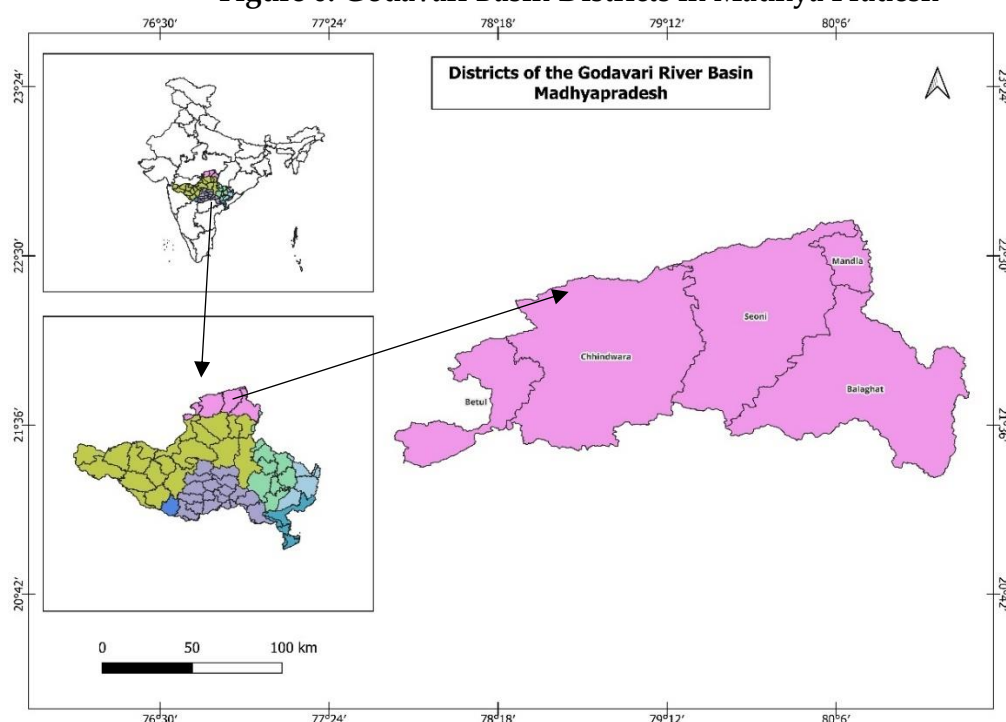
District level Highlights

Category	District(s)	Trend	Significance
Major Gains			
● Non-Agricultural Uses	Bidar, Gulbarga	Consistent increase in share across both districts	Reflects infrastructure development, settlement growth, and land conversion from agriculture.
● Net Area Sown	Bidar, Gulbarga	Noticeable rise in share	Suggests expansion of cultivated land.
Major Losses			
● Culturable Waste Land	Bidar, Gulbarga	Sharp decline in share	Indicates reclamation of unused cultivable land for other purposes.
● Current Fallow	Bidar, Gulbarga	Significant reduction in share	Points to a decrease in seasonally idle land, possibly due to more intensive land use or improved cropping patterns.

2.5.4. Madhya Pradesh

In Madhya Pradesh, the Godavari River Basin encompasses the districts of Balaghat, Betul, Chhindwara, Mandla, and Seoni. These districts, either wholly or partially within the basin. Between 2000 and 2022, the districts of Madhya Pradesh falling within the Godavari River Basin exhibited a mix of stability, notable declines in certain land use types, and an increase in few categories.

Figure 6: Godavari Basin Districts in Madhya Pradesh



Source: Revenue Map of the Godavari River Basin – Madhya Pradesh, developed using QGIS

Note: The inset map at the top left highlights the overall geographical extent of the Godavari River Basin within India, providing a national context for the basin's reach. The middle-left map provides a more focused view of the basin's distribution across various states, emphasizing the intricate network of river systems. The primary map on the right specifically highlights the districts within Madhya Pradesh that form part of the Godavari River Basin, shaded in pink colour.

Forest area remained constant with only a marginal decline (–0.13% in both area and share) (Table – 14), indicating sustained forest management with minimal change in extent. On-agricultural uses showed a slight reduction (–3.44%), suggesting limited expansion of infrastructure or settlement in the basin's Madhya Pradesh segment compared to other states. Barren and unculturable land increased moderately (+5.58%), which may reflect land degradation or classification changes.

Permanent pasture and grazing land remained almost unchanged (–0.49%), while land under miscellaneous tree crops, though negligible in total share, recorded a sharp rise (+80.52%), possibly due to small-scale diversification or plantation activities.

Table 14: Change in Land Use Categories – Madhya Pradesh (2000-01 & 2022-23)

Land Use Category	2000-01(ha)	2022-23(ha)	% Change
Forests	23,02,294	22,99,276	-0.13
Non-Agricultural Uses	2,33,624	2,25,579	-3.44
Barren & Unculturable Land	77,531	81,859	+5.58
Permanent Pasture & Grazing Land	1,59,718	1,58,941	-0.49
Misc. Tree Crops & Groves	806	1,455	+80.52
Culturable Waste Land	1,57,230	1,13,898	-27.56
Fallow Lands (Other than the current Fallows)	1,45,405	78,004	-46.35
Current Fallow	1,94,126	68,641	-64.64
Net Area Sown	16,87,449	19,30,530	+14.41
Total Area	49,58,183	49,58,183	

Source: Compiled from Directorate of Economics and Statistics Data.

Table 15: Land Use Composition as % of Total Geographical Area in Madhya Pradesh (2000-01 & 2022-23)

Land Use Category	2000-01(%)	2022-23(%)	Change (%)
Forests	46.43	46.37	-0.13
Non-Agricultural Uses	4.71	4.55	-3.44
Barren & Unculturable Land	1.56	1.65	+5.58
Permanent Pasture & Grazing Land	3.22	3.21	-0.49
Misc. Tree Crops & Groves	0.02	0.03	+80.52
Culturable Waste Land	3.17	2.30	-27.56
Fallow Lands (Other than the current Fallows)	2.93	1.57	-46.35
Current Fallow	3.92	1.38	-64.64
Net Area Sown	34.03	38.94	+14.41

Source: Compiled from Directorate of Economics and Statistics Data. The data represent the share of each land use category as a percentage of the total geographical area Madhya Pradesh for the years 2000-01 and 2022-23.

The highest declines were in culturable waste land (–27.56%), fallow lands other than current fallows (–46.35%), and current fallow (–64.64%). These reductions suggest reclamation of underutilised land, changes in cropping practices, or improved cultivation continuity.

Net area sown increased substantially (+14.41% in both area and share), highlighting an expansion of cultivated land within the basin's Madhya Pradesh portion—contrasting with trends in some other states where agricultural land has contracted. This shift indicates a more intensive use of available agricultural land, potentially linked to better irrigation access or favourable cropping conditions.

In terms of share, forests remained almost constant (-0.13%) (Table – 15), confirming their stability in both physical extent and proportion of total area. Non-agricultural uses declined slightly (-3.44%). The share of culturable waste land, current fallows, and other fallows declined sharply, while net sown area increased notably, indicating a shift toward more intensive cultivation. Non-agricultural uses and miscellaneous tree crops showed only minor changes, remaining a negligible share of total land use.

2.5.4.1. District-Level Land Use Analysis

When we look at district level, Forest areas remained largely stable, with only marginal declines in Balaghat (-0.31%) and Chhindwara (-0.35%) (Table – 16), while Mandla saw a slight increase (+0.05%). Non-agricultural uses expanded notably in Balaghat (+3.04%) and Mandla (+7.17%), likely reflecting infrastructure growth.

Barren and unculturable land decreased in Balaghat and Chhindwara suggesting land reclamation but increased in Betul and Mandla. Permanent pasture increases in Betul and Chhindwara.

Miscellaneous tree crops, though a very small category, surged dramatically in Betul and Chhindwara. Culturable waste land decreased in Balaghat (-87.34%) and Betul (-23.45%) but increased in Chhindwara. Both categories of fallow land contracted across all districts, with the highest drops in current fallow seen in Betul. Net area sown increased in every district, most notably in Betul and Balaghat. this trend consistent with the state level aggregates.

Whereas share of each district's total geographical area, the values are closely mirror the absolute changes. Forest cover remained stable, with the highest in Mandla (+0.05%) (Table – 17). Non-agricultural land use expanded in Balaghat and Mandla.

The share of barren and unculturable land reduced in Balaghat and Chinaware but increased in Betul and Mandla. Permanent pasture's share grew in Betul and Chhindwara (+15.26%), underlining livestock-based land use expansion. The share of miscellaneous tree crops grew in Betul and Chhindwara, despite its minimal contribution to overall area. Culturable waste lands dropped in Balaghat and Betul (-23.45%).

Both current and other fallow lands took up a smaller proportion of the total area in all districts, particularly in Betul. Net sown area gained share across all districts, with Betul (+20.56%) and Balaghat (+13.86%) seeing the most prominent increases.

Table 16: Land Use Area Change by Districts, Madhya Pradesh (2000-01 & 2022-23)

Land Use Category	Balaghat (%)	Betul (%)	Chhindwara (%)	Mandla (%)
Forests	-0.31	-0.23	-0.35	+0.05
Non-Agricultural Uses	3.04	-31.86	-2.98	+7.17
Barren & Unculturable Land	-4.03	+17.07	-26.19	+9.17
Permanent Pasture & Grazing Land	-0.10	+3.78	+15.26	-4.27
Misc. Tree Crops & Groves	+4.71	+13725.00	+209.68	+6.67
Culturable Waste Land	-87.34	-23.45	+31.12	+0.88
Fallow Lands (Other than the current Fallows)	-50.17	-53.58	-26.78	-42.46
Current Fallow	-38.12	-92.28	-59.64	-47.83
Net Area Sown	+13.86	+20.56	+8.08	+13.71

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The above table represents the %= percentage change in hectares from 2000-01 to 2022-23 in selected districts of Madhya Pradesh.

Table 17: Share of Total Geographical Area Change by Districts, Madhya Pradesh (2000-01 & 2022-23)

Land Use Category	Balaghat (Change in Share (%))	Betul (Change in Share (%))	Chhindwara (Change in Share (%))	Mandla (Change in Share (%))
Forests	-0.31	-0.23	-0.35	+0.05
Non-Agricultural Uses	+3.04	-31.86	-2.98	+7.17
Barren & Unculturable Land	-4.03	+17.07	-26.19	+9.17
Permanent Pasture & Grazing Land	-0.10	+3.78	+15.26	-4.27
Misc. Tree Crops & Groves	+4.71	+13725.00	+209.68	+6.67
Culturable Waste Land	-87.34	-23.45	+31.12	+0.88
Fallow Lands (Other than the current Fallows)	-50.17	-53.58	-26.78	-42.46
Current Fallow	-38.12	-92.28	-59.64	-47.83
Net Area Sown	+13.86	+20.56	+8.08	+13.71

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The table shows the change in the share of each land use category as a percentage of the total geographical area between 2000-01 and 2022-23.

Key Highlights
State-Level Trends (Madhya Pradesh)

Land Use Category	Area Change (%)	Change in Share (%)	Significance
Forests	-0.13	-0.13	Minimal changes in conservation or land diversion.
Non-Agricultural Uses	-3.44	-3.44	Reduced expansion of infrastructure and settlements.
Barren & Unculturable Land	+5.58	+5.58	Minor degradation or land left unused for cultivation.
Permanent Pasture & Grazing Land	-0.49	-0.49	Largely unchanged, indicating stable livestock-related land use.
Misc. Tree Crops & Groves	+80.52	+80.52	Sharp growth from a small base, possibly due to diversification or plantation initiatives.
Culturable Waste Land	-27.56	-27.56	Reclamation for cultivation or other productive uses.
Fallow Lands (Other than the current Fallows)	-46.35	-46.35	Increased cropping frequency or land brought under regular use.
Current Fallow	-64.64	-64.64	Reduced seasonal idling and improved cultivation intensity.
Net Area Sown	+14.41	+14.41	Increasing of agriculture in some regions.

Note: *Area Change (%)*: Percent change in total area under each category (in hectares) between 2000-01 and 2022-23.
Change in Share (%): Difference in that category's proportion of total geographical area (in percentage points) between 2000-01 and 2022-23.

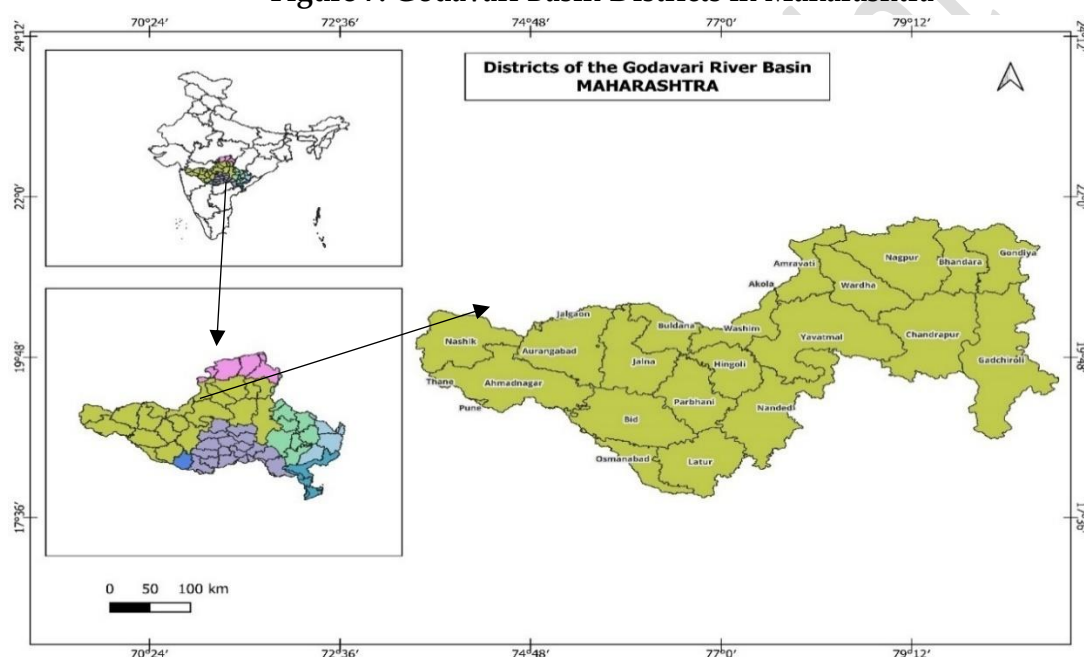
District Level Highlights

Category	District(s)	Trend	Significance
Major Gains			
● Net Area Sown	Balaghat, Betul, Chhindwara, Mandla	Increase in share across all districts	Indicates revival or expansion of cultivated land, possibly through reclamation or intensification of agriculture.
● Misc. Tree Crops & Groves	Betul, Chhindwara	Strong growth from a small base	Suggests diversification into perennial crops or small-scale plantation development.
Major Losses			
● Current Fallow	All districts	Decline in share	Reflects reduced seasonal idling and more consistent agricultural use.
● Fallow Lands (Other than Current Fallows)	All districts	Decline in share	Higher cropping frequency and reduced long-term land idling.

2.5.5. Maharashtra

Maharashtra accounts for nearly 48% of the Godavari River Basin, making it one of the largest contributors to the basin area. The basin within the state encompasses a wide range of districts, including Ahmadnagar, Akola, Amravati, Aurangabad, Bhandara, Bid, Buldana, Chandrapur, Gadchiroli, Gondiya, Hingoli, Jalgaon, Jalna, Latur, Nagpur, Nanded, Nashik, Osmanabad, Parbhani, Pune, Thane, Wardha, Washim, and Yavatmal. Between 2000 and 2022, Maharashtra's land use patterns reveal a clear shift towards non-agricultural expansion, increased barren land, and a contraction in cultivated areas.

Figure 7: Godavari Basin Districts in Maharashtra



Source: Revenue Map of the Godavari River Basin – Maharashtra, developed using QGIS.

Note: The inset map at the top left highlights the overall geographical extent of the Godavari River Basin within India, providing a national context for the basin's reach. The middle-left map provides a more focused view of the basin's distribution across various states, emphasizing the intricate network of river systems. The primary map on the right specifically highlights the districts within Maharashtra that form part of the Godavari River Basin, shaded in green colour.

Forest area decreased by 4.53% (Table – 18) in absolute terms, with its share of total geographical area falling from 17.58% to 17.13%, (Table – 19) possibly due to land diversion for development and other competing uses. Non-agricultural uses saw the highest gain (+33.46% in share), indicating rapid infrastructure growth, urbanisation, and industrial expansion. Barren and unculturable land also increased by 36.81% in area (+39.65% in share), suggesting land degradation or conversion from other categories. Permanent pasture and grazing land increased (+14.21% in area), highlighting continued relevance of livestock-based

activities. Culturable waste land registered a small improvement (+3.72%), indicating persistent portions of cultivable land remaining unused.

Table 18: Change in Land Use Categories – Maharashtra (2000-01 & 2022-23)

Land Use Category	2000-01(ha)	2022-23(ha)	% Change
Forests	40,60,000	38,76,200	-4.53
Non-Agricultural Uses	10,93,900	14,30,200	+30.74
Barren & Unculturable Land	7,92,000	10,83,500	+36.81
Permanent Pasture & Grazing Land	9,26,300	10,57,900	+14.21
Misc. Tree Crops & Groves	1,79,300	1,68,200	-6.19
Culturable Waste Land	5,42,600	5,62,800	3.72
Fallow Lands (Other than the current Fallows)	7,64,200	6,37,300	-16.61
Current Fallow	8,77,500	11,62,800	+32.51
Net Area Sown	1,38,55,900	1,26,42,800	-8.76
Total Area	2,30,91,700	2,26,21,700	-2.04

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The observed discrepancies in the total reported land area for Maharashtra may be attributed to differences in data sources and estimation methodologies used in compiling land use statistics. According to *Land Use Statistics briefly: 2013–14 to 2022–23*, in cases where current year data has not been received from State/UT Governments, the figures have been estimated using the most recent data available from earlier years, the Agriculture Census, or advance estimates provided by the respective States (Directorate of Economics and Statistics, 2022).

In contrast, both fallow lands other than current fallows (–16.61%) and net area sown (–8.76%) declined, underscoring reduced agricultural intensity. However, current fallows expanded (+32.51% in area and +35.27% in share), which may reflect climatic variability, water stress, or changing cropping patterns leading to seasonal cultivation gaps. The decline in net area sown from 60.00% to 55.89% of total area indicates to a gradual contraction of agriculture in favour of non-agricultural activities and possibly ecological constraints.

Table 19: Land Use Composition as % of Total Geographical Area in Maharashtra (2000-01 & 2022-23)

Land Use Category	2000-01(%)	2022-23(%)	Change (%)
Forests	17.58	17.13	-2.54
Non-Agricultural Uses	4.74	6.32	+33.46
Barren & Unculturable Land	3.43	4.79	+39.65
Permanent Pasture & Grazing Land	4.01	4.68	+16.58
Misc. Tree Crops & Groves	0.78	0.74	-4.24
Culturable Waste Land	2.35	2.49	+5.88
Fallow Lands (Other than the current Fallows)	3.31	2.82	-14.87
Current Fallow	3.80	5.14	+35.27
Net Area Sown	60.00	55.89	-6.86

Source: Compiled from Directorate of Economics and Statistics Data. The data represent the share of each land use category as a percentage of the total geographical area of Maharashtra for the years 2000 and 2022.

2.5.5.1. District-Level Land Use Analysis

The district level trend of land use area highlights that Forest cover declined in most districts, with the sharpest drops in Thane, Gadchiroli, and Amravati (Table – 20), possibly due to deforestation, urban expansion, and land diversion. However, a few districts like Aurangabad and Pune recorded marginal increases, indicating localized conservation or reforestation efforts.

Table 20: Land Use Area Change by Districts, Maharashtra (2000- 01 & 2022-23)

District	Forests	Non-Agricultural Uses	Barren & Unculturable Land	Permanent Pasture & Grazing Land	Misc. Tree Crops & Groves	Culturable Waste Land	Fallow Lands (Other than current Fallows)	Current Fallow	Net Area Sown
Ahmednagar	-0.66	-44.27	+52.61	-17.89	-78.57	-35.28	+102.19	+1561.59	-17.54
Akola	+16.02	+171.22	+34.57	-4.60	-68.75	-59.26	-4.62	-60.15	-1.82
Amravati	-7.41	+12.56	-4.02	+14.58	+15.38	-11.43	-18.30	+46.03	+1.11
Aurangabad	+6.51	-37.72	+117.17	-25.06	+1071.43	+72.94	-48.51	+32.34	+2.40
Beed	-11.37	+51.39	+97.73	-20.39	-71.43	+78.00	+34.52	+1161.54	-14.40
Bhandara	-5.57	+29.65	-31.65	+29.69	+203.70	+131.37	-89.66	-86.28	+10.26
Buldhana	+60.05	+64.32	+40.96	+16.85	-90.00	-25.68	-64.47	-66.55	+2.68
Chandrapur	+11.26	-0.33	+2.11	+8.80	+208.22	+14.83	-74.14	-88.01	+21.60
Gadchiroli	-5.07	+13.29	-14.04	-9.27	-31.91	+74.07	-66.84	+18.18	+36.76
Gondia	-3.62	+12.10	-40.00	+16.38	-11.11	+108.33	-84.38	-49.53	+7.36
Hingoli	+263.49	+3.03	-35.00	+28.93	-90.00	-2.54	+64.94	+278.50	-12.72
Jalgaon	+0.13	-44.93	+89.84	-20.08	-6.67	-53.68	-86.49	-68.25	+4.34
Jalna	-24.62	-63.54	-53.55	+39.69	+325.93	+126.83	-11.65	+161.57	-6.30
Latur	-48.57	+43.55	+87.38	+39.62	+555.56	+105.31	+88.59	+182.12	-16.83
Nagpur	-3.15	+14.55	-9.83	+0.73	-20.59	-15.29	-46.97	-61.20	+12.02
Nanded	-11.89	+55.06	-25.60	-27.82	-10.26	+35.99	+186.57	+3.05	-2.28
Nashik	-0.22	+5.45	+45.00	-45.54	-88.51	-63.01	-70.20	+20.00	+7.19
Osmanabad	+7.32	+42.21	+22.58	+32.54	+37.50	+21.32	+493.98	+499.44	-35.14
Parbhani	-76.98	-9.28	-14.74	+44.44	-67.50	-4.90	-11.67	+373.17	-0.27
Pune	+15.12	+431.78	+130.45	+238.41	-38.67	+50.30	-61.81	+99.06	-60.44
Thane	-55.67	-12.79	-47.18	-54.13	-11.48	-17.65	+1.92	-73.95	-59.55
Wardha	-25.21	-8.21	-45.98	+37.69	+89.80	+9.05	-36.27	+78.69	-2.94
Washim	+23.75	+148.85	-9.76	-11.18	-87.76	-13.46	-57.75	-38.08	+7.84
Yavatmal	+4.28	+8.31	-10.87	+59.07	-38.50	-52.49	-44.12	-30.09	+0.50

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The above table represents the %= percentage change in hectares from 2000-01 to 2022-23 in selected districts of Maharashtra.

Non-agricultural uses expanded in many districts including Pune, Thane, Chandrapur, and Gadchiroli show the rapid urbanisation, infrastructure projects, and conversion of agricultural land for settlements and industry. Barren and unculturable land increased in districts such as

Nashik, Jalgaon, and Ahmednagar, which could be linked to land degradation, erosion, or reduced reclamation. On the other hand, districts like Bhandara and Hingoli saw reductions, possibly from rehabilitation and conversion into productive uses. Permanent pasture and grazing land increased in Thane and Yavatmal, suggesting a growing livestock base or shifting land use priorities. Culturable waste land trends were mixed — fallen area in Ahmednagar, Jalgaon, and Nagpur, while rising in Latur, Osmanabad, and Chandrapur, signalling underutilisation. Net area sown area reduced in many districts including Ahmednagar, Beed, and Osmanabad, reflecting agricultural contraction, at the same time increased in others districts like Amravati, Aurangabad, and Yavatmal, indicating expansion of cultivated land in certain regions.

When we look at relative change there is a clear shift in land use patterns. Forest cover declined in most districts, with steep reductions in Thane, Gadchiroli, and Nanded, indicating possible deforestation or reclassification. Non-agricultural uses increased notably in districts such as Pune, Thane, and Nagpur, reflecting rapid urbanisation, infrastructure growth, and land conversion from agriculture. Barren and unculturable land expanded sharply in Nashik, Pune, and Jalgaon, suggesting either land degradation or reallocation for non-productive purposes. Permanent pasture and grazing land saw large gains in Thane, Yavatmal, and Gondia, highlighting a shift towards livestock-related land use in some regions, while many other districts recorded declines. Current fallow land increased in districts like Ahmednagar, Nashik, and Jalgaon, pointing to rising seasonal idling of agricultural land. Net area sown generally declined in Ahmednagar and Beed, but registered gains in parts of Chandrapur and Yavatmal, indicating mixed agricultural trends within the state.

**Table 21: Share of Total Geographical Area Change by Districts, Maharashtra
(2000- 01 & 2022-23)**

District	Forests	Non-Agricultural Uses	Barren & Unculturable Land	Permanent Pasture & Grazing Land	Misc. Tree Crops & Groves	Culturable Waste Land	Fallow Lands (Other than current Fallows)	Current Fallow	Net Area Sown
Ahmednagar	+0.05	-0.66	+3.14	-0.47	-0.71	-0.68	+3.68	+8.49	-12.85
Akola	+0.76	+4.38	+0.52	-0.15	-0.41	-0.59	-0.06	-3.00	-1.46
Amravati	-1.92	+0.42	-0.07	+0.35	+0.07	-0.10	-0.34	+0.90	+0.69
Aurangabad	+0.53	-3.67	+1.15	-1.08	+0.74	+0.62	-0.97	+0.97	+1.71
Beed	-0.27	+1.90	+1.61	-0.69	-0.33	+1.53	+1.09	+7.07	-11.89
Bhandara	-1.05	+2.98	-0.73	+2.54	+1.61	+1.96	-2.28	-9.56	+4.53
Buldhana	+4.76	+2.74	+1.76	+0.63	-0.65	-0.98	-4.05	-5.82	+1.61
Chandrapur	+3.64	-0.03	+0.05	-3.53	+1.39	+0.39	-2.91	-7.19	+8.19
Gadchiroli	-3.84	+0.57	-0.17	-0.34	-0.10	+0.67	-0.88	+0.44	+3.65
Gondia	-1.33	+1.02	-1.50	+2.32	-0.03	+1.33	-3.23	-0.90	+2.32
Hingoli	+3.56	+0.06	-0.75	+0.75	-0.19	-0.06	+1.07	+6.39	-10.83
Jalgaon	+0.02	-1.14	+4.25	-0.86	-0.02	-0.63	-2.86	-1.72	+2.95
Jalna	-0.21	-4.58	-1.07	+1.00	+1.14	+1.35	-0.36	+7.66	-4.92
Latur	-0.24	+1.13	+1.26	+0.88	+2.10	+3.05	+2.28	+3.86	-14.32
Nagpur	-0.51	+1.29	-0.33	+0.04	-0.21	-0.64	-1.89	-3.82	+6.08
Nanded	-1.06	+1.79	-0.62	-1.03	-0.08	+1.13	+1.21	+0.23	-1.59
Nashik	-0.04	+0.15	+4.00	-1.21	-0.99	-2.16	-4.43	+1.13	+3.55
Osmanabad	+0.04	+0.87	+0.19	+0.73	+0.08	+1.16	+14.26	+11.96	-29.27
Parbhani	-3.39	-0.51	-0.22	+0.63	-0.43	-0.19	-0.55	+4.85	-0.21
Pune	+1.66	+17.80	+8.71	+10.00	-0.63	+1.06	-2.66	+2.43	-38.37
Thane	-19.70	-1.23	-1.97	-2.67	-0.31	-0.35	+0.02	-0.94	-23.17
Wardha	-3.08	-0.54	-1.27	+2.75	+0.70	+0.29	-1.70	+4.56	-1.67
Washim	+1.38	+3.80	-0.16	-0.74	-0.10	-0.27	-6.55	-2.55	+5.18
Yavatmal	+0.72	+0.38	-0.36	+2.73	-0.57	-1.72	-0.25	-1.24	+0.30

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The table shows the change in the share of each land use category as a percentage of the total geographical area between 2000-01 and 2022-23.

Key Highlights State-Level Trends (Maharashtra)

Land Use Category	Area Change (%)	Change in Share (%)	Significance
Forests	-4.53	-2.54	Diversion for infrastructure, agriculture, or other competing land uses.
Non-Agricultural Uses	+30.74	+33.46	Rapid urbanisation, infrastructure expansion, and industrial development.
Barren & Unculturable Land	+36.81	+39.65	Increase suggests land degradation, soil erosion, or permanent withdrawal from cultivation.
Permanent Pasture & Grazing Land	+14.21	+16.58	Continued or expanded use of land for livestock rearing and grazing activities.
Misc. Tree Crops & Groves	-6.19	-4.24	Reduction of perennial horticulture or reallocation of such lands to other uses.
Culturable Waste Land	+3.72	+5.88	Persistence of underutilised cultivable land.
Fallow Lands (Other than the current Fallow)	-16.61	-14.87	Reduced long-term fallowing, possibly due to land conversion or intensified cultivation.
Current Fallow	+32.51	+35.27	Seasonal cropping gaps linked to climatic factors, market conditions, or water scarcity.
Net Area Sown	-8.76	-6.86	Contraction of cultivated land as agricultural areas are diverted to non-agricultural uses.

Note: *Area Change (%)*: Percent change in total area under each category (in hectares) between 2000-01 and 2022-23.
Change in Share (%): Difference in that category's proportion of total geographical area (in percentage points) between 2000-01 and 2022-23.

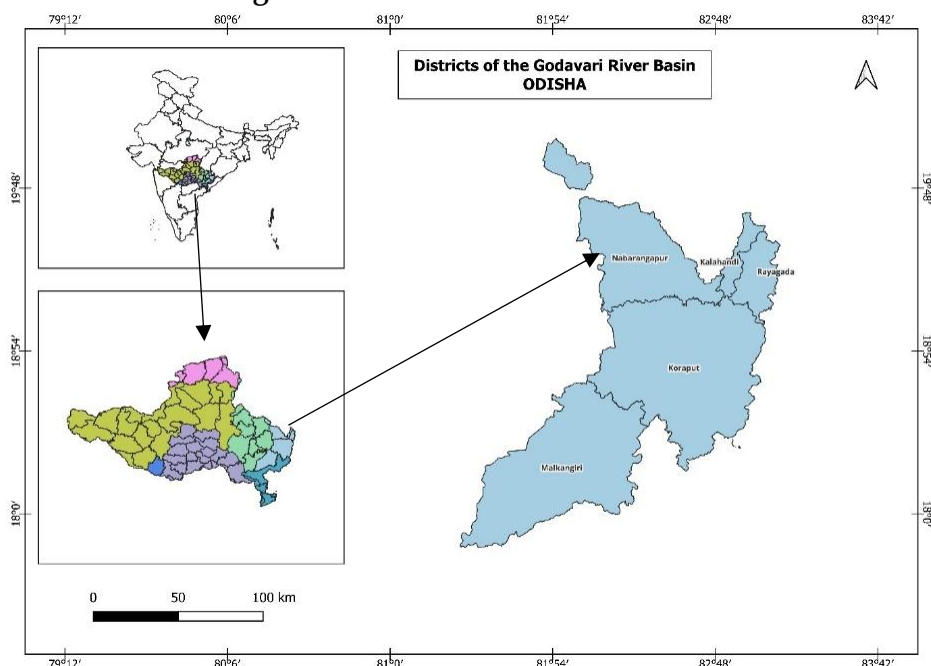
District Level Highlights

Category	District(s)	Trend	Significance
Major Gains			
● Non-Agricultural Uses	Most districts, notably Pune, Thane, Ahmednagar	Substantial rise in share	Reflects rapid urbanisation, infrastructure expansion, and conversion of agricultural land to settlements or industrial use.
● Current Fallow	Districts like Ahmednagar, Beed, Latur, Osmanabad	Noticeable increase in share	Indicates expansion of short-term land idling, possibly due to crop rotation, climatic stress, or water availability issues.
Major Losses			
● Net Area Sown	Several districts including Ahmednagar, Beed, Yavatmal	Decline in share	Suggests reduction in cultivated land, possibly due to diversion to non-agricultural uses or land degradation.
● Forests	Districts such as Gadchiroli, Thane, Chandrapur	Decline in share	May reflect deforestation, encroachment.

2.5.6. Odisha

The Godavari River Basin part of Odisha covers the five districts—Kalahandi, Koraput, Malkangiri, Nabarangapur, and Rayagada. Odisha's land use transformation points towards declining forest cover, expansion of urban and non-agricultural areas, and increasing seasonal fallows, with mixed trends in agricultural cropping patterns.

Figure 8: Godavari Basin Districts in Odisha



Source: Revenue Map of the Godavari River Basin – Odisha, developed using QGIS.

Note: The inset map at the top left highlights the overall geographical extent of the Godavari River Basin within India, providing a national context for the basin's reach. The middle-left map provides a more focused view of the basin's distribution across various states, emphasizing the intricate network of river systems. The primary map on the right specifically highlights the districts within Odisha that form part of the Godavari River Basin, shaded in light blue colour.

Between 2000 and 2022, Odisha experienced major shifts in land use patterns. Forest area decreased in area (–63.69%) (Table -22) and share (–50.28%) (table -23), indicating large-scale deforestation or reclassification of forest land. In contrast, non-agricultural uses more than doubled in share (+107.52%), reflecting rapid urbanisation, infrastructure expansion, and industrial development. Current fallow land increased highest in both area and share (+102.15% in area, +176.80% in share), suggesting increased seasonal land idling, possibly due to changes in cropping practices, water scarcity, or climate variability.

Other categories such as barren & unculturable land (+8.41% area, +48.45% share), permanent pasture (+4.55% area, +43.16% share), and miscellaneous tree crops & groves (+34.32% share) also grew, indicating expansion of non-crop land uses. Meanwhile, net area sown declined in

absolute terms (–24.97%) but its share slightly increased (+2.74%), suggesting that the reduction in total reported area may have proportionally benefited agricultural land share.

Table 22: Change in Land Use Categories - Odisha (2000-01 & 2022-23)

Land Use Category	2000-01(ha)	2022-23(ha)	% Change
Forests	13,64,000	4,95,267	-63.69
Non-Agricultural Uses	1,64,000	2,48,550	+51.55
Barren & Unculturable Land	3,80,000	4,11,974	+8.41
Permanent Pasture & Grazing Land	95,000	99,321	+4.55
Misc. Tree Crops & Groves	1,14,000	1,11,826	-1.91
Culturable Waste Land	85,000	67,256	-20.88
Fallow Lands (Other than the current Fallows)	98,000	1,11,539	+13.82
Current Fallow	86,000	1,73,849	+102.15
Net Area Sown	11,46,000	8,59,872	-24.97
Total Area	35,32,000	25,79,454	

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The observed discrepancies in the total reported land area for Odisha may be attributed to differences in data sources and estimation methodologies used in compiling land use statistics. According to *Land Use Statistics briefly: 2013–14 to 2022–23*, in cases where current year data has not been received from State/UT Governments, the figures have been estimated using the most recent data available from earlier years, the Agriculture Census, or advance estimates provided by the respective States. Prior to 2009-10, the Director of Agriculture and Food Production, Odisha, was the reporting authority/data source of Land Use Statistics (LUS), and the statistics/data furnished by them were based on eye estimation. Data source from 2009-10 onwards is the Directorate of Economics & Statistics (DES), which is the SASA (State Agriculture Statistics Authority). (Directorate of Economics and Statistics, 2022).

Table 23: Land Use Composition as % of Total Geographical Area in Odisha (2000-01 & 2022-23)

Land Use Category	2000-01(%)	2022-23(%)	Change (%)
Forests	38.62	19.20	-50.28
Non-Agricultural Uses	4.64	9.64	+107.52
Barren & Unculturable Land	10.76	15.97	+48.45
Permanent Pasture & Grazing Land	2.69	3.85	+43.16
Misc. Tree Crops & Groves	3.23	4.34	+34.32
Culturable Waste Land	2.41	2.61	+8.34
Fallow Lands (Other than the current Fallows)	2.77	4.32	+55.85
Current Fallow	2.43	6.74	+176.80
Net Area Sown	32.45	33.34	+2.74

Source: Compiled from Directorate of Economics and Statistics Data. The data represent the share of each land use category as a percentage of the total geographical area in Odisha for the years 2000-01 and 2022-23.

2.5.6.1. District-Level Land Use Analysis

When we observed the districts trend the similar pattern can be observed, Between 2000 and 2022, the selected districts of Odisha experienced substantial shifts in land use patterns, with forests showing a marked decline across all districts, most severely in Kalahandi (–81.74% area, –27.72% share)(Table – 24)and Malkangiri (–67.08% area, –28.08% share)(Table – 25),

reflecting pressures from deforestation and land diversion. At the same time, non-agricultural uses expanded in Malkangiri, Nabarangpur and Kalahandi indicating rapid urbanization and infrastructure development. Barren and unculturable land increased in Kalahandi and Rayagada, whereas reduction in Malkangiri due to possible reclamation. In Nabarangpur there is a raise in permanent pasture, while miscellaneous tree crops and groves grew in Nabarangpur and Rayagada due to horticultural expansion. Malkangiri recorded highest increase in the culturable waste land (+214.96%, +2.91%), whereas Koraput and Rayagada saw declines.

Long-term fallow lands increased notably in Kalahandi (+112.28%, +4.89%) and Koraput (+66.24%, +2.72%), while current fallows increased in Koraput and Kalahandi pointing to seasonal cultivation gaps. In terms of cultivation, Malkangiri and Nabarangpur (+7.58% share) showed increased net area sown, suggesting reclamation of land for agriculture, whereas Kalahandi and Koraput experienced reduction in area.

Table 24: Land Use Area Change by Districts, Odisha (2000-01 & 2022-23)

Land Use Category	Kalahandi (%)	Koraput (%)	Malkangiri (%)	Nabarangpur (%)	Rayagada (%)
Forests	-81.74	-53.18	-67.08	-61.12	-48.76
Non-Agricultural Uses	+88.94	+13.13	+120.76	+119.92	-26.42
Barren & Unculturable Land	+81.78	+7.47	-61.30	-17.61	+18.68
Permanent Pasture & Grazing Land	+31.47	-28.28	+29.99	+303.55	-43.61
Misc. Tree Crops & Groves	-66.86	-18.61	+3.56	+88.62	+23.55
Culturable Waste Land	-18.63	-52.43	+214.96	-3.72	-39.90
Fallow Lands (Other than the current Fallows)	+112.28	+66.24	-55.48	-17.87	-27.13
Current Fallow	+228.57	+373.03	+133.28	+25.15	-4.19
Net Area Sown	-32.63	-44.19	+13.29	-8.81	-25.78

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The above table represents the Area Change (%) = percentage change in hectares from 2000 to 2022 selected districts of Odisha.

**Table 25: Share of Total Geographical Area Change by Districts, Odisha
(2000-01 & 2022-23)**

Land Use Category	Kalahandi (Change in Share (%))	Koraput (Change in Share (%))	Malkangiri (Change in Share (%))	Nabarangpur (Change in Share (%))	Rayagada (Change in Share (%))
Forests	-27.72	-9.10	-28.08	-22.70	-11.90
Non-Agricultural Uses	+7.16	+2.68	+10.79	+6.45	-0.13
Barren & Unculturable Land	+8.07	+6.44	-4.07	+0.24	+10.80
Permanent Pasture & Grazing Land	+2.44	-0.19	+2.04	+3.26	-0.87
Misc. Tree Crops & Groves	-0.50	+0.56	+1.24	+2.80	+1.77
Culturable Waste Land	+0.46	-1.37	+2.91	+0.30	-0.59
Fallow Lands (Other than the current Fallows)	+4.89	+2.72	-1.18	+0.23	-0.11
Current Fallow	+6.66	+7.96	+1.95	+1.84	+1.39
Net Area Sown	-1.44	-9.69	+14.41	+7.58	-0.36

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The table shows the change in the share of each land use category as a percentage of the total geographical area between 2000-01 and 2022-23.

Key Highlights
State - Level Trends (Odisha)

Land Use Category	Area Change (%)	Change in Share (%)	Significance
Forests	-63.69	-50.28	Large-scale decline in forest cover, indicating deforestation, land conversion, or reclassification.
Non-Agricultural Uses	+51.55	+107.52	Rapid urbanisation, infrastructure expansion, and industrial growth.
Barren & Unculturable Land	+8.41	+48.45	Expansion of degraded land, possibly due to soil erosion or reduced cultivation viability.
Permanent Pasture & Grazing Land	+4.55	+43.16	Growth in grazing areas, potentially reflecting livestock sector support.
Misc. Tree Crops & Groves	-1.91	+34.32	Share growth despite slight area drops, suggesting concentration in reduced total area.
Culturable Waste Land	-20.88	+8.34	Decline in unused cultivable land, possibly brought under other uses.
Fallow Lands (Other than the current Fallows)	+13.82	+55.85	Increase in long-term idle land, indicating reduced cropping intensity in certain regions.
Current Fallow	+102.15	+176.80	Seasonal idling, possibly due to water scarcity, climate variability, or crop profitability issues.
Net Area Sown	-24.97	+2.74	Decline in cultivated area but slight rise in share.

Note: *Area Change (%)*: Percent change in total area under each category (in hectares) between 2000-01 and 2022-23.
Change in Share (%): Difference in that category's proportion of total geographical area (in percentage points) between 2000-01 and 2022-23.

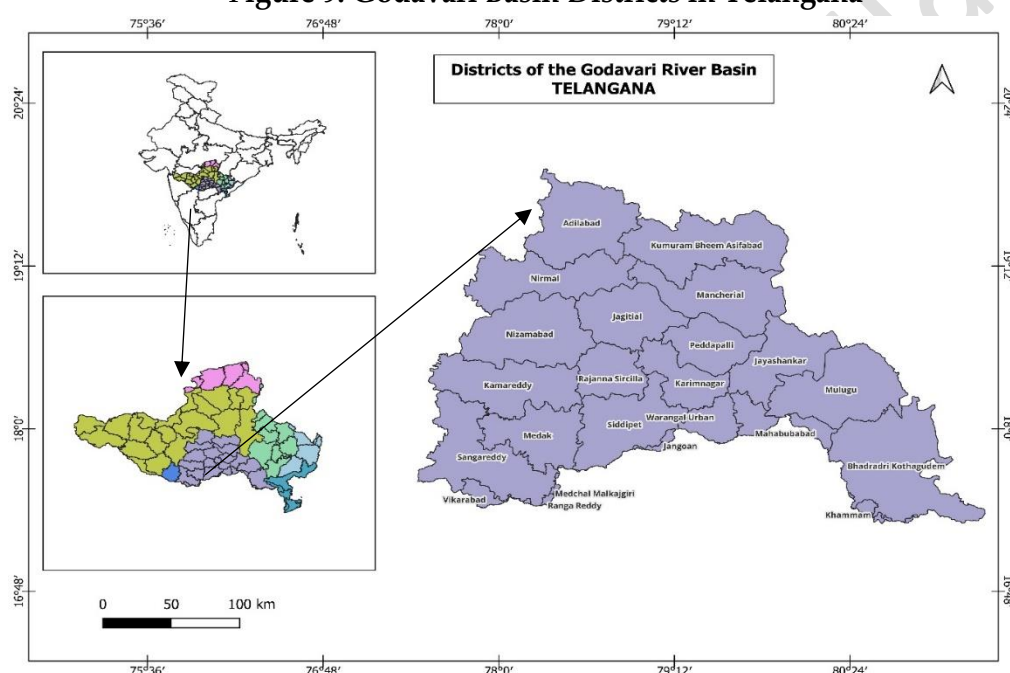
District Level Highlights

Category	District(s)	Trend	Significance
Major Gains			
● Non-Agricultural Uses	Kalahandi, Malkangiri, Nabarangpur	Large increase in share	Reflects urbanisation, infrastructure growth, and conversion from agricultural or forest land.
● Current Fallow	Koraput, Kalahandi	Increased in share	Suggests higher seasonal idling, possibly linked to water scarcity, crop rotation, or climate variability.
Major Losses			
● Forests	All districts (notably Kalahandi, Malkangiri, Nabarangpur)	Steep decline in share	Indicates large-scale deforestation or land conversion.
● Net Area Sown	Koraput, Rayagada, Kalahandi	Noticeable fall in share	Suggests reduction in cultivated area due to diversion to other uses or degradation.
● Fallow Lands (Other than Current Fallows)	Malkangiri, Nabarangpur, Rayagada	Decline in share	Reflects lower long-term idling and possible land use intensification.

2.5.7. Telangana

Telangana accounts for nearly 18% of the Godavari River Basin. The basin area within the state spans across 24 districts, including Adilabad, Bhadrachalam, Jagtial, Jangoan, Jayashankar, Kamareddy, Karimnagar, Khammam, Kumuram Bheem Asifabad, Mahabubabad, Mancherla, Medak, Medchal Malkajgiri, Mulugu, Nirmal, Nizamabad, Peddapalli, Rajanna Sircilla, Ranga Reddy, Sangareddy, Siddipet, Vikarabad, Warangal Rural, and Warangal Urban. Telangana's land use change highlights a clear shift towards increased cultivation and reduced idle land, with moderate urban growth and stable forest cover.

Figure 9: Godavari Basin Districts in Telangana



Source: Revenue Map of the Godavari River Basin – Telangana, developed using QGIS.

Note: The inset map at the top left highlights the overall geographical extent of the Godavari River Basin within India, providing a national context for the basin's reach. The middle-left map provides a more focused view of the basin's distribution across various states, emphasizing the intricate network of river systems. The primary map on the right specifically highlights the districts within Telangana that form part of the Godavari River Basin, shaded in light purple colour.

Forest area remained constant with only a decline of 0.51% in share (Table – 26), indicating consistent conservation levels despite some regional pressures. Net Area Sown saw a remarkable increase in its share of total geographical area by 36.60%, suggesting substantial expansion of cultivated land—possibly driven by irrigation projects and improved agricultural practices. On the other hand, there is a decline in Fallow Lands, both other than current fallows (–58.39%) and current fallows (–73.91%), implying reduced idle agricultural

land and more intensive land use. Permanent Pasture & Grazing Land declined sharply by – 34.53%, potentially indicating conversion to cropland or other uses.

Table 26: Change in Land Use Categories – Telangana (2000-01 & 2022-23)

Land Use Category	2000-01(ha)	2022-23(ha)	% Change
Non-Agricultural Uses	23,92,843	23,66,302	-1.11
Barren & Unculturable Land	5,60,579	6,25,478	+11.58
Permanent Pasture & Grazing Land	4,27,481	4,01,005	-6.19
Misc. Tree Crops & Groves	2,53,778	1,65,148	-34.92
Culturable Waste Land	55,234	67,308	+21.86
Fallow Lands (Other than the current Fallows)	1,57,850	70,471	-55.36
Current Fallow	4,74,104	1,96,064	-58.65
Net Area Sown	9,11,575	2,36,412	-74.07
Land Use Category	29,51,289	40,07,110	+35.77
Total Area	81,84,733	81,35,298	

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The discrepancies observed in the total reported land area for Telangana may be attributed to differences in data sources and estimation methodologies used in compiling land use statistics. According to *Land Use Statistics briefly: 2013–14 to 2022–23*, in cases where current year data has not been received from State/UT Governments, the figures have been estimated using the most recent data available from earlier years, the Agriculture Census, or advance estimates provided by the respective States. (Directorate of Economics and Statistics, 2022).

Table 27: Land Use Composition as % of Total Geographical Area in Telangana (2000-01 & 2022-23)

Land Use Category	2000-01(%)	2022-23(%)	Change (%)
Forests	29.24	29.09	-0.51
Non-Agricultural Uses	6.85	7.69	+12.26
Barren & Unculturable Land	5.22	4.93	-5.62
Permanent Pasture & Grazing Land	3.10	2.03	-34.53
Misc. Tree Crops & Groves	0.67	0.83	+22.60
Culturable Waste Land	1.93	0.87	-55.08
Fallow Lands (Other than the current Fallows)	5.79	2.41	-58.39
Current Fallow	11.14	2.91	-73.91
Net Area Sown	36.06	49.26	+36.60

Source: Compiled from Directorate of Economics and Statistics Data. The data represent the share of each land use category as a percentage of the total geographical area Telangana for the years 2000-01 and 2022-23.

While Non-Agricultural Uses raised pointing to gradual urbanisation and infrastructure growth, Barren & Unculturable Land recorded a slight decline in share (–5.62%), possibly due to land reclamation efforts. Interestingly, Miscellaneous Tree Crops & Groves expanded by 22.60%, due to diversification into horticulture and perennial plantations. Culturable Waste Land s decline in share (–55.08%) (Table -27), aligning with the broader trend of bringing more land under productive use.

2.5.7.1. District-Level Land Use Analysis

When we observe the district wise land use changes in Telangana, forests expanded in most districts like Warangal (41.58%), Adilabad, and Rangareddi (12.27%,) (Table – 28) while declining sharply in Karimnagar and Khammam, Non-agricultural uses generally increased, particularly in Ranga Reddi and Nizamabad, reflecting rapid urbanization and infrastructure development, whereas a few districts like Adilabad and Khammam recorded declines. Agricultural categories present a mixed value. Net Area Sown area increased in Nizamabad, Medak, and Ranga Reddi, suggesting agricultural intensification, while Khammam and Warangal experience declines. Conversely, current fallows and fallow other than current fallows declined across almost all districts, pointing to better utilization or conversion of idle land. Certain categories such as permanent pasture and culturable waste witnessed large decreases in several districts, possibly due to land conversion for cultivation or non-agricultural purposes. On the other hand, specific land types like miscellaneous tree crops shows high increased in the Nizamabad, suggesting crop diversification efforts.

Table 28: Land Use Area Change by Districts, Telangana (2000-01 & 2022-23)

Land Use Category	Adilabad (%)	Karimnagar (%)	Khammam (%)	Medak (%)	Nizamabad (%)	Ranga Reddi (%)	Warangal (%)
Forests	+6.90	-49.54	-33.98	+6.02	+0.97	+12.27	+41.58
Non-Agricultural Uses	-18.43	-2.33	-16.99	-4.04	+28.43	+54.00	+26.64
Barren Land	+12.08	-22.06	-24.92	+1.73	-35.11	+26.15	+14.82
Permanent Pasture	+73.89	-57.69	-48.11	-6.41	-73.13	-30.52	-44.18
Misc Tree Crops	+32.88	+22.44	-14.57	-33.15	+224.26	-24.04	-5.73
Culturable Waste	+33.60	-69.04	-85.81	-47.64	-65.14	-32.18	-94.93
Fallow Other	-82.47	-61.87	-88.79	-40.53	-100.00	+66.56	-91.50
Current Fallow	-86.53	-85.88	-80.17	-59.59	-100.00	-41.91	-36.28
Net Area Sown	+26.76	+30.81	-3.60	+54.62	+74.55	+61.67	-1.76

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The above table represents the % = percentage change in hectares from 2000-01 to 2022-23

When looking at share of total geographical area changes Net Area Sown registered notable increases in districts such as Adilabad (+8.9%), Medak (+23.6%), and Nizamabad (+13.1%) (Table – 29) indicating agricultural intensification or reclamation of idle lands. In contrast, Karimnagar and Khammam area is decreased in this category. Non-Agricultural Uses

expanded significantly in Ranga Reddi and Nizamabad, reflecting urban growth, infrastructure development, and industrialisation pressures. Forests area declined in Karimnagar, Khammam and Warangal indicating deforestation or encroachment.

Several categories experienced substantial shrinkage, pointing to long-term land use transformation. Current Fallow and Fallow Lands (other than current fallows) dropped sharply across almost all districts, suggesting a shift toward more continuous cultivation cycles or reduced seasonal idling. Permanent Pasture and Grazing Land also decreased in Adilabad, Karimnagar, and Nizamabad indicating possible conversion to cropland or non-agricultural use. On the other hand, Culturable Waste Land reduced in most districts except Adilabad and Medak, implying improved land utilisation.

**Table 29: Share of Total Geographical Area Change by Districts, Telangana
(2000-01 & 2022-23)**

Land Use Category	Adilabad (Change in Share (%))	Karimnagar (Change in Share (%))	Khammam (Change in Share (%))	Medak (Change in Share (%))	Nizamabad (Change in Share (%))	Ranga Reddi (Change in Share (%))	Warangal (Change in Share (%))
Forests	+3.23	-7.15	-4.34	-0.71	+0.67	-1.23	+12.58
Non-Agricultural Uses	-0.67	+1.88	+1.12	-1.23	+2.9	+2.31	+1.3
Barren Land	+0.35	+0.14	+0.19	-0.6	-2.74	-0.09	+0.69
Permanent Pasture	+0.66	-2.06	-0.71	-0.44	-2.33	-2.81	-1.71
Misc Tree Crops	+0.19	+0.36	+0.21	-0.22	+1.00	-0.4	-0.01
Culturable Waste	+0.33	-0.96	-1.07	-1.5	-1.32	-1.59	-2.51
Fallow Other	-4.81	-2.24	-1.17	-3.27	-7.22	+2.54	-8.3
Current Fallow	-8.38	-15.12	-3.43	-9.55	-16.32	-8.72	-1.85
Net Area Sown	+9.11	+25.14	+9.2	+17.53	+25.36	+9.99	-0.18

Source: Compiled from Directorate of Economics and Statistics Data.

Note: The table shows the change in the share of each land use category as a percentage of the total geographical area between 2000–01 and 2022–23.

Key Highlights
State - Level Trends (Telangana)

Land Use Category	Area Change (%)	Change in Share (%)	Significance
Forests	-1.11	-0.51	Sustained conservation with minimal loss.
Non-Agricultural Uses	+11.58	+12.26	Moderate urbanisation, infrastructure growth, and land conversion.
Barren & Unculturable Land	-6.19	-5.62	Slight reduction suggests marginal reclamation or improved land use.
Permanent Pasture & Grazing Land	-34.92	-34.53	Due to conversion to cropland or other uses.
Misc. Tree Crops & Groves	+21.86	+22.60	Diversification into horticulture and perennial plantations.
Culturable Waste Land	-55.36	-55.08	Converting idle land to productive uses.
Fallow Lands (Other than the current Fallows)	-58.65	-58.39	Higher cropping intensity and reduced long-term idling.
Current Fallow	-74.07	-73.91	Reduced seasonal idling and more consistent cultivation.
Net Area Sown	+35.77	+36.60	Irrigation expansion and intensified agriculture.

Note: *Area Change (%)*: Percent change in total area under each category (in hectares) between 2000-01 and 2022-23.
Change in Share (%): Difference in that category's proportion of total geographical area (in percentage points) between 2000-01 and 2022-23.

District level Highlights

Category	District(s)	Trend	Significance
Major Gains			
● Net Area Sown	Adilabad, Medak, Nizamabad	Significant increase in share	Reflects agricultural revival and expansion of cultivated land, possibly due to improved irrigation and farming practices.
● Non-Agricultural Uses	Ranga Reddi, Nizamabad, Khammam	Increase in share	Indicates urbanisation, industrial growth, and conversion from agricultural or forest land.
Major Losses			
● Forests	Karimnagar, Khammam	Decline in share	Deforestation or encroachment for agriculture, mining, or urban expansion.
● Current Fallow	Nizamabad, Medak	Decline in Share	Reduced seasonal land idling, possibly due to intensified cultivation or crop pattern changes.
● Permanent Pasture & Grazing Land	Adilabad, Nizamabad, Ranga Reddi	Decline in share	May impact livestock activities and rural livelihoods dependent on grazing.

The land use dynamics of the Godavari River Basin reveal significant variation across its seven states. On the positive side, Telangana and Madhya Pradesh show strong agricultural revival, with substantial expansions in net sown area and sharp reductions in fallows and culturable wastelands. These changes have been largely supported by irrigation expansion, reclamation initiatives, and diversification into tree crops. Similarly, Andhra Pradesh reported ecological gains through forest regeneration. In contrast, Maharashtra reflects the pressures of rapid urbanization and industrialization, with soaring non-agricultural uses, declining net sown area, and rising barren land—underscoring the costs of development-led land diversion. Odisha presents the sharpest ecological imbalance, marked by massive forest loss, surging non-agricultural land, and widespread expansion of barren land and seasonal fallows, pointing to heightened vulnerability from deforestation, climate variability, and land degradation. States such as Chhattisgarh and Karnataka occupy an intermediate position. Chhattisgarh shows relatively stable forest cover but rising fallows and declining cultivated land in key districts, reflecting pressures on agricultural viability alongside urban growth. Karnataka, by contrast, combines modest agricultural expansion with improved land utilization through reduced fallows and reclamation of wastelands, though it faces rising urbanization pressures.

On one hand, agricultural revival and reclamation efforts are evident in several states, demonstrating the positive impact of watershed management, irrigation expansion, and afforestation initiatives. On the other, ecological degradation and development pressures remain acute in others. While state governments have already introduced a range of interventions to address land use challenges (Appendix - 4), the findings point to the need for strengthening and refining these efforts. In states like Andhra Pradesh and Chhattisgarh, where fallow land is rising, policies should priorities irrigation access, soil fertility enhancement, and labor support to sustain cultivation. Maharashtra and Odisha, facing severe deforestation and urban pressures, require stronger regulatory frameworks and ecological restoration measures to balance development with conservation. In Telangana and Madhya Pradesh, where agriculture is reviving, the challenge lies in preventing over-intensification by promoting sustainable cropping systems, water-use efficiency, and agroforestry diversification.

The district-wise analysis presented in this chapter highlights the heterogeneous nature of land use change across the basin. While some districts are experiencing agricultural contraction and rising fallows, others are witnessing agricultural intensification or rapid urban expansion. This diversity implies that policies must be altered, state-level approach. Programmes for land utilisation, conservation, and agricultural support should instead be change to district-specific contexts, reflecting local resource endowments, ecological conditions, and livelihood dependencies.

2.6. Key Takeaways

Basin-Wide Summary

- ✚ The Godavari River Basin witnessed a substantial ecological shift, with forest area expanding in most states, driven by afforestation and conservation efforts.
- ✚ Net sown area declined in share across nearly all regions, while fallow lands increased, suggesting emerging constraints in farming viability.
- ✚ Urbanisation and infrastructure growth led to steady increases in non-agricultural land uses, particularly around urban centres.
- ✚ State-level aggregates often mask significant intra-state differences, highlighting the importance of district-level analysis.

Andhra Pradesh

- ✚ Forests increased by +48.26% in area and +6.4 percentage points in share, representing the strongest ecological recovery in the basin.
- ✚ Fallow lands (other than current fallows) grew by +176.2%, indicating possible shifts in cultivation practices or land abandonment.
- ✚ Net sown area saw a -6.42% drop in share, reflecting growing pressures on agricultural viability.

District insights:

- East Godavari: Highest decline in culturable waste land (-5.79%) and large increase in forest and fallow lands.
- West Godavari: Moderate forest gain; shrinking culturable land and permanent pasture and & Grazing Land.

Chhattisgarh

- ✚ Forests continue to dominate the basin area, with minimal change in composition.
- ✚ Net sown area is limited due to soil and terrain; fallow land increased in many districts.

District insights:

- Bastar: Remains forest dominant.
- Dantewada: Records a slight increase in non-agricultural and fallow categories.
- Dhamtari: Shows the highest increase in fallow lands.
- Kanker: Shows the highest increase in culturable waste land.

Karnataka

- ✚ Net sown area expanded by +8.75% in area reflecting intensification of agriculture and growing pressure on cultivable land.
- ✚ Current fallows contracted sharply, with a -59.8% drop in area and a -6.1 percentage point decline in share, suggesting reduced land left fallow and possible overuse of agricultural land.
- ✚ Non-agricultural uses grew by +10.4% in area and +0.43 percentage points in share, indicating increasing urbanization and infrastructural expansion.

District insights:

- Bidar: Non-agricultural uses increased markedly (+15.5%), reflecting rising urbanization and infrastructural expansion. Net area sown expanded (+13.9%), highlighting intensification of cultivation.
- Gulbarga: Fallow lands (other than current fallows) increased (+123.5%), indicating possible land abandonment or shifts in cultivation practices. Current fallows declined significantly (-58.1%), suggesting intensification of land use and reduced land left uncultivated.

Madhya Pradesh

- ✚ Net area sown expanded by +14.4% in area and gained +4.9 percentage points in share, reflecting strong agricultural intensification.

- ✚ Current fallows declined steeply (-64.6%) along with other fallow lands (-46.4%), indicating shrinking idle land and continuous cultivation pressure.
- ✚ Culturable waste land reduced significantly (-27.6%), suggesting limited scope for future land reclamation.
- ✚ Forests remained broadly stable (around 46% of the state's area), highlighting ecological continuity despite other shifts.

District insights:

- In Balaghat & Mandla Stable cultivation gains with reduced fallows. This indicates intensification of agriculture and a decline in land kept idle, reflecting pressure on available resources.
- In Betul, Strongest expansion of sown area along with a collapse of fallows. This suggests continuous cultivation with minimal rest periods for the land, which may have long-term sustainability implications.
- In Chhindwara, we can see expansion of sown area.

Maharashtra

- ✚ Non-agricultural uses expanded (+30.7% in area; +1.6 percentage points in share), reflecting rapid urbanization and infrastructure growth.
- ✚ Current fallows increased to (+32.5% in area; +1.3 percentage points in share), suggesting irregular cultivation cycles and possible stress in farming viability.
- ✚ Net area sown declined to -8.8% in area indicating contraction of cultivable land and pressure on agricultural production.
- ✚ Barren and unculturable land increased markedly (+36.8% in area; +1.4 percentage points in share), pointing to rising land degradation challenges.

District insights:

- Chandrapur and Nanded: Notable increase in fallow lands.
- Nashik: Agricultural base remains strong but under urban pressure.

Odisha

- ✚ Forest cover declined drastically (-63.7% in area; -50.3 percentage points in share), marking one of the most severe ecological contractions among the states.

- ✚ Current fallows increased (+102.1% in area; +176.8% in share), reflecting instability in cultivation and possible stress on agricultural viability.
- ✚ Non-agricultural uses more than doubled (+51.6% in area; +107.5% in share), pointing to rapid urbanization and expansion of infrastructure.
- ✚ Barren and unculturable land increased (+8.4% in area; +48.5% in share), suggesting rising land degradation pressures.
- ✚ Net area sown contracted by -25% in area, yet its share showed a marginal increase (+2.7 percentage points), indicating intensified use of the remaining cultivable land.

District insights:

- Kalahandi severe reductions in forest cover (-82%), alongside significant declines in net sown area (-33%), reflecting ecological loss and agricultural contraction.
- Malkangiri recorded a sharp increase in net sown area (+13.3%) and expansion of culturable waste land (+215%), but forests declined drastically (-67%), pointing to major land-use reallocation.
- Nabarangpur showed dramatic growth in permanent pasture and grazing land (+304%) and an increase in non-agricultural uses (+120%), suggesting diversification of land use beyond cultivation.
- Rayagada witnessed forest loss (-49%) and a contraction in net sown area (-26%), while barren and unculturable land increased (+19%), indicating emerging degradation pressures.

Telangana

- ✚ Net Area Sown increased (+35.8% in area; +36.6% in share), reflecting intensified agriculture, supported by irrigation expansion and improved farming practices.
- ✚ Current fallows and other fallows declined sharply (-74.1% and -58.7% respectively in area), indicating reduced idle land and more continuous cultivation cycles.
- ✚ Non-agricultural uses increased (+11.6% in area; +12.3% in share), pointing to urban growth, industrialization, and infrastructure development.
- ✚ Forests remained broadly stable (-1.1% in area; -0.5% in share), indicating relative conservation.

District insights:

- Net Area Sown expanded in Adilabad (+9.1%), Medak (+23.6%), and Nizamabad (+25.4%), highlighting agricultural revival and effective land utilization.
- Non-agricultural uses increased in Rangareddy (+10.0%) and Nizamabad (+2.9%), reflecting rapid urbanization, industrial expansion, and infrastructure growth.
- Forests: Expanded in Warangal (+12.6%), Ranga Reddy (+12.3%), and Adilabad (+3.2%), showing localized conservation gains. On the other hand, declined in Karimnagar (-7.2%) and Khammam (-4.3%), indicating deforestation, encroachment, or mining-related pressures.
- Current fallows: Reduced across almost all districts

Overall Observations

- ✚ Agricultural contraction is emerging as a common trend, especially in eastern and upland districts.
- ✚ Fallow land rise, particularly long-term fallows, may signal stress in the agricultural economy or changing land-use incentives.
- ✚ Forest expansion, while broadly positive, requires qualitative validation (e.g., biodiversity recovery vs. monoculture plantations).
- ✚ Urban and infrastructure growth continues to expand at the expense of cultivable land in fringe districts across Telangana and Maharashtra.

3. LAND DEGRADATION

3.1. Introduction

Over the past six decades, global trends have witnessed a sharp increase in both population and per capita consumption, intensifying pressure on land resources for agriculture, forestry, and urban expansion (IPCC, 2019; Singh et al., 2022). These anthropogenic drivers have significantly altered land use patterns, contributing to rising greenhouse gas emissions, widespread biodiversity loss, and the degradation of vital ecosystems such as forests, grasslands, wetlands, and savannahs. Estimates of land degradation vary across global assessments, with the IPCC reporting that 25% of ice-free land is degraded, the World Atlas of Desertification suggesting this figure could be as high as 75% (Cherlet et al., 2018), and the Global Land Outlook (UNCCD, 2022) placing it at around 40%. Regardless of the variance, the global consensus highlights the urgency of the problem and its far-reaching consequences for food production, climate regulation, and human security.

Sustainable land management (SLM) and soil protection are increasingly recognized as critical to addressing interconnected challenges of food insecurity, poverty, and environmental degradation (Lal, 2005; Von Braun, 2013). In response to the escalating crisis, the United Nations Sustainable Development Goals (SDGs), particularly SDG 15, emphasize the need to combat desertification, restore degraded land, and promote the sustainable use of terrestrial ecosystems (NAP, 2023).

In the Indian context, addressing land degradation and promoting restoration efforts is of paramount importance due to its direct implications for economic stability, environmental health, and the livelihoods of millions. With a vast population dependent on land for food and income, India's limited land resources are under immense pressure. The country not only supports a significant proportion of the global human and livestock populations but also hosts a large extent of arid, semi-arid, and dry sub-humid zones, making it especially vulnerable to degradation. Agriculture remains a cornerstone of India's economy, with a substantial portion of the workforce engaged in this sector. However, a significant share of agricultural land is rainfed, which is more prone to soil erosion, degradation, and declining productivity due to climate variability and inadequate resource access (Singh et al., 2023).

Recent national assessments, such as the Degradation and Desertification Atlas of India by the Space Applications Centre (SAC), 2019, have highlighted a significant rise in land degradation across India, with approximately one-third of the country's total geographic area exhibiting signs of degradation. The primary causes of this degradation include water and wind erosion, vegetation loss, and a range of natural and anthropogenic factors. While certain types of degradation, such as wind erosion and salinity, have shown a modest decline in their affected areas, the overall trend indicates a continuing expansion of degraded land. This situation underscores the critical need for sustainable land management practices to mitigate further degradation, enhance soil health, improve agricultural resilience, and ensure food and livelihood security for future generations.

In this context, the Godavari River Basin, one of the largest and most ecologically diverse river systems in India, represents a crucial landscape for assessing the patterns, drivers, and intensity of land degradation. Given its extensive geographical coverage and diverse ecological characteristics, a detailed examination of the spatial distribution and severity of land degradation within this basin is essential for developing targeted conservation strategies.

The present study aims to provide a comprehensive analysis of land degradation types and their intensity within the Godavari River Basin, focusing on state-level profiles. Rather than examining each district separately, this approach aggregates data from all districts within each state that fall within the basin, providing a consolidated view of the degradation patterns at the state level. This method allows for a clearer understanding of the regional trends of land degradation.

3.2. Data and Methodology

The data presented in this section is sourced from the Land Degradation Atlas Dashboard, published by the Space Applications Centre (SAC), Indian Space Research Organisation (ISRO), Government of India.

The Godavari River Basin, one of India's largest and most ecologically significant river systems, spans multiple states and supports extensive agricultural and industrial activities. However, the region faces significant challenges due to increasing land degradation, which threatens the long-term sustainability of land use. This section examines trends in land degradation across six states—Andhra Pradesh, Karnataka, Chhattisgarh, Madhya

Pradesh, Maharashtra, Odisha, and Telangana—over three time periods: 2003-05, 2011-13, and 2018-19. The analysis aims to provide insights into various forms of land degradation, including vegetation loss, soil erosion, salinity, waterlogging, and human-induced changes, which are critical for effective policymaking and resource management.

The key land degradation categories considered in this study include Vegetation Degradation, Water Erosion, Wind Erosion, Salinity, Water Logging, Manmade Degradation, Barren/Rocky Land, and Settlement Expansion. These classifications are based on the definitions provided in the Desertification and Land Degradation Atlas of India by the Space Applications Centre (SAC), ISRO. The following section presents the definitions of each land degradation category as outlined in the atlas, providing a comprehensive framework for the subsequent analysis.

3.2.1. Key Land Degradation categories

We classify the land based on the classification given by the Desertification and Land Degradation Atlas of India by the Space Applications Centre (SAC), ISRO. As per this classification, the land is classified into nine categories. These are the following.

i. Vegetation Degradation: Vegetation degradation refers to the decline in plant biomass and vegetative ground cover due to factors such as deforestation and overgrazing. This process is a significant contributor to soil degradation, particularly in terms of soil erosion and the depletion of organic matter. Vegetation plays a crucial role in maintaining soil stability and fertility. Its destruction accelerates soil degradation, making the land more vulnerable to erosion by wind and water. When vegetation cover is lost, the topsoil becomes more susceptible to removal by natural forces, leading to a reduction in soil organic content. This, in turn, weakens soil structure, reduces aggregation, and diminishes its overall stability. As organic material is lost, the soil's capacity to retain water and essential nutrients declines, further hampering vegetation regeneration. The resulting degradation of soil quality not only impacts agricultural productivity but also disrupts ecological balance.

ii. Water Erosion: Water erosion refers to the loss of soil cover caused by rainfall or surface runoff. It is classified into three types based on severity: sheet and rill erosion (minor, common in agricultural lands), gully erosion (moderate, involving narrow and shallow

gullies), and ravine erosion (severe, characterized by deep and wide gullies). In the context of land degradation and desertification, water erosion specifically excludes river erosion.

iii. Wind Erosion: Wind erosion, driven by Aeolian processes, involves the displacement of soil particles and sand, sometimes reaching high altitudes. It is most severe in areas with minimal or no vegetation, high wind speeds, dry and loose soil, smooth surfaces, and large exposed land areas. The removal of nutrient-rich topsoil diminishes soil fertility, reducing its ability to support plant growth and sustain agricultural productivity. Additionally, windblown dust and sand can accumulate on cultivated land, burying crops and further limiting agricultural yields.

iv. Water logging: Waterlogging occurs when soil becomes saturated with water for extended periods, restricting air circulation and affecting plant growth. This condition arises in undrained land where standing water accumulates, reducing soil productivity, especially in agriculture, as crops require oxygen at varying depths. The severity of waterlogging depends on how long the water remains stagnant. Factors such as flooding, salt-rich hard pans, excessive irrigation, and poor drainage planning contribute to rising water tables. Prolonged waterlogging can also lead to soil salinization, further impacting land fertility.

v. Salinity and alkalinity Salinity and alkalinity are soil characteristics that primarily affect cultivated and irrigated areas. Soil salinity occurs when water-soluble salts accumulate due to natural processes or human activities. Factors such as excessive irrigation, drought, high evapotranspiration, rising groundwater levels, and increased soil toxicity contribute to this issue. Overuse of irrigation and fertilizers further intensifies salinity, negatively impacting soil fertility and agricultural productivity.

vi. Manmade Degradation: Land degradation processes caused directly or indirectly by human activities, rather than natural factors, are classified as man-made desertification. These include activities such as mining, quarrying, brick kiln operations, industrial waste discharge, urban expansion, and improper disposal of city waste, all of which contribute to environmental deterioration.

vii. Barren/Rocky Land: Barren or rocky areas are a type of wasteland with little to no productive potential. These regions typically lack significant soil cover, either due to weathering or erosion caused by external processes.

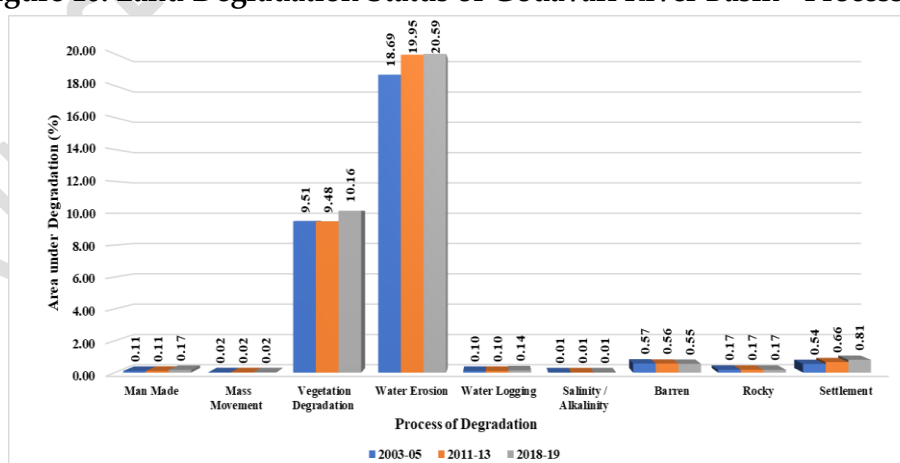
viii. Settlement: Settlement refers to areas where natural ecosystems, cropland, or other land categories have been permanently converted into built-up environments, including urban and rural settlements (IPCC, 2019).

ix. Mass Movement: The spontaneous downward movement of soil and rock under the influence of gravity (but without the dynamic action of moving fluids) is included under the general term Mass Movement (mass wasting). The mass movement processes include all forms of downslope movement of soils, overburden, or bedrock under the direct influence of gravity. Mass movement represents the spontaneous yielding of earth materials when gravitational force exceeds the internal strength of the material. It involves sliding, rolling, and flowage of masses of soil, overburden, and bedrock.

3.3. Trends in Land Degradation in the Godavari River Basin

The analysis of land degradation within the Godavari River Basin indicates a consistent and notable increase in the extent of degraded land over the assessed time periods. In the 2003-05 period, approximately 29.73% of the total geographical area, equivalent to about 1,43,54,777 hectares, was classified as degraded. This proportion increased to 31.08% (1,50,06,450) during 2011-13 and further expanded to 32.63% (1,55,61,852) by 2018-19. These findings highlight a progressive escalation in land degradation, reflecting the ongoing pressures from both natural and anthropogenic factors, and underscore the need for effective land management strategies to reduce further degradation in the region.

Figure 10: Land Degradation Status of Godavari River Basin - Process-wise.



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The figure illustrates the distribution of land degradation across various degradation processes in the Godavari River Basin, expressed as a percentage of the total geographical area. Processes include Man-made, Mass Movement, Vegetation Degradation, Water Erosion, Water Logging, Salinity/Alkalinity, Barren, Rocky, and Settlement categories.

The most significant land degradation process in the Godavari River Basin is Water Erosion, which contributed 18.69% in 2003–05, 19.95% in 2011–13, and 20.59% in 2018–19. This is followed by Vegetation Degradation, accounting for 9.51%, 9.48%, and 10.16% across the same respective periods. Between 2011–13 and 2018–19, notable increases were observed in forest/scrublands undergoing vegetation degradation and agriculture areas affected by water erosion and waterlogging. Settlement-induced degradation also rose, from 0.54% (2,60,995 ha) in 2003–05 to 0.81% (3,85,384 ha) in 2018–19, reflecting the pressure from expanding urban development (Figure 10).

Table 30: Land Degradation Trends in the Godavari River Basin

Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Man Made	52,094	0.11	55,165	0.11	81,359	0.17	3,071	26,194
Mass Movement	10,376	0.02	10,673	0.02	11,268	0.02	297	595
Vegetation Degradation	45,90,013	9.51	45,77,749	9.48	48,44,638	10.16	-12,264	2,66,889
Water Erosion	90,24,639	18.69	96,29,803	19.95	98,19,534	20.59	6,05,164	1,89,731
Water Logging	50,505	0.10	50,505	0.10	67,190	0.14	0	16,685
Salinity / Alkalinity	6,083	0.01	6,083	0.01	6,083	0.01	0	0
Barren	2,75,671	0.57	2,72,122	0.56	2,64,082	0.55	-3,549	-8,040
Rocky	84,401	0.17	84,401	0.17	82,314	0.17	0	-2,087
Settlement	2,60,995	0.54	3,19,949	0.66	3,85,384	0.81	58,954	65,435
Total degradation	1,43,54,777	29.73	1,50,06,450	31.08	1,55,61,852	32.63		
Total Land Area	4,82,79,768		4,82,78,166		4,76,89,413			

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The table presents the temporal trends in land degradation processes across the Godavari River Basin for the periods 2003–05, 2011–13, and 2018–19. The data represents the area under each degradation process, expressed both in absolute area (hectares) and as a percentage of the basin's geographical area. The table also shows the change in degraded area (in hectares) across consecutive periods (B–A and C–B).

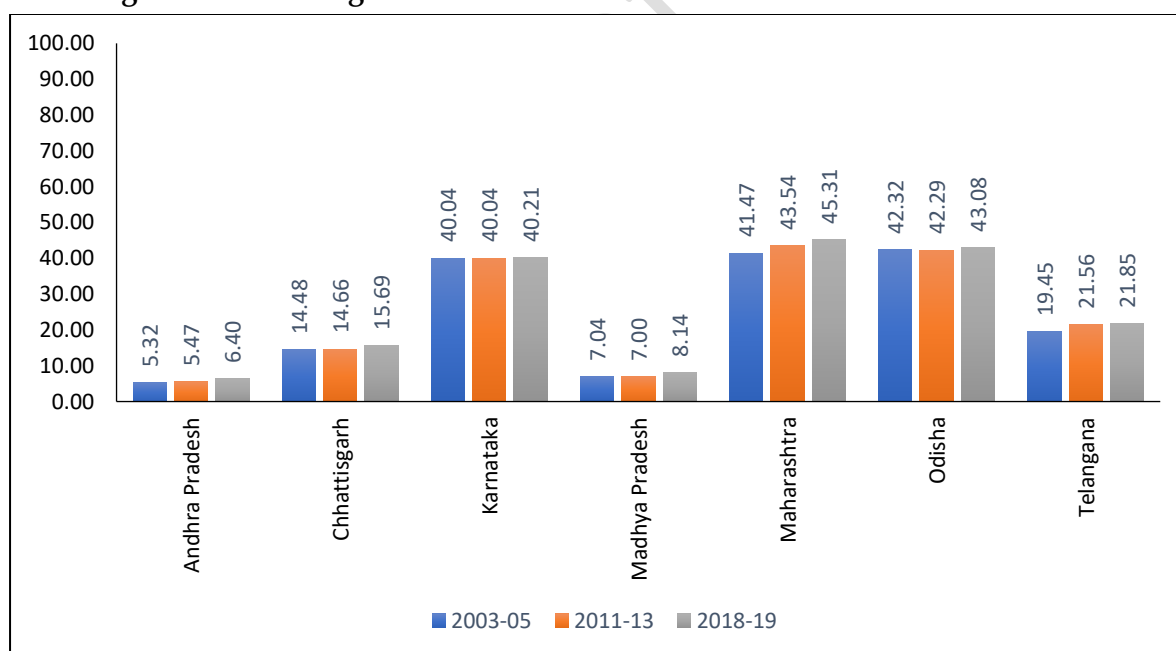
Other processes, such as Water Logging, increased modestly from 0.10% (50,505 ha) in both 2003–05 and 2011–13 to 0.14% (67,190) in 2018–19, while Man-made degradation rose steadily from 0.11% to 0.17% over the same period. In contrast, Barren Land slightly declined from 0.57% in 2003–05 to 0.55% in 2018–19, and Rocky Land saw a negligible drop (Table 30). The extent of land affected by Salinity/Alkalinity remained unchanged at 6,083 ha throughout the entire period. Overall, the trend indicates that land degradation in the

Godavari basin is intensifying, particularly due to natural processes like water erosion and vegetation stress, compounded by anthropogenic pressures like expanding settlements and infrastructure development.

Key Observations Godavari River Basin

Aspect	Observations
Overall Trend	Steady increase in degraded land from 29.73% (2003–05) to 32.63% (2018–19).
Major Degradation Process	Water Erosion, followed by Vegetation Degradation.
Highest Increment	Settlement (+65,435 ha), Water Erosion (+1,89,731 ha), and Vegetation Degradation (+2,66,889 ha).
Urbanization Impact	Marked increase in settlement-induced degradation, growing from 0.54% to 0.81%.
Policy Focus Areas	Watershed management to reduce erosion, vegetation restoration programs, sustainable urban development, and controlling the expansion of settlements.

Figure 11: Land Degradation Trends in the Godavari River Basin – State Wise



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The figure presents the percentage of geographical area under land degradation for individual states within the Godavari River Basin across three time periods: 2003–05, 2011–13, and 2018–19. The states covered include Andhra Pradesh, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, and Telangana.

The analysis of land degradation across districts within the Godavari River Basin in seven states—Telangana, Odisha, Maharashtra, Madhya Pradesh, Karnataka, Chhattisgarh, and Andhra Pradesh—reveals a consistent upward trend in degraded land between 2003–05

and 2018–19. Among these, Maharashtra (45.31%) and Odisha (43.08%) reported the highest share of degraded land in 2018–19. Karnataka shows a stable but substantial degradation footprint of 40.21. Telangana and Chhattisgarh exhibit a steady rise in degraded area, with Telangana increasing from 19.45% to 21.85%, and Chhattisgarh from 14.48% to 15.69. Madhya Pradesh shows a moderate but clear increase from 7.04% to 8.14%, while Andhra Pradesh has the lowest degradation share, though it rose from 5.32% to 6.40% over the period. These patterns underline the need for river basin-level planning and coordinated land management strategies, as degradation dynamics in the Godavari basin.

3.4.1. Andhra Pradesh

i. State Overview

Andhra Pradesh, situated in the southeastern part of India, spans a geographical area of approximately 1,60,205 square kilometres. The state is geographically diverse, marked by a mix of coastal plains and hilly terrains inland. The Godavari, Krishna, Tungabhadra, and Pennar rivers form the state's major river systems, and it has the second-longest coastline in India after Gujarat. While the coastal region endures a humid tropical climate with frequent cyclones and storm surges, the western Rayalaseema region experiences a dry and cooler climate. The annual temperature varies widely, ranging from 12°C to 40°C (DLD Atlas of India, 2016).

ii. Land degradation Overview

The analysis of land degradation trends in the Godavari Basin districts of Andhra Pradesh reveals a steady increase over the assessed time periods. In the 2003-05 period, approximately 1,12,611 hectares of land, representing 5.32% of the total area, were classified as degraded. This area expanded to 1,15,761 hectares (5.47%) during 2011-13 and further increased to 1,35,483 hectares (6.40%) by 2018-19. (Figure – 12). Although the percentage increase appears moderate, this trend indicates a persistent and escalating pressure on land resources, driven primarily by water-related stresses, urban expansion, and other anthropogenic influences.

From Table 31, several key observations can be made regarding the patterns of land degradation in the region. Water erosion has shown a slight but persistent increase over the assessed periods, indicating ongoing soil vulnerability and the gradual loss of

productive land. In contrast, water logging experienced a sharp rise in post-2011, potentially reflecting challenges in irrigation management and inefficient water use practices. Settlement expansion has nearly doubled, increasing from 3,969 hectares in the 2003-05 period to 8,617 hectares by 2018-19, highlighting the impact of rapid urbanization and infrastructure growth on land resources. Meanwhile, vegetation degradation has remained constant, yet it continues to pose a significant challenge to land productivity, reducing the overall ecological health of the region.

Table 31: Land Degradation Dynamics in Andhra Pradesh

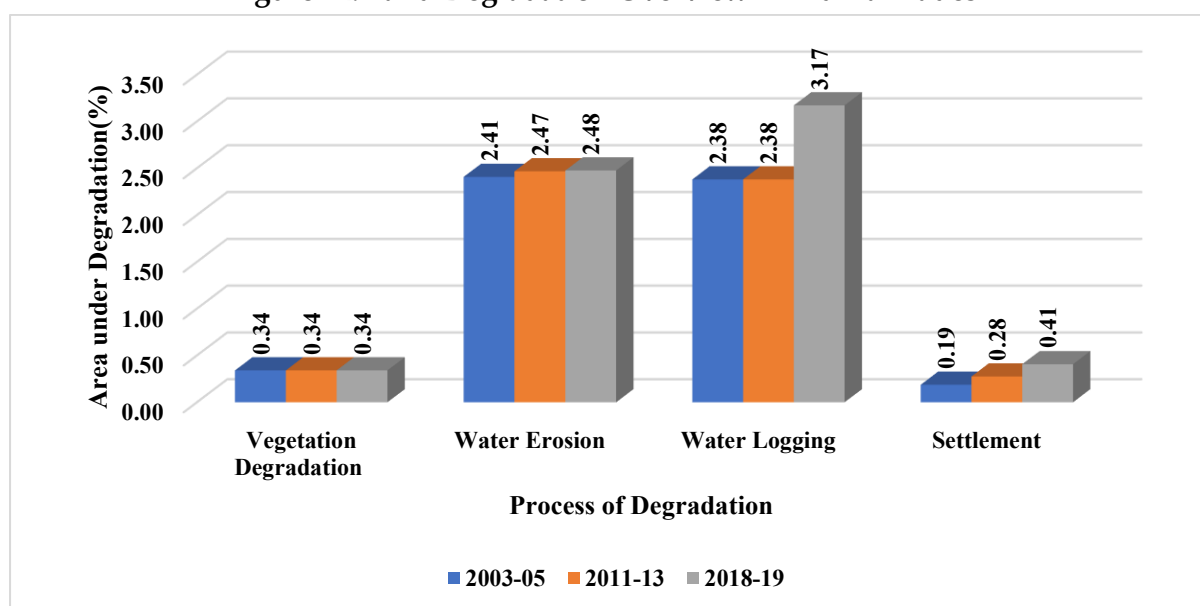
Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Vegetation Degradation	7,219	0.34	7,219	0.34	7,219	0.34	0	0
Water Erosion	50,994	2.41	52,267	2.47	52,457	2.48	1,273	190
Water Logging	50,429	2.38	50,429	2.38	67,190	3.17	0	16,761
Settlement	3,969	0.19	5,846	0.28	8,617	0.41	1,877	2,771
Total	1,12,611	5.32	1,15,761	5.47	1,35,483	6.40	3,150	19,722
Total Land Area	21,18,003		21,18,001		21,18,266			

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This table presents the dynamics of land degradation in Andhra Pradesh across three time periods (2003–05, 2011–13, and 2018–19). The figures reflect both the affected area (in hectares) and its percentage share of the total geographical area. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Andhra Pradesh, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the table.

Land degradation trends in the Godavari Basin districts of Andhra Pradesh underscore the critical need for integrated land and water management strategies to address the growing pressures on soil and water resources. Key interventions should focus on controlling water erosion through effective watershed management programs, reducing waterlogging by upgrading drainage infrastructure, and regulating urban expansion to limit settlement-driven degradation. Additionally, promoting sustainable agricultural practices such as natural farming and agroforestry can help restore soil health and enhance land resilience. To effectively combat land degradation, these state-specific measures should be aligned with broader national initiatives like the National Mission for Sustainable Agriculture (NMSA) and the Watershed Development Component of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), which aim to promote sustainable agricultural practices and enhance water use efficiency (MoEF & CC, 2015).

Figure 12: Land Degradation Overview – Andhra Pradesh



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This figure provides the dynamics of land degradation in Andhra Pradesh across three time periods (2003–05, 2011–13, and 2018–19). The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Andhra Pradesh, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the figure.

3.4.1.1. District-level Dynamics of Land Degradation

The examination of land degradation indicators in the East and West Godavari districts uncovers consistent trends over the studied periods. In East Godavari, vegetation degradation remains stable, while water erosion gradually increases, indicating growing soil vulnerability. Water logging also shows a slight upward trend, though the change is minimal. Conversely, West Godavari exhibits stability in both vegetation degradation and water logging, with the latter remaining consistently high over the years. Water erosion experiences only a slight rise, while settlement expansion is higher. Overall, the findings suggest that East Godavari is experiencing higher water erosion, whereas West Godavari is dealing with water logging problems. The most significant transformation is seen in settlement expansion, which more than doubles from 2003–05 to 2018–19, in both the districts, underscoring rapid urbanization and heightened land conversion pressures. A detailed presentation of district-wise statistics is available in *Appendix 2.A*

Key Highlights
State - Level Trends (Andhra Pradesh)

Indicator	Direction & Change	Share of Basin Area (2003 → 2018)	Significance
Total Degraded Land	● +20.3% (area-wise)	5.32% → 6.40%	Overall increase highlights rising stress on land quality.
Water Erosion	● +1,463 ha	2.41% → 2.48%	Key driver of degradation; linked to runoff and topsoil loss.
Water Logging	● +16,761 ha	2.38% → 3.17%	Sharp rise post-2011; linked to drainage inefficiencies and irrigation issues.
Settlement Expansion	● +4,648 ha	0.19% → 0.41%	Doubled in two decades; reflects urban pressure on land.
Vegetation Degradation	▬ Constant (7,219 ha)	No recovery or mitigation observed.	Persistent stress on biomass and soil cover.

District Level Highlights

District	Critical Issue	Key Observations	Policy Focus
East Godavari	Water Erosion & Urbanization	Consistently high-water erosion	Watershed Management, erosion control
West Godavari	Water Logging & Urbanization	Consistently high-water logging; Settlements doubled.	Improved drainage infrastructure and urban planning

3.4.2. Chhattisgarh

i. State Overview

Chhattisgarh, located in the central part of India, spans an area of approximately 1,35,192 sq. km. The state's landscape is defined by the Vindhyan ranges, interspersed with four major river systems—Narmada, Godavari, Rihand, and Mahanadi. Chhattisgarh is rich in red lateritic soils, vast mineral deposits, and forested regions, making it a key ecological and industrial state. The climate is mostly hot and dry, with intense dust storms in summer and ample rainfall during the *monsoon* (DLD Atlas of India, 2016).

ii. Land degradation overview

The analysis of land degradation trends in the Godavari Basin districts of Chhattisgarh reveals a consistent and accelerating increase over the assessed time periods. In the 2003-05 period, approximately 7,90,958 hectares of land, representing 14.48% of the total area, were classified as degraded. This area expanded slightly to 8,00,964 hectares (14.66%) during 2011-13, before rising more sharply to 8,57,302 hectares (15.69%) by 2018-19. This amounts to a net increase of 663.44 hectares over the 15-year period, with most of this

expansion (56,338 hectares) occurring between 2011-13 and 2018-19, indicating a more rapid acceleration in recent years. This trend underscores the growing pressures on land resources in the region, driven by a combination of natural and anthropogenic factors.

From Table 32, it is evident that the leading form of land degradation in the Godavari Basin districts of Chhattisgarh is Vegetation Degradation, which affected 5,66,186 hectares in 2003-05 and increased to 5,78,479 hectares in 2018-19, reflecting a net increase of 12,293 hectares over the 15-year period. Water Erosion is another significant concern, with the affected area expanding from 2,20,677 hectares in 2003-05 to 2,72,588 hectares in 2018-19, representing a sharp rise of 51,911 hectares. This substantial increase suggests ongoing soil loss from sloped agricultural land and highlights the need for effective erosion control measures. Settlement expansion has also contributed to the overall degradation, increasing from 31.93 hectares in 2003-05 to 43.43 hectares in 2018-19, reflecting the impact of growing infrastructure and urban pressures in the region. Notably, Man-Made Degradation doubled in the latest period, increasing from 902 hectares in 2011-13 to 1,892 hectares in 2018-19, despite remaining constant between 2003-05 and 2011-13.

Table 32: Land Degradation Dynamics in Chhattisgarh

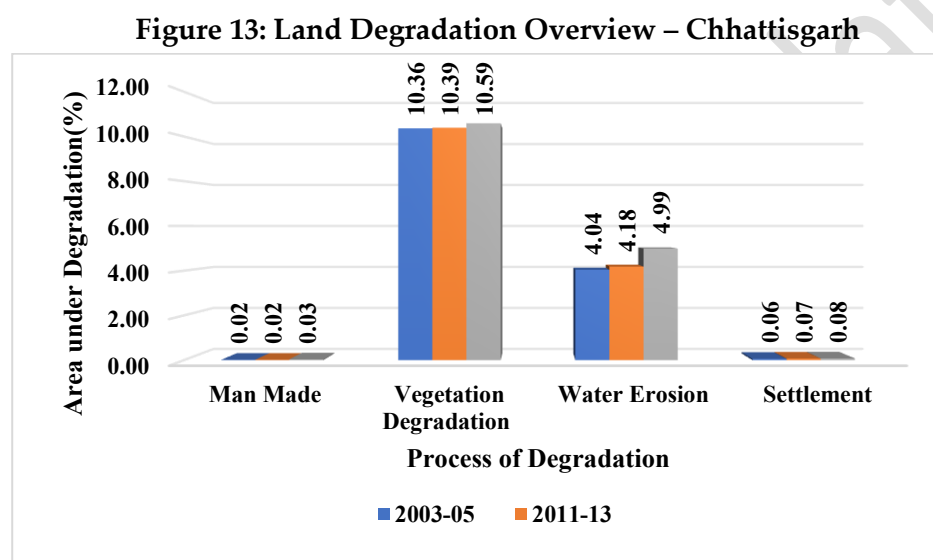
Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Man Made	902	0.02	902	0.02	1,892	0.03	0	990
Vegetation Degradation	5,66,186	10.36	5,67,668	10.39	5,78,479	10.59	1,482	10,811
Water Erosion	2,20,677	4.04	2,28,461	4.18	2,72,588	4.99	7,784	44,127
Settlement	3,193	0.06	3,933	0.07	4,343	0.08	740	410
Total	7,90,958	14.48	8,00,964	14.66	8,57,302	15.69	10,006	56,338
Total Land Area	54,64,212		54,64,210		54,64,111			

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This table presents the dynamics of land degradation in Chhattisgarh across three time periods (2003–05, 2011–13, and 2018–19). The figures reflect both the affected area (in hectares) and its percentage share of the total geographical area. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Chhattisgarh, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the table.

In summary, the Godavari Basin region of Chhattisgarh is experiencing a progressive increase in land degradation, driven primarily by natural factors such as water erosion and

vegetation stress, along with increasing anthropogenic pressures. These trends underscore the need for targeted conservation efforts and sustainable land management practices. Enhancing water conservation, improving land-use practices, and promoting increased afforestation to stabilize soil, reduce water runoff, and enhance groundwater recharge. Strengthening these initiatives can significantly mitigate climate impacts and support long-term ecological and economic resilience in Chhattisgarh⁵.



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This figure provides the dynamics of land degradation in Chhattisgarh across three time periods (2003–05, 2011–13, and 2018–19). The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Chhattisgarh, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the figure.

3.4.2.1. District-level Dynamics of Land Degradation

When we observe the land degradation indicators in the Chhattisgarh at the district level, water erosion and vegetation degradation are the most, with some districts also experiencing notable man-made pressures and settlement expansion. Bastar shows high water erosion and vegetation degradation, with a gradual increase in degraded area under water erosion (from 1,12,585 ha in 2003–05 to 1,34,300 ha in 2018–19). Similarly, Sukma reflects a high vegetation degradation (over 22,000 ha), though water erosion remains relatively low. Districts such as Bastar, Bijapur, Kondagaon, and Rajnandgaon show high

⁵<https://ceedindia.org/wp-content/uploads/2024/12/Brief-Note-Transformative-Pathways-for-Climate-Resilient-Chhattisgarh-2.pdf>.

levels of water erosion. In Bijapur, Rajnandgaon, and Dhamtari, vegetation degradation has also remained high. Balod, though showing relatively low absolute values, records a steady increase in man-made degradation from 506 ha in 2003–05 to 915 ha in 2018–19. A detailed presentation of district-wise statistics is available in *Appendix 2.B*

Key Highlights State - Level Trends (Chhattisgarh)

Indicator	Direction & Change	Share of Area (2003 → 2018)	Significance
Total Degraded Land	● +8.40% (area-wise)	14.48% → 15.69%	Overall increase, highlighting growing ecological stress
Water Erosion	● +44,127 ha	4.04% → 4.99%	Indicating intensified soil erosion risk
Man Made	● +990 ha	0.02% → 0.03%	Localized anthropogenic pressures
Settlement Expansion	● +410 ha	0.06% → 0.08%	Steady urbanization trend impacting land use
Vegetation Degradation	● +10,811 ha	10.36% → 10.59%	Dominant form of degradation; persistent decline in vegetation cover

District Level Highlights

District	Critical Issue	Key Observations	Policy Focus
Balod	Vegetation degradation and settlement	Settlement expansion and man-made degradation increasing.	Promote urban planning, regulate man-made pressures, strengthen vegetation conservation.
Bastar	Water erosion and vegetation degradation	Vegetation degradation and settlement stable. Water erosion increased	Watershed management, soil erosion control.
Bijapur	Vegetation degradation and water erosion	Vegetation degradation consistently high. Water erosion increased.	Afforestation and soil conservation
Dakshin Bastar Dantewada	Water erosion	Vegetation degradation stable. Water erosion increased.	Strengthen watershed management, erosion control
Dhamtari	Vegetation degradation	Vegetation degradation increased.	Promote large-scale afforestation, improve drainage, restore degraded vegetation.
Kondagaon	Vegetation degradation and water erosion	Vegetation degradation declined slightly. Water erosion increased. Settlement stable.	Integrated soil-water conservation, regeneration of vegetation cover.
Narayanpur	Vegetation degradation	Vegetation degradation increased. Water erosion stable.	Afforestation, biodiversity restoration, protection of forest resources.
Rajnandgaon	Vegetation degradation with rising settlement	Vegetation degradation remained high. Water erosion increased Settlement nearly	Watershed management, urban planning, regulate land-use change

		doubled. Man-made pressures appeared in recent years	
Sukma	Vegetation degradation and water erosion	Vegetation degradation consistently high. Water erosion increased.	Intensive watershed management, erosion control measures, afforestation drives.
Uttar Bastar Kanker	Vegetation degradation	Vegetation degradation slightly declined. Water erosion stable.	Vegetation regeneration, sustainable forest management, soil conservation.

3.4.3. Karnataka

i. State overview

Karnataka, situated in the southern part of India, covers a total geographical area of 1,91,791 sq. km. Karnataka is topographically divided into three natural regions: the coastal strip (Paschima Karavali), the Western Ghats (Malenadu or Sahyadris), and the Deccan Plateau (Bayaluseema). The Sahyadris are known for their dense evergreen forests, while the Krishna and Kaveri rivers drain the plateau regions and support extensive agricultural activity. The climate across the state is semi-arid tropical, with temperatures ranging from 10°C to 45°C. Rainfall varies drastically, from about 3500 mm annually in coastal areas to much lower levels in the state's interior (DLD Atlas of India, 2016).

ii. Land Degradation Overview

Karnataka has experienced noticeable changes in land degradation patterns over the time of 2003–05, 2011–13, and 2018–19. The total area under land degradation remained stable at approximately 6,56,900 ha (40.04%) from 2003 to 2013 but slightly increased to 6,59,691 ha (40.21%) by 2018–19. This indicates a marginal rise of about 2,794 ha in degraded land over the last seven-year period. From Table 33, we can observe that Water Erosion is the most dominant, affecting over 6,12,860 ha, increasing from 6,11,716 ha in 2003–05 to 6,12,340 ha in 2018–19. Vegetation Degradation remained constant across all three periods, at around 29,281 ha, indicating a steady. Mass Movement showed a consistent rise from 10,376 ha in 2003–05 to 11,268 ha in 2018–19, pointing toward increasing landslides or slope failures, particularly in hilly or high-gradient zones like the Western Ghats. Notably, settlement-induced degradation increased significantly from 4,966 ha to 6,802 ha, highlighting the growing pressure of urbanization and infrastructure development in the state (Figure 14).

Table 33: Land Degradation Dynamics in Karnataka

Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Mass Movement	10,376	0.63	10,673	0.65	11,268	0.69	297	595
Vegetation Degradation	28,695	1.75	29,281	1.78	29,281	1.78	586	0
Water Erosion	6,12,860	37.36	6,11,716	37.29	6,12,340	37.33	-1,144	624
Settlement	4,966	0.30	5,227	0.32	6,802	0.41	261	1,575
Total	6,56,897	40.04	6,56,897	40.04	6,59,691	40.21	0	2,794
Total Land Area	16,40,463		16,40,463		16,40,463			

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

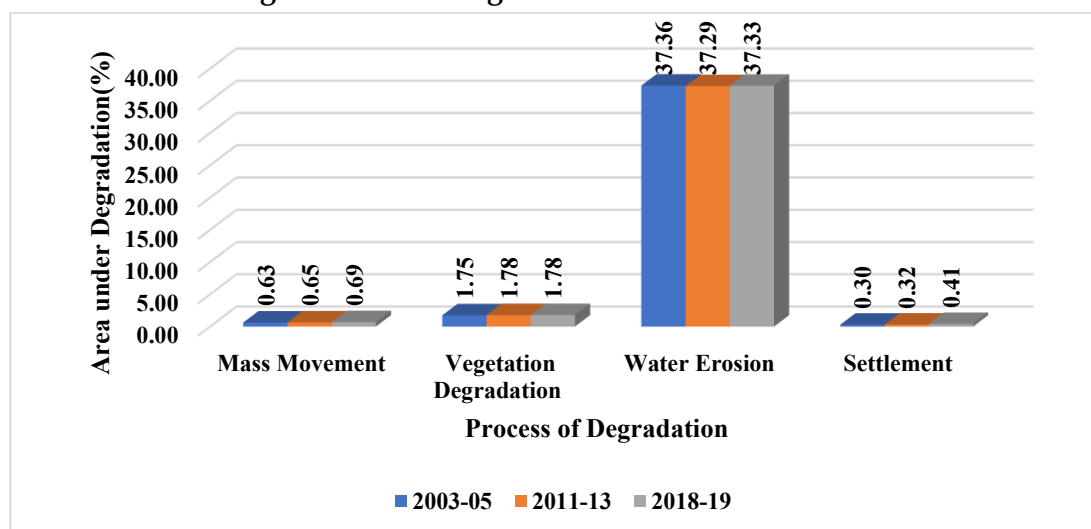
Note: This table presents the dynamics of land degradation in Karnataka across three time periods (2003–05, 2011–13, and 2018–19). The figures reflect both the affected area (in hectares) and its percentage share of the total geographical area. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Karnataka, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the table.

In the Godavari River Basin portion of Karnataka, only two districts, Bidar and Kalaburagi, are included. Both are primarily prone to water erosion, which remains the dominant form of land degradation in these regions. Bidar is particularly affected by consistently high levels of erosion. Kalaburagi, while also experiencing significant water erosion, shows a notable rise in mass movement.

Overall, Karnataka's Godavari basin region reflects a balanced but evolving pattern of land degradation, with a net increase in certain anthropogenic stressors such as settlements and mass movement, even as natural processes like water erosion show slight recovery. To address the evolving land degradation in Karnataka's Godavari basin, it is essential to strengthen erosion control, promote slope stabilization, and implement sustainable urban planning to reduce the impact of settlements and mass movement on vulnerable landscapes. The Government of Karnataka, through its State Action Plan for Climate Change (KSAPCC), has outlined a comprehensive framework to enhance the state's resilience to climate-related challenges. This plan emphasizes adaptation, mitigation, and disaster response measures to address critical issues like waterlogging, soil erosion, and extreme weather events. It calls for coordinated efforts by key state departments, including Water Resources, Agriculture, and the State Disaster Management Authority, to implement targeted interventions aimed at reducing climate vulnerability and improving disaster

preparedness. These measures are designed to strengthen the state's capacity to respond effectively to the growing impacts of climate change (MoEF & CC, 2015, 2015).

Figure 14: Land Degradation Overview – Karnataka



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This figure represents the dynamics of land degradation in Karnataka across three time periods (2003–05, 2011–13, and 2018–19). The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Karnataka, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the figure.

3.4.3.1. District-level Dynamics of Land Degradation

The analysis of degradation patterns of districts in Karnataka reports that variations in the land degradation in few districts. Bidar is characterized by consistently high-water erosion with emerging settlement pressures, while Kalaburagi demonstrates a more diversified set of degradation drivers, including mass movement, vegetation loss, and urban expansion, alongside a gradual reduction in water erosion.

In Bidar, vegetation degradation remained almost constant at ~7515 ha across all years, while water erosion has been the most significant and persistent issue, increasing slightly from 3,41,869 ha in 2003–05 to 3,42,797 ha in 2018–19. Settlement expansion emerged only in 2018–19 (735 ha), indicating the onset of urbanization pressures on land use. The overall trend reflects a stable but sizeable erosion challenge, coupled with localized human-induced changes.

In Kalaburagi, multiple forms of degradation are evident. Mass movement showed a gradual increase from 10,376 ha (2003–05) to 11,268 ha (2018–19). Vegetation degradation also increased from 21,210 ha to 21,766 ha. Water erosion, however, displayed a steady

decline from 2,70,991 ha in 2003–05 to 2,69,543 ha in 2018–19, suggesting possible stabilization or effective soil conservation measures. Settlement areas expanded from 4,966 ha in 2003–05 to 6,067 ha in 2018–19. A detailed presentation of district-wise statistics is available in *Appendix 2.C*

Key Highlights State - Level trends (Karnataka)

Indicator	Direction & Change	Share of Area (2003 →2018)	Significance
Total Degraded Land	● +0.43% (area-wise)	40.04% → 40.21%	Overall increase in degraded land, indicating persistent environmental stress.
Water Erosion	● +624 ha	37.36% → 37.33%	stabilization or improved management practices.
Mass Movement	● +595ha	0.63% → 0.69%	localized slope instability
Settlement Expansion	● +1,575 ha	0.30% → 0.41%	Growth in urbanization and infrastructure pressure
Vegetation Degradation	● +586 ha	1.75% → 1.78%	Ecological decline.

District Level Highlights

District	Critical Issue	Key Observations	Policy Focus
Bidar	Water erosion and settlement pressure	Water erosion is the dominant issue, consistently high. Vegetation degradation remained stable	Watershed management, soil conservation, afforestation, and sustainable urban planning to contain new settlement impacts.
Kalaburagi	Mass movement, water erosion, and settlement growth	Mass movement increased gradually. Vegetation degradation increased slightly. Water erosion declined, however settlements expanded steadily.	Integrated slope stabilization and soil conservation measures, vegetation regeneration, and planned urban development to balance infrastructure growth with ecological stability.

3.4.4. Madhya Pradesh

i. State Overview

Madhya Pradesh, located in the central part of India, is the second-largest state in the country, spanning a geographical area of 3,08,252 sq. km. The terrain of Madhya Pradesh is geologically diverse, comprising undulating plateaus, Vindhya hills, escarpments, and alluvial plains, enriched by major rivers like the Chambal, Narmada, and Betwa. Forest types in the state range from dry thorn forests to tropical moist deciduous and evergreen

forests, supported by a diverse soil base, including black cotton soil, sandy soil, and rich alluvial soils. The climate is marked by hot, dry summers and cold winters, with an average monsoon rainfall of around 990 mm (DLD Atlas of India, 2016).

ii. Land Degradation Overview

In terms of land degradation in the Godavari basin districts of Madhya Pradesh, there are both increases and slight improvements across various categories over the timeframes 2003–05, 2011–13, and 2018–19. The total area affected by land degradation decreased marginally from 3,33,733 hectares in 2003–05 to 3,31,911 ha in 2011–13 and then rose again to 3,33,512 ha by 2018–19. This indicates a net decline of 1,822 ha in the first interval, followed by a rise of 1,601 ha.

Table 34: Land Degradation Dynamics in Madhya Pradesh

Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Man Made	1,774	0.04	2,379	0.05	2,840	0.07	605	461
Vegetation Degradation	1,51,713	3.20	1,48,540	3.13	1,48,629	3.63	-3,173	89
Water Erosion	1,76,152	3.72	1,76,428	3.72	1,76,777	4.31	276	349
Settlement	4,094	0.09	4,564	0.10	5,266	0.13	470	702
Total	3,33,733	7.04	3,31,911	7.00	3,33,512	8.14	-1,822	1,601
Total Land Area	47,38,647		47,38,451		40,98,651			

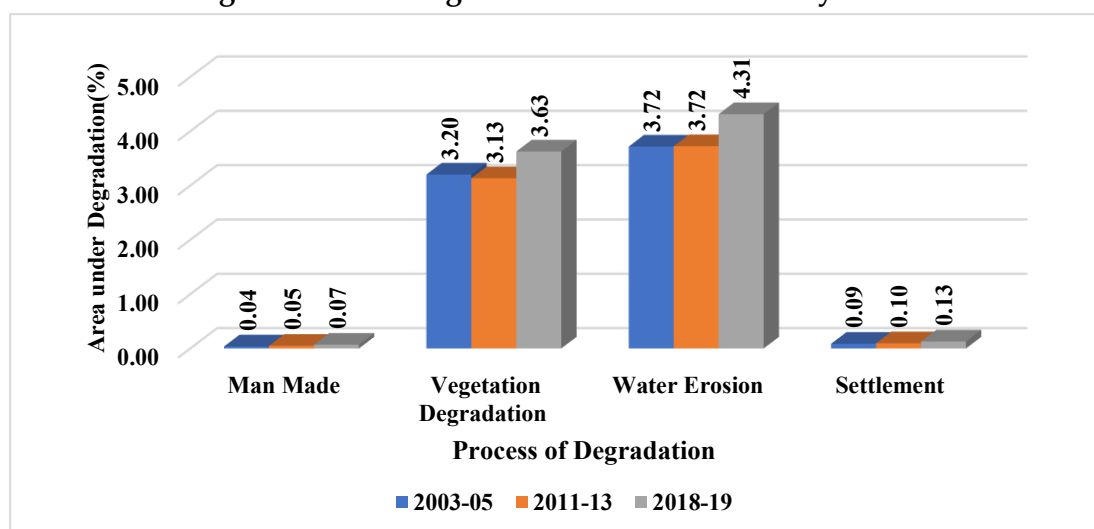
Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This table presents the dynamics of land degradation in Madhya Pradesh across three time periods (2003–05, 2011–13, and 2018–19). The figures reflect both the affected area (in hectares) and its percentage share of the total geographical area. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Madhya Pradesh, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the table.

From Table -34, we can observe that Water Erosion remains the most significant contributor to land degradation, affecting 1,76,152 ha in 2003–05 and steadily increasing to 1,76,777 ha in 2018–19. This trend, with a total gain of 625 ha, reflects the persistent issue of soil loss in sloped or agricultural areas. Vegetation Degradation, which accounted for 1,51,713 ha in 2003–05, slightly decreased by 2011–13 (to 1,48,540 ha) and remained constant thereafter. This small fluctuation suggests a partial stabilization of forest and scrubland cover. Settlement-related degradation shows a clear upward trend, increasing from 4,094 ha in 2003–05 to 5,266 ha in 2018–19—an overall gain of 1,172 ha, which points to the expansion

of infrastructure and urban footprints. Similarly, man-made degradation, though relatively small in area, increased significantly from 1,774 ha to 2,840 ha, suggesting growing anthropogenic stress (Figure 15).

Figure 15: Land Degradation Overview - Madhya Pradesh



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This figure presents the dynamics of land degradation in Madhya Pradesh across three time periods (2003–05, 2011–13, and 2018–19). The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Madhya Pradesh, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the figure.

In summary, land degradation in the Madhya Pradesh portion of the Godavari basin reflects a combination of persistent natural processes, such as water erosion, and increasing anthropogenic pressures, such as settlement growth and human-induced changes. While the overall degraded area remained stable over the 15-year period, the increase in settlement and man-made factors signals the need for proactive land-use planning and sustainable development strategies. To address the challenges of vegetation loss and water erosion in Madhya Pradesh, it is essential to strengthen climate resilience through comprehensive land management policies. The state has already taken significant steps through the Environmental Planning and Coordination Organization (EPCO) and the Madhya Pradesh Climate Change Cell, which have been established to mainstream climate adaptation and mitigation into state planning. Building on these initiatives, the focus should be on integrated watershed management, soil restoration, afforestation, and

sustainable agricultural practices to reduce soil erosion and enhance groundwater recharge⁶.

3.4.4.1. District-level Dynamics of Land Degradation

The district-level data for Madhya Pradesh reveals diverse degradation patterns across Balaghat, Betul, Chhindwara, Mandla, and Seoni. In Balaghat, water erosion remains the dominant form of degradation, consistently exceeding 1,05,000 ha across all periods, while man-made degradation steadily increased from 483 ha in 2003–05 to 1,292 ha in 2018–19. Vegetation degradation and settlement expansion remained relatively stable. Betul shows a similar pattern of vegetation degradation, increasing from 57,780 ha to 58,816 ha, while water erosion remained limited (around 3500 ha). Minor fluctuations are observed in man-made degradation and settlement areas. In Chhindwara, vegetation degradation is significant but slightly declined from 59,381 ha in 2003–05 to 56,250 ha in 2018–19. Meanwhile, man-made pressure increased from 327 ha to 613 ha, and settlement expansion increased from 1,507 ha to 1,849 ha, indicating growing anthropogenic stress. Mandla exhibits a unique pattern, with water erosion remaining constant at 20,899 ha and vegetation degradation minimal (543 ha), but settlement pressures emerged in 2018–19 (702 ha), reflecting recent urbanization. In Seoni high water erosion (around 46,400 ha), accompanied by declining vegetation degradation. Settlement areas also increased from 683 ha to 805 ha. A detailed presentation of district-wise statistics is available in *Appendix 2.D*.

Key Highlights State Level Trends (Madhya Pradesh)

Indicator	Direction & Change	Share of Area (2003 → 2018)	Significance
Total Degraded Land	● -0.05% (area-wise)	7.04% → 8.14%	Overall degraded land share has marginally declined
Water Erosion	● +624 ha	3.72% → 4.31%	Remains the leading driver of degradation; steady increase highlights growing soil erosion risks.
Man Made	● +461ha	0.04% → 0.07%	Though small in share, reflects rising human-induced disturbances such as mining, quarrying, or infrastructure.

⁶ <https://moef.gov.in/uploads/2018/07/Madhya-Pradesh-01.pdf>.

Settlement Expansion	● +702 ha	0.09% → 0.13%	Rapid growth in urbanization pressures, reflecting land-use change due to population and infrastructure expansion.
Vegetation Degradation	● +89 ha	3.20% → 3.63%	Gradual but persistent vegetation loss, signalling ecological stress and decline in green cover.

District Level Highlights

District	Critical Issue	Key Observations	Policy Focus
Balaghat	Water erosion with rising man-made pressures	Water erosion consistently high. Man-made degradation increased steadily. Vegetation degradation and settlements remained stable.	Watershed management, soil erosion control, regulate anthropogenic activities, strengthen forest conservation.
Betul	Vegetation degradation with water erosion	Vegetation degradation increased gradually. Water erosion low. Minor fluctuations in man-made and settlement areas.	Afforestation, soil conservation, promotion of sustainable land use.
Chhindwara	Vegetation degradation and expanding settlements	Vegetation degradation declined slightly. Man-made pressures doubled. Settlement expansion increased.	Control settlement sprawl, regulate land conversion, afforestation, and vegetation restoration.
Mandla	Water erosion with emerging settlement pressures	Water erosion stable. Minimal vegetation degradation. Settlement pressures emerged only in 2018–19.	Urban planning to manage new settlement growth, watershed management, conservation of forest areas.
Seoni	High water erosion with declining vegetation cover	Water erosion consistently high. Vegetation degradation declined. Settlements increased.	Watershed management, afforestation to restore vegetation, sustainable urban development.

3.4.5. Maharashtra

i. State Overview

Maharashtra, situated in the south-western part of India, is the third-largest state by area, covering approximately 3,07,713 sq. km. Geographically, the state comprises diverse landforms including the Sahyadri Range, the Western Ghats, the Deccan Plateau, the Konkan coastal belt, and fertile river valleys. Major rivers such as the Godavari, Krishna, Bhima, Tapi-Purna, and Wardha-Wainganga flow through the state, supporting a black cotton soil terrain. Maharashtra experiences a tropical monsoon climate, characterized by

intense summer heat, cooler winters, and highly variable monsoon patterns, ranging from torrential downpours in some areas to sparse rainfall in others (DLD Atlas of India, 2016).

ii. Land Degradation Overview

Land degradation in the Godavari basin districts of Maharashtra has shown a continuous upward trend over the years 2003–05, 2011–13, and 2018–19. In 2003–05, about 93,951.60 hectares (41.47%) of land were undergoing degradation. This increased to 98,661.50 ha (43.54%) in 2011–13 and further to 1,02,880.38 ha (45.31%) by 2018–19. This reflects an overall increase of 4,709.90 ha from 2003–05 to 2011–13, and an additional 4,218.88 ha from 2011–13 to 2018–19.

From Table 35, we can observe that the major drivers of land degradation in Maharashtra are Water Erosion, which is the most significant and has consistently increased, from 54,67,552 ha in 2003–05 to 60,45,240 ha in 2018–19. This reflects a net increase of 5,77,688 ha over 15 years. Vegetation Degradation, while slightly reduced by 7552 ha during the 2003–05 to 2011–13 period, surged by 2,39,618 ha in the following seven years, reaching 35,87,235 ha in 2018–19—a result of forest loss and over-exploitation of natural vegetation. Settlement-induced degradation consistently increased from 1,95,555 ha to 2,68,088 ha, reflecting increasing urban pressure and land-use changes. Additionally, man-made degradation almost doubled between 2011–13 and 2018–19, increasing by 24,342 ha, while categories such as barren and rocky land experienced gradual declines. Salinity/alkalinity-affected land remained static at 3,034 ha, indicating localized.

In conclusion, the Godavari basin region in Maharashtra is facing a progressive increase in land degradation, driven primarily by water erosion and vegetation loss, alongside expanding settlements and artificial pressures. To combat land degradation in Maharashtra, policies should be aligned with state policies such as regenerative agriculture, water conservation, and community-based land restoration. These initiatives emphasize practices such as agroforestry, organic farming, and the cultivation of drought-resilient crops to enhance soil health and biodiversity. Water conservation efforts include the construction of check dams and promoting rainwater harvesting to improve groundwater recharge. Community engagement is central to these strategies, with local stakeholders actively participating in planning and implementing land restoration projects.

These integrated approaches aim to build resilience against desertification and drought, ensuring sustainable livelihoods and environmental conservation in the region⁷.

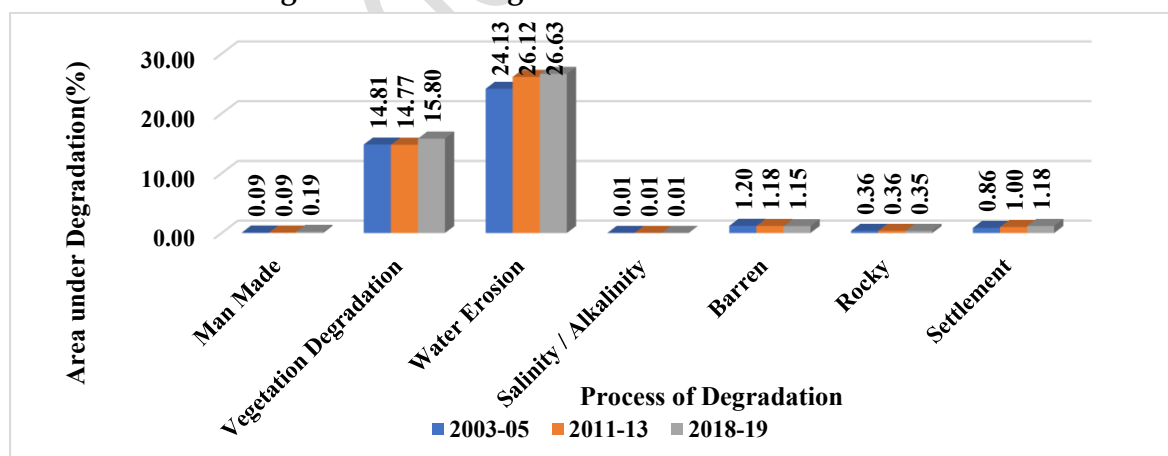
Table 35: Land Degradation Dynamics in Maharashtra

Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Man Made	19,562	0.09	19,562	0.09	43,904	0.19	0	24,342
Vegetation Degradation	33,55,169	14.81	33,47,617	14.77	35,87,235	15.80	-7,552	2,39,618
Water Erosion	54,67,552	24.13	59,19,669	26.12	60,45,240	26.63	4,52,117	1,25,571
Salinity / Alkalinity	3,034	0.01	3,034	0.01	3,034	0.01	0	0
Barren	2,71,872	1.20	2,68,248	1.18	2,60,208	1.15	-3,624	-8,040
Rocky	82,416	0.36	82,416	0.36	80,329	0.35	0	-2,087
Settlement	1,95,555	0.86	2,25,604	1.00	2,68,088	1.18	30,049	42,484
Total	93,95,160	41.47	98,66,150	43.54	1,02,88,038	45.31	4,70,990	4,21,888
Total Land Area	2,26,56,651		2,26,60,246		2,27,04,800			

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This table presents the dynamics of land degradation in Maharashtra across three time periods (2003–05, 2011–13, and 2018–19). The figures reflect both the affected area (in hectares) and its percentage share of the total geographical area. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Maharashtra, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the table.

Figure 16: Land Degradation Overview - Maharashtra



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This figure presents the dynamics of land degradation in Maharashtra across three time periods (2003–05, 2011–13, and 2018–19). The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Maharashtra, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the figure.

⁷ <https://www.switchon.org.in/wp-content/uploads/2024/06/Land-Restoration-Desertification-Drought-Resilience-in-Odisha.pdf>.

3.4.5.1. District-level Dynamics of Land Degradation

The analysis of Maharashtra districts falling within the Godavari River Basin reveals varied degradation patterns. vegetation loss and water erosion are the most widespread and persistent forms of land degradation in the basin.

Vegetation Degradation is high in Nashik, Pune, Yavatmal, Chandrapur, and Nagpur. Water Erosion emerges as the dominant form of degradation, affecting a wide of districts including Ahmadnagar, Jalgaon, Jalna, Bid, Buldana, Aurangabad, Osmanabad, Latur, Washim, and parts of Amravati and Thane. The magnitude of soil erosion in these regions highlights vulnerability to rainfall variability, over-cultivation. Districts like Ahmadnagar and Jalgaon are particularly critical, consistently reporting very high erosion levels.

Manmade degradation most visible in Chandrapur and Nagpur, where man-made degradation linked to mining, quarrying, and industrial activity has increased steadily. Simultaneously, settlement expansion is pronounced in Pune, Nagpur, Thane, and Amravati, underscoring the rapid pace of urbanization and infrastructure development. These trends suggest that land use change is becoming a key driver of degradation in urban-industrial hubs.

Barren and Rocky Land Expansion is largely concentrated in Ahmadnagar, Nashik, and Pune, pointing to soil exhaustion, over-extraction, and topsoil removal processes. The occurrence of salinity/alkalinity in Thane and Ahmadnagar further indicates soil quality deterioration due to irrigation practices and chemical imbalances. A detailed presentation of district-wise statistics is available in *Appendix 2.E*

Key Highlights State-Level Trends (Maharashtra)

Indicator	Direction & Change	Share of Area (2003 →2018)	Significance
Total Degraded Land	● +9.50% (area Percentage)	41.47% → 45.31%	Overall rise in degraded land, indicating intensifying ecological stress across the region.
Water Erosion	● +1,25,571ha	26.12% → 26.63%	Steady increase highlights persistent soil erosion risks.
Man Made	● +24,342ha	0.09% → 0.19%	Expansion of mining, quarrying, or industrial activities.

Settlement Expansion	● +42,484ha	0.86% → 1.18%	Urbanization trend, pointing to rapid population growth and infrastructure pressures.
Vegetation Degradation	● +2,39,618ha	14.81% → 15.80%	Vegetation loss, signaling serious deforestation and declining green cover.
Salinity / Alkalinity	▬ Constant (3,034 ha)	0.01	No significant expansion observed.
Barren	● - 8,040ha	1.20% → 1.15%	Stabilization or conversion of barren lands, though still ecologically fragile.

District Level Highlights

District	Critical Issue	Key Observations	Policy Focus
Ahmadnagar	Severe water erosion with barren/rocky expansion	Water erosion barren and rocky lands significant; vegetation stable.	Watershed management, soil conservation, regulate rocky/barren land expansion, promote sustainable agriculture.
Akola	vegetation loss with steady water erosion	Vegetation fluctuated water erosion declined slightly	Vegetation regeneration, micro-watershed interventions, soil fertility improvement.
Amravati	Vegetation decline	Vegetation decreased; water erosion remained high.	Afforestation, slope stabilization, soil conservation measures.
Aurangabad	High water erosion	Water erosion increased; vegetation declined; settlements expanded.	Watershed programs, forest regeneration, regulated land use.
Bhandara	Water erosion with emerging settlements	vegetation low; settlements increased.	Soil-water conservation, urban planning, vegetation enhancement.
Bid	water erosion with minor vegetation degradation	vegetation stable; man-made activity and settlement pressures small.	Watershed development, erosion control structures, sustainable agriculture.
Buldana	Water erosion with rising vegetation degradation	Water erosion increased; vegetation increased; settlements expanded.	Watershed and afforestation programs, soil fertility management.
Chandrapur	Man-made degradation and vegetation decline	Man-made degradation and vegetation increased	Regulate mining/industrial activity, afforestation, watershed rehabilitation.
Gadchiroli	Vegetation degradation with low erosion	Vegetation stable; water erosion decreased.	Forest conservation, watershed maintenance, biodiversity protection.
Gondiya	Stable vegetation with high erosion	Vegetation stable; Water erosion high	Soil conservation, afforestation in degraded zones, watershed management.

Hingoli	High vegetation degradation with low erosion	Vegetation stable	Vegetation regeneration, soil-water conservation.
Jalgaon	High water erosion with vegetation loss	Water erosion nearly doubled; vegetation stable.	Strong watershed management, afforestation, check-dam construction.
Jalna	Water erosion with stable vegetation	Water erosion high; vegetation low.	Soil erosion control, afforestation, watershed planning.
Latur	Severe water erosion with minor vegetation cover	Water erosion and vegetation low; man-made activity negligible.	Large-scale watershed projects, vegetation regeneration.
Nagpur	Man-made degradation with settlement expansion	Man-made degradation doubled; vegetation fluctuated; settlements increased.	Regulate urban-industrial expansion, afforestation, slope stabilization.
Nanded	High water erosion with moderate vegetation degradation	Water erosion increased; vegetation is stable; settlements expanded.	Soil-water management, vegetation regeneration, planned land use.
Nashik	High vegetation degradation with severe erosion	Vegetation and water erosion consistently high; barren/rocky land notable.	Integrated watershed management, afforestation, regulate barren/rocky land use.
Osmanabad	Severe erosion with low vegetation	Water erosion consistently; vegetation stable.	Soil erosion control, vegetation restoration, watershed management.
Parbhani	Water erosion with very low vegetation	Vegetation and water erosion is low	Vegetation regeneration, erosion control.
Pune	High vegetation degradation with settlement expansion	Vegetation consistently; water erosion and settlements expanded.	Urban planning, afforestation, slope management, regulate barren/rocky land.
Thane	Vegetation degradation with salinity and settlement expansion	Vegetation stable; water erosion declined; salinity patches present.	Coastal/soil salinity management, afforestation, sustainable urban planning.
Wardha	Vegetation degradation with low water erosion	Vegetation increased; erosion and settlements increased.	Afforestation, watershed development, urban planning.
Washim	High water erosion with vegetation decline	Vegetation declined; water erosion high.	Soil conservation, afforestation.
Yavatmal	Vegetation degradation	Vegetation and water erosion increased.	Watershed management, afforestation, and regulating settlement expansion.

3.4.6. Odisha

i. State Overview

Odisha, located along the eastern coast of India, covers a total area of 1,55,707 sq. km. Odisha is geographically diverse, comprising coastal plains, middle mountainous regions, plateaus, and rolling uplands. Several major rivers nourish the state, including the Mahanadi, Rishikulya, Shubarnarekha, and Baitarani. It also houses Chilika Lake, the largest lagoon in the country. Odisha experiences a tropical climate, with temperatures ranging from 15°C to 42°C, and an average annual rainfall of around 1500 mm (DLD Atlas of India, 2026).

ii. Land Degradation Overview

Land degradation in the Godavari basin districts of Odisha has shown a mostly stable pattern between 2003–05 and 2011–13, followed by an increase in 2018–19. The total degraded area in 2003–05 was 14,75,493 hectares (42.32%), which slightly decreased to 14,72,365 ha (42.29%) in 2011–13, and then increased to 15,01,923 ha (43.08%) in 2018–19.

Table 36: Land Degradation Dynamics in Odisha

Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Man Made	853	0.02	853	0.02	853	0.02	0	-0
Vegetation Degradation	1,63,900	4.70	1,58,688	4.56	1,58,680	4.55	-5,212	-8
Water Erosion	13,06,941	37.48	13,08,950	37.60	13,38,516	38.39	2,009	29,566
Barren	3,799	0.11	3,874	0.11	3,874	0.11	75	-0
Total	14,75,493	42.32	14,72,365	42.29	15,01,923	43.08	-3,128	29,558
Total Land Area	34,86,692		34,81,692		34,86,692			

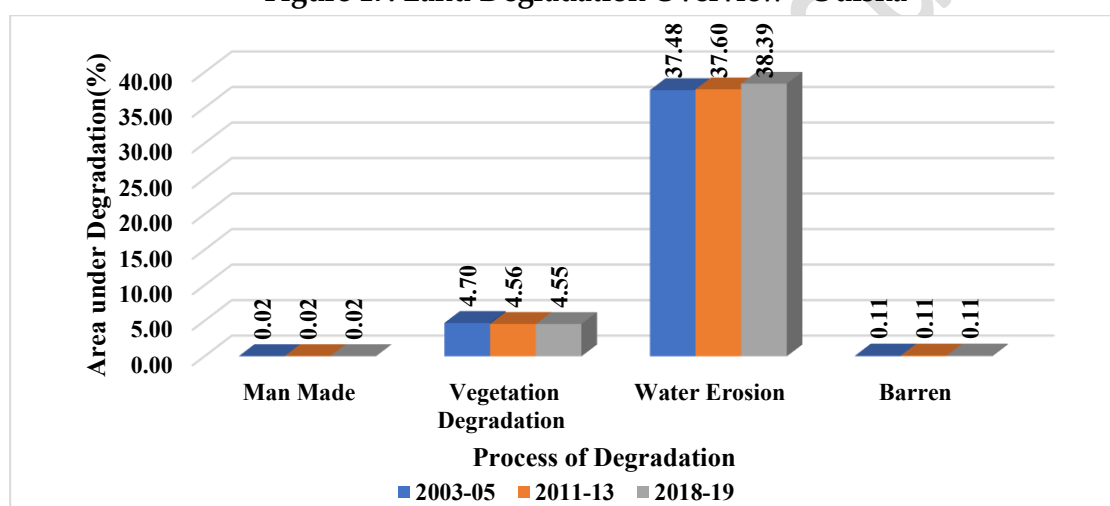
Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This table presents the dynamics of land degradation in Odisha across three time periods (2003–05, 2011–13, and 2018–19). The figures reflect both the affected area (in hectares) and its percentage share of the total geographical area. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Odisha, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the table.

From Table 36, we can observe that in Orissa, Water Erosion is the predominant cause of land degradation in the region, affecting 13,06,941 ha in 2003–05, increasing marginally to

13,38,516 ha in 2018–19, an overall rise of 31,575 ha over the 15 years. This continued expansion indicates persistent runoff issues and soil erosion, especially on sloped or exposed agricultural lands. Vegetation Degradation, on the other hand, declined slightly from 1,63,900 ha in 2003–05 to 1,58,680 ha in 2018–19, a reduction of 5212 ha, due to reforestation or land-use changes. Man-made degradation remained minimal and unchanged at 853 ha across all three timeframes, while barren land degradation increased slightly by 75 ha from 2003–05 to 2011–13 and then remained static. In summary, Odisha's Godavari basin districts have moderately increased overall land degradation, driven by water erosion. In contrast, vegetative and man-made degradation remained relatively constant or slightly reduced.

Figure 17: Land Degradation Overview - Odisha



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This figure presents the dynamics of land degradation in Odisha across three time periods (2003–05, 2011–13, and 2018–19). The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Odisha, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the figure.

A comprehensive approach emphasizing regenerative agricultural practices is essential to address the significant challenges of soil degradation, water erosion, and agricultural vulnerability in Odisha. Techniques like cover cropping, crop rotation, and minimal tillage can enhance soil fertility, improve structure, and increase water retention, reducing erosion and nutrient depletion. Additionally, strategies such as agroforestry, contour plowing, and rainwater harvesting are crucial for improving water infiltration, reducing runoff, and mitigating soil erosion, which are critical in erosion-prone landscapes (Abhay and Patra, 2022). These methods also support biodiversity conservation and ecosystem resilience by

promoting diversified cropping systems, natural pest control, and habitat restoration, which are vital for sustaining agricultural productivity amid environmental challenges (Sarma et al., 2024). Given the increasing impacts of climate change, such integrated approaches, supported by government policies, community organizations, and forest development authorities, are crucial for building a resilient agricultural system in Odisha.

3.4.6.1. District-level Dynamics of Land Degradation

The Godavari Basin districts of Odisha present a mixed structure of land degradation driven largely by water erosion, vegetation loss and barren land. In Kalahandi, water erosion is the dominant process, increasing from 3604.66 ha in 2003–05 to 3874.47 ha in 2018–1, while vegetation degradation declined from 328.12 ha to 282.05 ha over the same period. Man-made pressures and barren land (11.5 ha) remained stable.

In Koraput, vegetation degradation remained relatively stable, while water erosion at a high level. Similar patterns are seen in Malkangiri, where water erosion has consistently dominated, and vegetation degradation. Nabarangapur also dominance of water erosion, while vegetation degradation remained constant across the years. In Rayagada, water erosion is relatively lower compared to other districts, but vegetation degradation has remained high. A small but consistent barren land area was also recorded. A detailed presentation of district-wise statistics is available in *Appendix 2*.

Key Highlights State-Level Trends (Odisha)

Indicator	Direction & Change	Share of Area (2003 → 2018)	Significance
Total Degraded Land	● +1.80% (area Percentage)	42.32% → 43.08%	Overall increase in degraded land, highlighting gradual intensification of environmental stress across the region.
Water Erosion	● +29,5661ha	37.48% → 38.39%	Major driver of degradation; consistent increase reflects ongoing soil erosion risks and watershed fragility.
Man Made	▬ Constant (853 ha)	0.02 → 0.02	negligible change
Vegetation Degradation	● - 8ha	4.70% → 4.55%	Slight decline in vegetation degradation, indicating marginal recovery or stabilization of forest/green cover.
Barren	▬ Constant (3,874ha)	0.11 → 0.11	Negligible change

District Level Highlights

District	Critical Issue	Key Observations	Policy Focus
Kalahandi	High water erosion with declining vegetation cover	Water erosion increased, while vegetation degradation declined. Man-made degradation and barren land remained stable.	Watershed management, erosion control measures, reforestation programs to restore vegetation cover.
Koraput	High water erosion with Low vegetation loss	Water erosion remained consistently high, while vegetation degradation stayed stable. Man-made activity is very low.	Soil and water conservation, afforestation, community-based land-use management.
Malkangiri	Severe water erosion with low vegetation degradation	Water erosion consistently dominant with very less change across years. Vegetation degradation small but slightly declined.	Intensive watershed management, check-dam construction, soil fertility restoration.
Nabarangapur	High level of water erosion	Water erosion increased steadily. Vegetation degradation low and constant.	Watershed development, slope stabilization, afforestation.
Rayagada	Medium water erosion with Low vegetation degradation	Water erosion stable, vegetation degradation consistent. Barren land small but present.	Forest regeneration, soil conservation, reclamation of barren lands.

3.4.7. Telangana

i. State Overview

Telangana, India's newest state, was formed on June 2, 2014, and is in the south-central part of the country, covering an area of 1,14,840 sq. km. The region lies along the eastern seaboard of the Indian Peninsula and is divided into the Eastern Ghats and adjoining plains. The terrain comprises undulating uplands, erosional hills, and depressions. The Godavari and Krishna rivers and tributaries like the Manair, Bhima, Dindi, Kinnerasani, Manjeera, and Peddavagu drain the area. Telangana experiences a dry tropical climate, with temperatures ranging from 10°C to 40°C, and generally low rainfall (DLD Atlas of India, 2016).

ii. Land Degradation Overview

The Godavari basin districts of Telangana have undergone a steady increase in land degradation between 2003–05, 2011–13, and 2018–19. In 2003–05, approximately 15,89,849

hectares (19.45%) of land was degraded, which increased to 17,62,326 ha (21.56%) by 2011–13, and further increased to 17,85,903 ha (21.85%) in 2018–19.

Table 37 shows that the dominant degradation process in Telangana is Water Erosion, affecting 11,89,463 ha in 2003–05 and increasing to 13,32,312 ha by 2011–13. However, a minor decline to 13,21,616 ha in 2018–19 suggests possible localized mitigation efforts. Despite the dip, it remains the leading factor, comprising over 16% of the total degraded land. Vegetation Degradation increased consistently from 3,17,131 ha to 3,35,115 ha across the same period. Settlement-related degradation also saw a sharp rise, from 49,218 ha in 2003–05 to 92,268 ha in 2018–19, highlighting urban expansion.

Table 37: Land Degradation Dynamics in Telangana

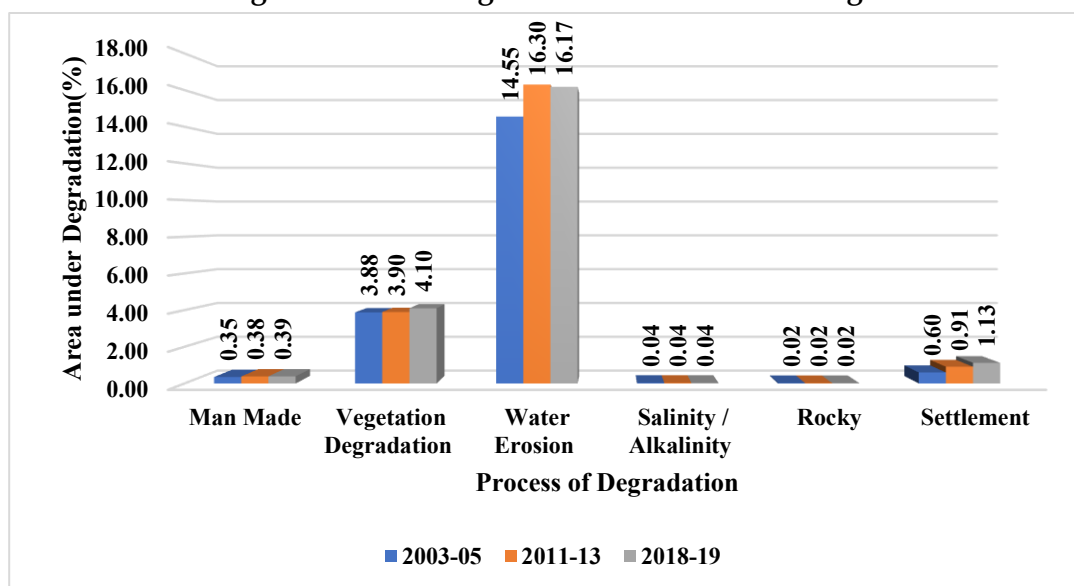
Process of Land Degradation	2003-05(A)		2011-13(B)		2018-19(C)		Change in (Ha)	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	(B-A)	(C-B)
Man Made	29,003	0.35	31,469	0.38	31,870	0.39	2,466	401
Vegetation Degradation	3,17,131	3.88	3,18,736	3.90	3,35,115	4.10	1,605	16,379
Water Erosion	11,89,463	14.55	13,32,312	16.30	13,21,616	16.17	1,42,849	-10,696
Salinity / Alkalinity	3,049	0.04	3,049	0.04	3,049	0.04	0	0
Rocky	1,985	0.02	1,985	0.02	1,985	0.02	0	0
Settlement	49,218	0.60	74,775	0.91	92,268	1.13	25,557	17,493
Total	15,89,849	19.45	17,62,326	21.56	17,85,903	21.85	1,72,477	23,577
Total Land Ares	81,74,837		81,74,840		81,72,648			

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This table presents the dynamics of land degradation in Telangana across three time periods (2003–05, 2011–13, and 2018–19). The figures reflect both the affected area (in hectares) and its percentage share of the total geographical area. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Telangana, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the table.

Man-made degradation, although relatively small in area, increased from 29,003 ha to 31,870 ha, while Salinity/Alkalinity and Rocky terrain degradation remained unchanged (Figure 18). This suggests limited salinization and geological impact in this region, possibly due to topography or soil characteristics. In conclusion, Telangana's portion of the Godavari basin is undergoing a gradual but consistent increase in land degradation, largely driven by water erosion, vegetative loss, and urban encroachment.

Figure 18: Land Degradation Overview - Telangana



Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: This figure presents the dynamics of land degradation in Telangana across three time periods (2003–05, 2011–13, and 2018–19). The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine categories of land degradation. For Telangana, the data have been compiled by combining the districts that fall within the Godavari River Basin. However, for these districts, information is available only for a few categories where degradation has occurred. Accordingly, only those categories are included in the figure.

3.4.7.1. District-level Dynamics of Land Degradation

The Godavari Basin districts of Telangana exhibit a highly heterogeneous pattern of land degradation, both natural processes such as water erosion and vegetation loss, and human-induced pressures such as settlement expansion and man-made degradation.

Water erosion remains the most widespread driver across several districts. Districts like Jangoan, Medak, Sangareddy, Siddipet, Vikarabad, and Ranga Reddy recorded large-scale erosion, with Ranga Reddy showing extremely high values (over 3,40,000 ha) (Table – 17). Sangareddy and Siddipet also experienced an upward trend in water erosion, with corresponding increases in settlement activity. Similarly, Adilabad, Kumuram Bheem Asifabad, Mancherial, and Nirmal faced moderate but consistent erosion, pointing to soil vulnerability. Vegetation degradation showed mixed patterns. In Adilabad and Kumuram Bheem Asifabad, vegetation remained substantial but stable, while in Mancherial it declined. Districts like Medchal Malkajgiri and Mulugu experienced new or intensified vegetation degradation by 2018–19, reflecting urbanization and deforestation pressures. By contrast, Nizamabad, Karimnagar, and Warangal districts reported relatively stable or minimal vegetation degradation, highlighting localized rather than widespread vegetation stress.

Man-made degradation and settlement expansion are increasingly evident in districts like Medchal Malkajgiri, Ranga Reddy, Khammam, Nagarkurnool-adjacent, and parts of Warangal recorded sharp rises in settlement area, with Ranga Reddy settlements expanding. Similarly, Medchal Malkajgiri saw significant settlement growth. Bhadradri Kothagudem, Medchal Malkajgiri and Peddapalli also show strong man-made degradation. Rocky terrain in Adilabad, Jayashankar, and Peddapalli, which persisted with smaller change across years. A detailed presentation of district-wise statistics is available in *Appendix 2.G*

Key Highlights State-Level Trends (Telangana)

Indicator	Direction & Change	Share of Area (2003 → 2018)	Significance
Total Degraded Land	● +12.34% (area Percentage)	19.45% → 21.85%	Increase in overall degraded land, reflecting intensified land stress across multiple categories.
Water Erosion	● -10,691ha	14.55% → 16.17%	Despite the small area decline recorded, the proportional share increased, showing continued dominance of erosion processes.
Man Made	● +401%	0.35% → 0.39%	Gradual rise in human-induced degradation, likely linked to mining, quarrying, and localized industrial activities.
Vegetation Degradation	● +16,379%	3.88% → 4.10%	Increasing value represents the pressure on forest/green cover from deforestation and land conversion.
Rocky	▬ Constant (1,985 ha)	0.02 → 0.02	Stable rocky terrain: no expansion but continues to represent localized unproductive land.
Salinity/Alkalinity	▬ Constant (3,049 ha)	0.04 → 0.04	Remains a constant soil issue, without significant spread across the landscape.
Settlement	● +17,493%	0.60% → 1.13%	Rapid settlement expansion, pointing to urban growth and infrastructure pressures as emerging drivers of degradation.

District Level Highlights

District	Critical Issue	Key Observations	Policy Focus
Adilabad	Vegetation degradation with Low water erosion	Vegetation remained stable; water erosion was consistent.	Forest regeneration, soil conservation, and regulating land use.
Bhadradri Kothagudem	Rising man-made pressures	Man-made degradation increased; water erosion remained constant.	Regulation of mining/industrial activities
Jagitial	Vegetation degradation with new settlements	Vegetation increased; settlement expansion emerged by 2018–19.	Afforestation, sustainable urban planning.
Jangoan	High water erosion	Water erosion increased; vegetation minimal.	Watershed management, soil erosion control.
Jayashankar	Vegetation degradation with man-made pressures	Vegetation slightly increased; rocky terrain stable.	Regulate mining, afforestation, soil conservation.

Kamareddy	Declining water erosion with low vegetation loss	Water erosion decreased; vegetation declined slightly.	Watershed strengthening, vegetation restoration.
Karimnagar	Stable vegetation with urban pressures	Vegetation consistently low; settlements stable.	Urban planning, green cover restoration.
Khammam	Rising man-made and settlement expansion	Man-made degradation emerged in 2018–19; settlements increased.	Regulate industrial/urban growth, afforestation.
Kumuram Bheem Asifabad	Vegetation degradation with low water erosion	Vegetation increased; water erosion declined; man-made pressures grew.	Forest regeneration, regulate man-made activity, soil conservation.
Mahabubabad	Persistent low-level degradation	Vegetation degradation constant; water erosion stable.	Afforestation and watershed management at local scale.
Mancherial	Declining vegetation and erosion	Vegetation dropped; water erosion decreased.	Vegetation restoration, soil fertility improvement.
Medak	Rising water erosion with vegetation stability	Water erosion increased; vegetation stable.	Watershed development, afforestation.
Medchal Malkajgiri	Settlement expansion and new vegetation degradation	Settlements increased	Sustainable urban planning, regulate urban sprawl, afforestation.
Mulugu	Rising vegetation degradation	Vegetation increased; water erosion negligible.	Forest protection, vegetation regeneration.
Nirmal	Moderate vegetation and erosion	Vegetation stable; water erosion decreased slightly; settlements increased.	Afforestation, soil conservation, urban regulation.
Nizamabad	Stable vegetation with rising settlements	Vegetation stable; settlements increased.	Urban planning, vegetation conservation.
Peddapalli	Rising man-made pressures	Man-made degradation increased; vegetation stable.	Regulation of man-made activities, soil and water conservation.
Rajanna Sircilla	Stable vegetation	Water erosion dropped; vegetation stable.	Strengthen watershed conservation, monitor land use.
Ranga Reddy	Severe water erosion and settlement expansion	Water erosion consistently high; settlements expanded; vegetation stable; salinity constant.	Integrated watershed management, salinity control, sustainable urban planning.
Sangareddy	Water erosion and settlement growth	Water erosion increased; vegetation stable; settlements increased.	Watershed management, regulate settlement growth.
Siddipet	Water erosion with man-made activity	Water erosion increased vegetation stable	Soil conservation, regulate man-made expansion.
Vikarabad	High water erosion	Water erosion increased; vegetation stable.	Afforestation, watershed strengthening.
Warangal Rural	Low-level degradation	Water erosion stable; vegetation minimal.	Vegetation restoration, erosion control.
Warangal Urban	Urban settlements with minimal vegetation	Settlements stable; vegetation is low.	Sustainable urban planning, green cover initiatives.

3.6. Key Takeaways

Basin-Wide Trends

- ✚ Degraded area rose from 29.73% (2003–05) to 32.63% (2018–19) across the Godavari River Basin—reflecting increasing stress from both natural (erosion, vegetation loss) and anthropogenic factors (urbanization, mining).
- ✚ Water erosion remains the dominant degradation process (>20% share in 2018–19), followed by vegetation degradation (10.16%), highlighting a dual risk to both soil and green cover.
- ✚ Settlement-related degradation more than doubled, from 0.54% to 0.81% of total area—evidence of rapid urban expansion into vulnerable ecosystems.

State-Level Highlights

Andhra Pradesh

- ✚ Total degraded land increased from 5.32% to 6.40%.
- ✚ Sharpest rise in water logging (+167.6 ha), while settlements doubled.
- ✚ Vegetation degradation remained constant; urbanization and irrigation mismanagement are emerging concerns.

Chhattisgarh

- ✚ Degradation rose from 14.48% to 15.69%, driven by:
- ✚ Persistent vegetation degradation (10.59%).
- ✚ Rapid rise in water erosion (+441 ha), especially in hilly terrain.
- ✚ Emerging man-made pressures (+9.9 ha) and settlement growth.

Karnataka

- ✚ Stable degradation footprint (~40%), but with localized pressures
- ✚ Dominated by water erosion, especially in Bidar and Kalaburagi
- ✚ Mass movement and settlement expansion rising in high-slope and urban fringe areas.

Madhya Pradesh

- ✚ Slight net increase in degradation from 7.04% to 8.14%.
- ✚ Water erosion increased, while vegetation degradation remained stable.

- ✚ Noticeable rise in settlements and man-made pressures, especially in Chhindwara and Balaghat.

Maharashtra

- ✚ Degradation rose from 41.47% to 45.31%, the highest in the basin.
- ✚ Major drivers: water erosion (+1,25,571 ha), vegetation loss, and urban expansion.
- ✚ Districts like Chandrapur, Nashik, Nagpur exhibit severe degradation across multiple drivers.

Odisha

- ✚ Modest increase in degradation (42.32% to 43.08%) with:
- ✚ Dominant water erosion.
- ✚ Slight recovery in vegetation cover.
- ✚ Minimal man-made or settlement-related changes.

Telangana

- ✚ Degradation rose from 19.45% to 21.85%
- ✚ Vegetation loss and urban expansion.
- ✚ Water erosion remained high, though showing signs of stabilization.
- ✚ Rapid rise in settlement area (+17,493 ha), especially around Ranga Reddy, Medchal.

Overall Observations

- ✚ Water erosion and vegetation degradation are the most persistent and widespread threats across all states.
- ✚ Settlement-induced degradation is a rapidly growing stressor, particularly in districts near urban hubs.
- ✚ Man-made degradation (e.g., mining, quarrying) is small in area but growing in intensity in states like Maharashtra, Telangana, and Chhattisgarh.
- ✚ District-level variations are critical—some districts show stability while others (e.g., Nashik, Ranga Reddy, Bidar) face compounded degradation drivers.

4. VEGETATION HEALTH ASSESSMENT

4.1. Introduction

Vegetation degradation is a major driver of land degradation in the Godavari River Basin, alongside water erosion and expanding settlements. These processes, observed consistently across basin states, exert ecological pressure that directly affects land productivity and resilience. In this context, the Normalized Difference Vegetation Index (NDVI) serves as a robust, satellite-derived metric for assessing vegetative health and land cover change. As a proxy for chlorophyll activity, NDVI enables reliable detection of long-term greenness trends and provides early signals of land degradation or recovery (Tucker, 1979).

Tracking NDVI changes at the district level offers critical insights into spatial and temporal vegetation stress, especially in areas impacted by deforestation, overgrazing, or hydrological imbalance. NDVI trend analysis supports early warning systems, complements land use datasets, and helps quantify shifts in ecosystem function. This approach aligns with India's national commitment to Land Degradation Neutrality (LDN) under the UNCCD, as well as with the National Action Programme (NAP, 2023), both of which prioritize nature-based monitoring frameworks.

NDVI has become a cornerstone in vegetation health monitoring due to its strong correlation with photosynthetic activity and primary productivity. Long-term analyses using global datasets like GIMMS3g (Global Inventory Modeling and Mapping Studies - 3rd Generation) and MODIS (Moderate Resolution Imaging Spectroradiometer) have revealed greening, browning, and desertification trends at regional to global scales. Such datasets allow for consistent, coarse-resolution time-series analyses that reflect changes in land condition. NDVI thus provides a direct and quantitative proxy for vegetation dynamics, supporting evidence-based interventions in land management and restoration (Yengoh et al., 2014).

In this section, we assess vegetation health across the Godavari River Basin from 2000 to 2022 using NDVI time-series data at the district level. The analysis highlights spatial variations, seasonal trends, and long-term changes in vegetative cover to inform land degradation monitoring and ecological planning.

4.2. Data and Methodology

4.2.1. Data

NDVI data for the years 2000 to 2023 was obtained from the MODIS Terra satellite (MOD13Q1 product), which provides 16-day composites at a spatial resolution of 500 meters. This dataset was selected due to its balance between spatial coverage, temporal frequency, and long-term continuity. The data is available at VEDAS (Visualization of Earth Observation Data and Archival System) platform of the Space Applications Centre (ISRO)⁸. Monthly NDVI values for districts within the Godavari River Basin were extracted from 2001 to 2023. The district-level NDVI data were aggregated to compute monthly average NDVI values for each constituent state and basin region. A complete list of these districts, categorized by state, is provided in Appendix 3.

4.2.2. Methodology

This methodological framework, powered by satellite-based remote sensing and GIS processing, enables the systematic monitoring of seasonal and long-term vegetation trends. NDVI provides an effective means of quantifying vegetation cover and health, enabling the detection of land degradation trends over time. This study utilizes the Normalized Difference Vegetation Index (NDVI) as a proxy for assessing vegetation condition and detecting potential drought impacts in the Godavari River Basin region from 2001 to 2023. The NDVI index, derived from satellite-based remote sensing, reflects the health and density of green vegetation. NDVI values are calculated from red and near-infrared (NIR) bands of satellite imagery using the formula:

$$NDVI = \frac{(NIR-RED)}{(NIR+RED)} \quad -(1)$$

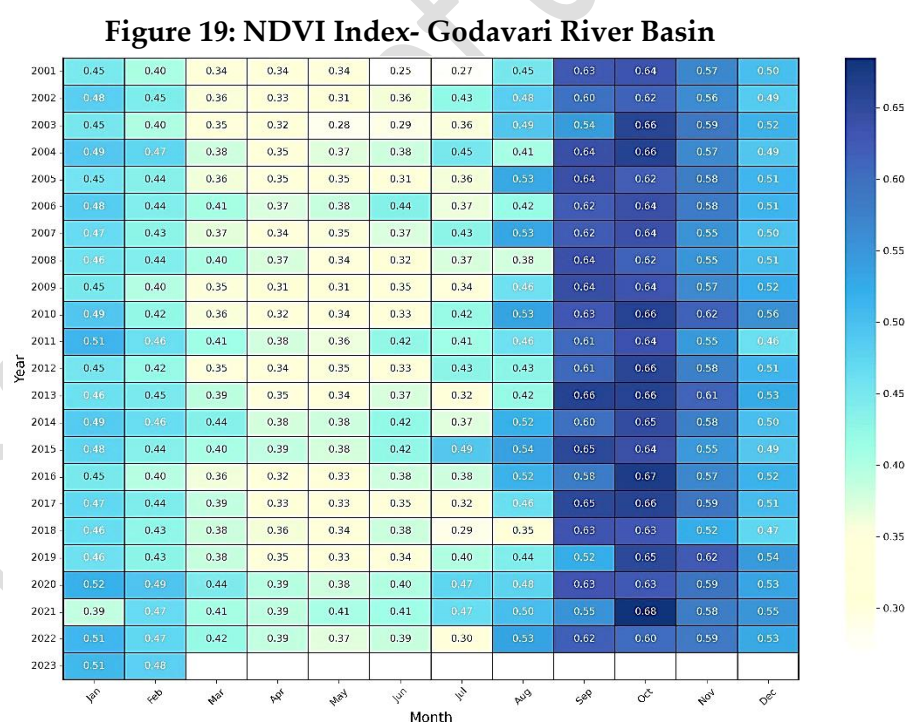
where NIR and Red are the reflectance in visible and near-infrared channels. Water, clouds, and snow have higher reflectance in the visible region, and consequently, NDVI assumes negative values for these features. Bare soil and rocks exhibit similar reflectance in visible and near-IR regions; the index values are near zero. NDVI will be between -1 and 1, with the higher index values associated with greater green leaf area.

⁸ <https://vedas.sac.gov.in/krishi/dashboard/index.html>.

4.3. Trends in NDVI Index:

4.3.1. Godavari River Basin

The aggregated NDVI heatmap of Godavari River basin-based districts' average from 2001 to 2023 shows a clear and consistent seasonal vegetation cycle. NDVI values begin relatively higher in January and February, usually around 0.45–0.51, reflecting the post-harvest or winter cropping season. As the months progress from April to July, NDVI values steadily decline, bottoming out in July, with averages as low as 0.30–0.35. This reflects widespread pre-monsoon dry conditions and reduced vegetative activity during summer (Figure 19). A strong monsoon-induced recovery is evident from August onwards, with September and October showing the highest NDVI values, consistently around 0.60 to 0.66. This reflects a region-wide greening response to monsoon rains, increased vegetation growth, and active agriculture. Notably, these peak values remain stable over time, suggesting that while seasonal recovery remains strong, there is no major upward shift in post-monsoon NDVI values across the decades.



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.

Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Godavari River Basin from 2001 to 2023. The color gradient on the right represents NDVI values ranging from approximately 0.30 (low vegetation cover) to above 0.65 (high vegetation cover). The figure captures apparent seasonal variations in vegetation across months.

The long-term NDVI patterns of the Godavari River Basin reveal a seasonally resilient yet structurally stagnant vegetation system, with persistent pre-monsoon declines and strong monsoon-driven recovery. For cultivation, this implies that agricultural productivity remains highly dependent on monsoonal rainfall, while dry-season vegetation stress has not reduced over two decades. Such seasonal cycles are consistent with broader NDVI-based drought monitoring studies in India, which highlight the strong correlation between vegetation greenness and rainfall deviations, particularly across semi-arid and drought-prone zones (Kamble et al., 2010). While early-year improvements in NDVI may suggest better soil moisture retention or modified cropping practices, the lack of a structural upward trend in summer greenness underscores continued vulnerability to pre-monsoon drought stress. In contrast, other parts of India have exhibited notable greening trends; for example, Western India shows post-monsoon NDVI increases since the 1980s, linked to climatic shifts and land-use adaptation (Singh et al., 2024), while mangrove restoration in the Krishna–Godavari delta has resulted in significant localized NDVI improvements, demonstrating the effectiveness of targeted ecological interventions (Chandra et al., 2023). Moreover, recent work on semi-arid Marathwada highlights how NDVI and related indices (NDWI, NDDI) effectively captured the severity of agricultural droughts, reinforcing the utility of vegetation indices for agricultural planning in rainfall-dependent regions (Patil et al., 2024). These comparisons indicate that although the Godavari Basin retains its seasonal resilience, the absence of a long-term upward greening trend differentiates it from other regions where either policy interventions or ecological restoration have driven measurable improvements. Thus, for sustainable cultivation in the basin, enhancing watershed management, irrigation efficiency, and crop diversification becomes important measures to persistent pre-monsoon vegetation stress.

Key Observations:

The lowest NDVI values were observed in pre-monsoon months (April–July).
The highest greening is recorded during September–November.
No strong long-term upward or downward trend in vegetation health.

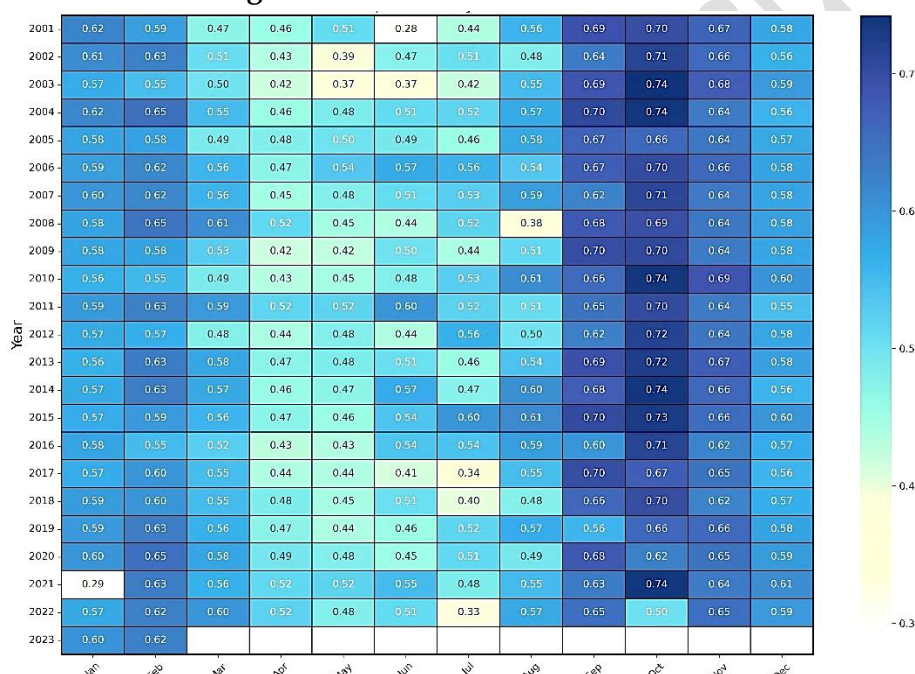
4.3.2. Andhra Pradesh

The NDVI heatmap for Andhra Pradesh from 2001 to 2023 displays monthly vegetation dynamics. A general pattern can be observed where the NDVI values tend to dip during

the summer months (April to July), with July frequently showing the lowest values, likely due to pre-monsoon dry spells. Post-monsoon months, especially September to November, consistently show higher NDVI values, indicating greener vegetation cover due to increased rainfall and agricultural activity.

Regarding long-term trends, the NDVI values during the driest months (April to July) do not show a clear improving trend; they fluctuate modestly around the same range throughout the 23 years. There is some mild improvement in early months like January and February in the last 5–7 years, which may suggest slightly better vegetative retention or early sowing patterns. Conversely, July NDVI remains persistently low, underscoring continued vegetation stress during peak summer.

Figure 20: NDVI Index- Andhra Pradesh



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.

Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Andhra Pradesh region from 2001 to 2023. The colour gradient on the right represents NDVI values ranging from approximately 0.30 (low vegetation cover) to above 0.70 (high vegetation cover). The figure captures apparent seasonal variations in vegetation across months.

However, there is no clear increasing trend in NDVI values that would suggest substantial improvement in vegetation health over time. Some years, like 2010, 2015, and 2020, exhibit relatively higher NDVI values in the post-monsoon months, but this is not sustained across all years. Early-year months like January and February show a slight dip in NDVI in recent years compared to the early 2000s, suggesting a potential decline in winter crop vegetation

or delayed sowing patterns (Figure 20). Over the years, the NDVI values appear relatively stable with moderate inter-annual variability.

To address these recurring vegetation stresses, targeted interventions are essential. The Andhra Pradesh Drought Mitigation Project (APDMP) has already emphasized supplementary irrigation, soil-water conservation, and crop diversification to strengthen resilience in drought-prone districts (Government of Andhra Pradesh, 2017). Similarly, the State Water Policy outlines watershed development, water harvesting, and improved irrigation efficiency as central strategies to mitigate vegetation stress (Government of Andhra Pradesh, 2016). Satellite-based vegetation monitoring by the Andhra Pradesh State Remote Sensing Applications Centre (APSAC) further provides real-time NDVI and VCI information to guide adaptive management responses (APSAC, 2022). In addition, Andhra Pradesh Community-Managed Natural Farming (APCNF) promotes regenerative agricultural practices that improve soil moisture retention and long-term crop sustainability (APCNF, 2021). The steady NDVI values suggest that only by improving irrigation systems, supporting winter cultivation, and encouraging climate-friendly farming can vegetation health improve in the long run.

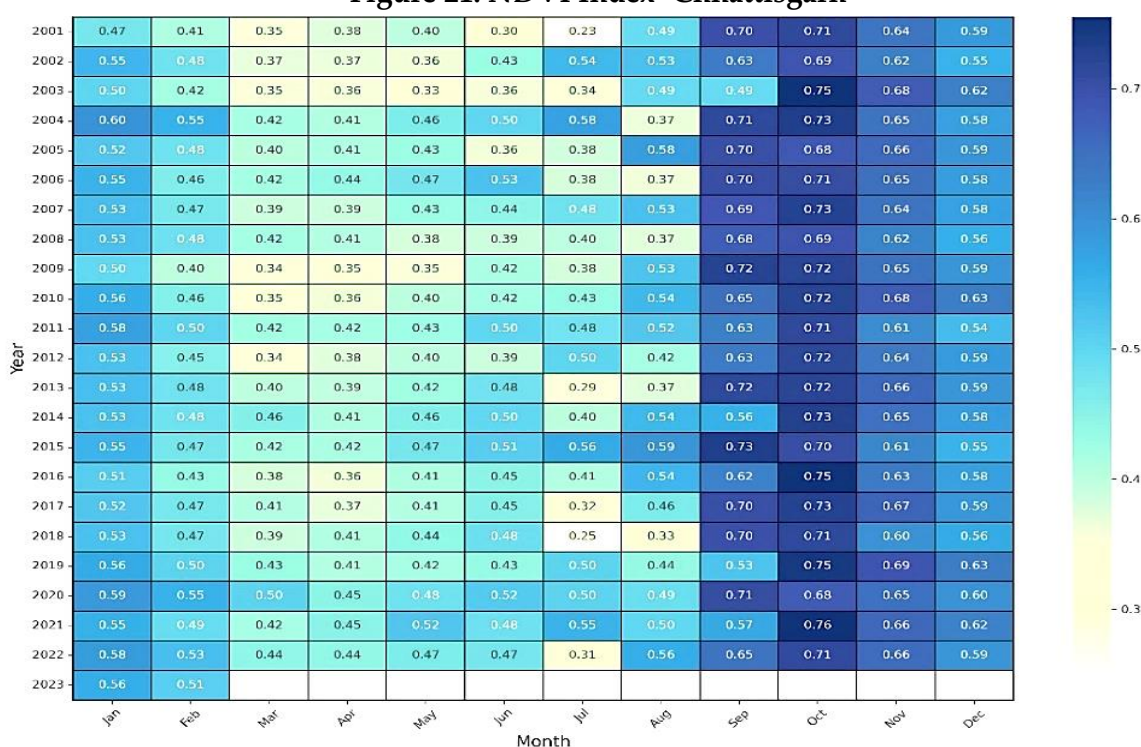
Key Observations:

The lowest NDVI values were observed in pre-monsoon months (April–July).
The highest greening is recorded during September–November.
No strong long-term upward or downward trend in vegetation health.
Slight weakening of winter vegetation (January–February) in recent years.

4.3.3. Chhattisgarh

Chhattisgarh displays one of the healthiest NDVI profiles among the states analysed. Despite the usual seasonal dip from April to July, the NDVI strongly recovers from August to November, consistently reaching values above 0.7 (Figure 21). Over the years, the state exhibits a noticeable upward trend, especially in August and September, indicating an overall improvement in vegetation health. This trend aligns with expanding green cover or well-managed agricultural patterns.

Figure 21: NDVI Index- Chhattisgarh



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.

Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Chhattisgarh region from 2001 to 2023. The color gradient on the right represents NDVI values ranging from approximately 0.20 (low vegetation cover) to above 0.70 (high vegetation cover). The figure captures apparent seasonal variations in vegetation across months.

The NDVI trends for Chhattisgarh (2001–2023) indicate relatively strong vegetation health, with post-monsoon NDVI values consistently above 0.7 and signs of improvement during August–September. This resilience aligns with the state’s large forest cover and expansion of cultivated land. However, the recurring pre-monsoon stress and recent decline in winter NDVI suggest that additional policy support is required to sustain vegetation gains. Chhattisgarh has adopted several interventions that align with these needs. The State Action Plan on Climate Change emphasizes afforestation, water conservation, and the promotion of climate-resilient agriculture to address both monsoonal variability and land degradation (Government of Chhattisgarh, 2014). National programs such as the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) have been widely implemented to expand micro-irrigation and watershed development, reducing seasonal stress on crops (Government of India, 2017). Furthermore, studies highlight that NDVI-based monitoring is effective for drought assessment and policy planning in central India, reinforcing its value for decision-making (Kamble et al., 2010; Patil et al., 2024). In recent years, Chhattisgarh has also

promoted organic and natural farming practices through state-supported missions, aiming to enhance soil moisture retention and sustainable cultivation (Chhattisgarh Government, 2020). Together, these policies suggest that while Chhattisgarh is relatively better positioned in terms of vegetation health, long-term resilience will depend on strengthening dry-season irrigation, scaling up natural farming, and continuing forest conservation efforts.

Key Observations:

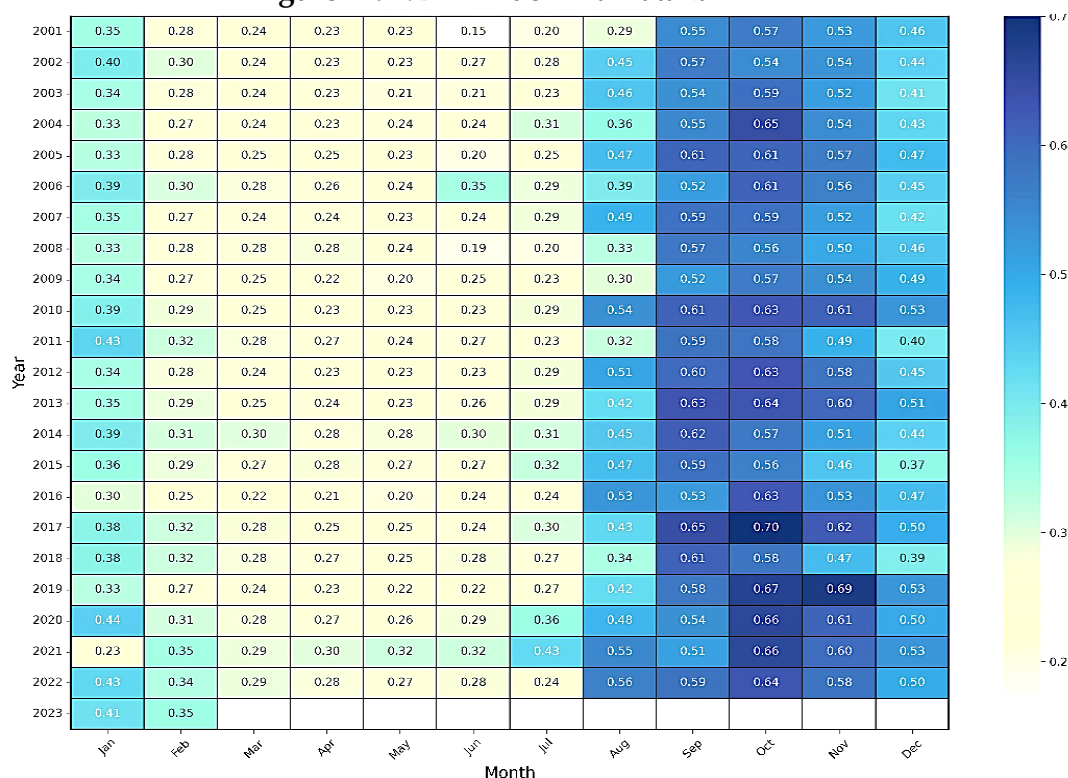
The lowest NDVI values were observed in pre-monsoon months (April–June).
High NDVI values, representing dense vegetation, are recorded in the post-monsoon period (August–November)
No strong long-term upward or downward trend in vegetation health.
From around 2018 onwards, a slightly diminished NDVI is observed during January–March,

4.3.4. Karnataka

Karnataka’s NDVI timeline indicates persistent summer stress, with values from March to July often between 0.2 and 0.3. While a recovery is observed after August, with NDVI rising above 0.6 by October (Figure – 22), this rebound remains modest. There is no clear upward trend in NDVI over time, and the seasonal cycle remains stable, highlighting a consistent vegetation pattern tied closely to rainfall cycles.

The stability of NDVI trends underscores the need for sustained interventions to reduce summer stress and enhance dry-season cultivation. Karnataka has already prioritized such measures through the State Action Plan on Climate Change, which emphasizes micro-irrigation, watershed management, and promotion of drought-tolerant crops in semi-arid zones (Government of Karnataka, 2015). National initiatives such as the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) have also been implemented in the region to expand irrigation efficiency and water harvesting structures (Government of India, 2021). In addition, the state government’s Krishi Bhagya scheme, launched specifically for drought-prone districts of North Karnataka, has promoted farm ponds and protective irrigation (Government of Karnataka, 2023), aligning well with the needs reflected in NDVI analysis. Strengthening these measures, alongside crop diversification and promotion of climate-resilient agriculture, will be essential to seasonal resilience and long-term vegetation health improvements.

Figure 22: NDVI Index- Karnataka



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.

Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Karnataka region over 2001–2023. The color gradient on the right represents NDVI values ranging from approximately 0.20 (low vegetation cover) to above 0.70 (high vegetation cover). The figure captures apparent seasonal variations in vegetation across months.

Key Observations:

Lowest NDVI values are recorded from January to May
Peak NDVI values during August–October
Low NDVI values in early years (2002–2009)
NDVI (December–February) remains at moderate values

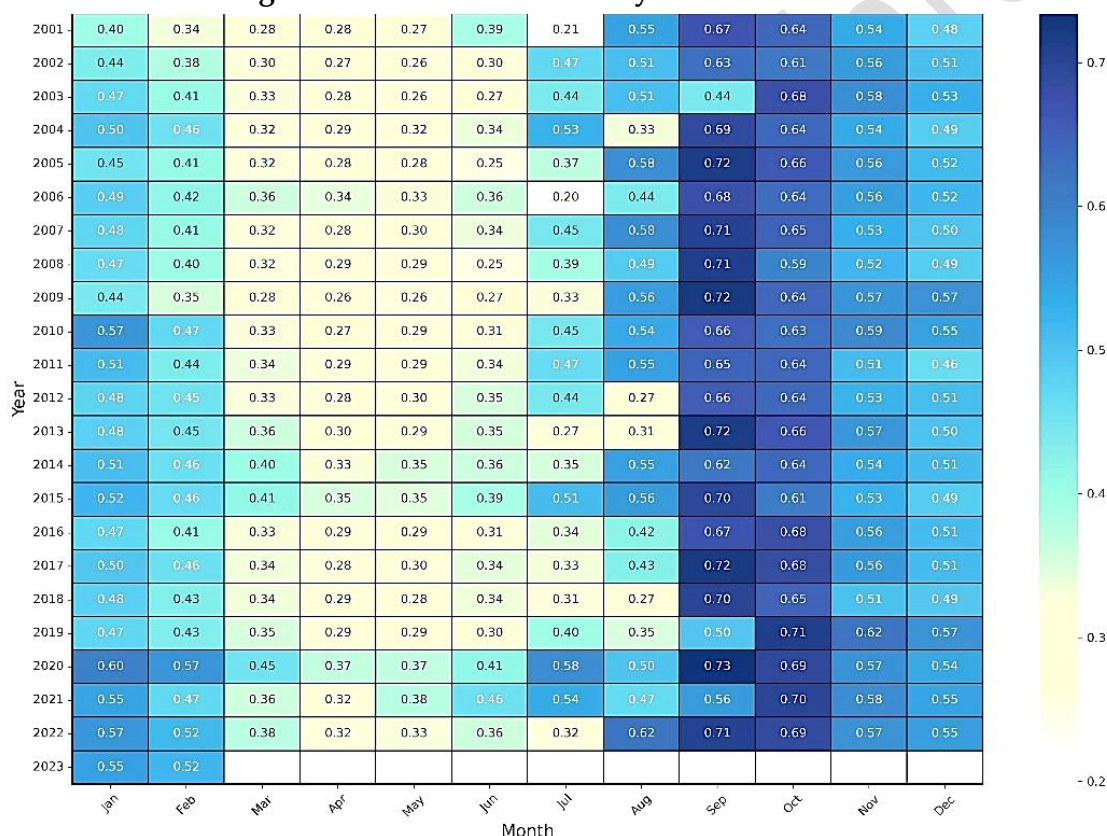
4.3.5. Madhya Pradesh

Madhya Pradesh exhibits a similar NDVI pattern to Odisha, with pronounced summer dips and sharp post-monsoon recovery. NDVI values during September to October frequently reach 0.7 or more. A gradual upward trajectory in overall NDVI, particularly in the post-monsoon months, is visible over the 23 years (Figure 23). This implies enhanced vegetation health tied to improved land use practices or greening efforts.

These NDVI improvements point towards positive outcomes from greening initiatives and improved agricultural management. Madhya Pradesh's State Action Plan on Climate

Change (SAPCC) emphasizes afforestation, watershed management, and promotion of climate-resilient crops, which align with the observed gradual upward trend in NDVI (Government of Madhya Pradesh, 2014). National-level interventions such as the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) and National Mission on Sustainable Agriculture (NMSA) have been implemented to expand irrigation and promote sustainable land use, both of which are crucial for reducing pre-monsoon stress (Government of India, 2016). For continued gains, the state should focus on water management in dry periods, support for winter farming, and conserving forests.

Figure 23: NDVI Index- Madhya Pradesh



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.

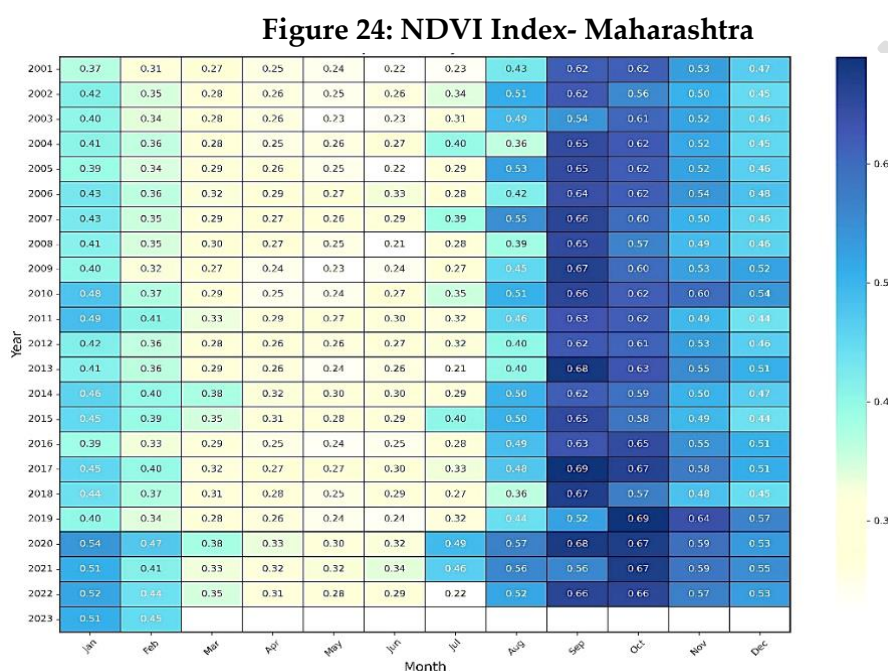
Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Madhya Pradesh region from 2001 to 2023. The color gradient on the right represents NDVI values ranging from approximately 0.20 (low vegetation cover) to above 0.70 (high vegetation cover). The figure captures apparent seasonal variations in vegetation across months.

Key Observations:

Lowest NDVI values occur consistently from March to June.
Peak NDVI values during August–October
From around 2010 onwards, NDVI values in the early monsoon months (June–July) have gradually improved.
January–February shows a moderate NDVI level

4.3.6. Maharashtra

In Maharashtra, NDVI patterns show more pronounced dips during the dry months (April–July), with July often hitting the lowest values near 0.2. The post-monsoon rebound is present but relatively subdued compared to Odisha or Madhya Pradesh. While recent years show some improvement in early months (Jan–Feb), the overall NDVI trend appears flat to slightly positive, marked by high variability (Figure 24).



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.

Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Maharashtra region over the period 2001–2023. The color gradient on the right represents NDVI values ranging from approximately 0.3 (low vegetation cover) to above 0.6 (high vegetation cover). The figure captures clear seasonal variations in vegetation across months.

From the figure – 24 we can observe that there is a low value in the summer highlight the need for policies that address Maharashtra’s drought vulnerability, especially in semi-arid districts like Marathwada and Vidarbha. The Maharashtra State Adaptation Action Plan on Climate Change (MSAAPCC) emphasizes watershed management, farm-level water harvesting, and promotion of climate-resilient cropping systems (Government of Maharashtra, 2014). Complementing this, the Jalyukt Shivar Abhiyan, launched in 2015, has focused on decentralized water storage and drought-proofing measures across thousands of villages (Directorate General of Information and Public Relations, Government of Maharashtra, 2015). At the national level, the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) has expanded micro-irrigation and protective irrigation, particularly

important for stabilizing NDVI during the pre-monsoon period (Government of India, 2016). NDVI trends in semi-arid parts of Maharashtra are closely linked to rainfall variability and water availability, underscoring the importance of combining irrigation expansion with drought monitoring through vegetation indices (Kamble et al., 2010; Patil et al., 2024). Strengthening these efforts through crop diversification, improved rabi support, and community-based natural resource management will be essential to reduce NDVI volatility and achieve sustainable gains in vegetation health.

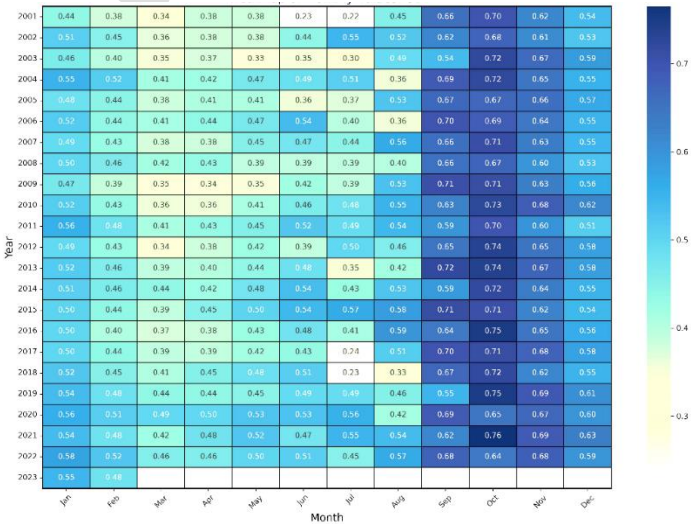
Key Observations:

Lowest NDVI values occur consistently from February to June.
Peak NDVI values during August–October
No major long-term trend
November – December shows a moderate NDVI level

4.3.7. Odisha

In Odisha, a more favourable NDVI profile is evident. The summer NDVI decline is noticeable from April to July, but the recovery from August to November is strong and consistent, with NDVI often surpassing 0.7 during September and October (Figure – 25). Over the years, Odisha has demonstrated a mild but consistent upward trend, especially in the monsoon and post-monsoon seasons, suggesting improved vegetation cover, possibly due to better rainfall, forestry initiatives, or sustained agricultural activity.

Figure 25: NDVI Index- Odisha



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.
Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Odisha region over 2001–2023. The color gradient on the right represents NDVI values ranging from approximately 0.30 (low vegetation cover) to above 0.70 (high vegetation cover). The figure captures apparent seasonal variations in vegetation across months.

The Odisha Forestry Sector Development Project (OFSDP) has been central to strengthening joint forest management and increasing canopy density, which is reflected in stronger NDVI values during the monsoon and post-monsoon months (Government of Odisha, 2023). The state's Action Plan on Climate Change also highlights ecosystem-based adaptation strategies, including mangrove restoration in coastal zones and expansion of resilient agroforestry systems (Government of Odisha, 2018). At the same time, national programs such as PMKSY have improved water availability, contributing to vegetation gains during the early monsoon (Government of India, 2016). For Odisha, the Scaling up community-based forest restoration, strengthening climate-smart agriculture, and integrating NDVI monitoring into district-level planning will be key to maintaining Odisha's favourable NDVI profile while reducing vulnerability to climate shocks.

Key Observations:

The lowest NDVI values are recorded from March to June, particularly in April and May.
Peak NDVI levels from August to October
The seasonal NDVI pattern is highly consistent.
In recent years (2016–2022), NDVI values have increased in July and August.

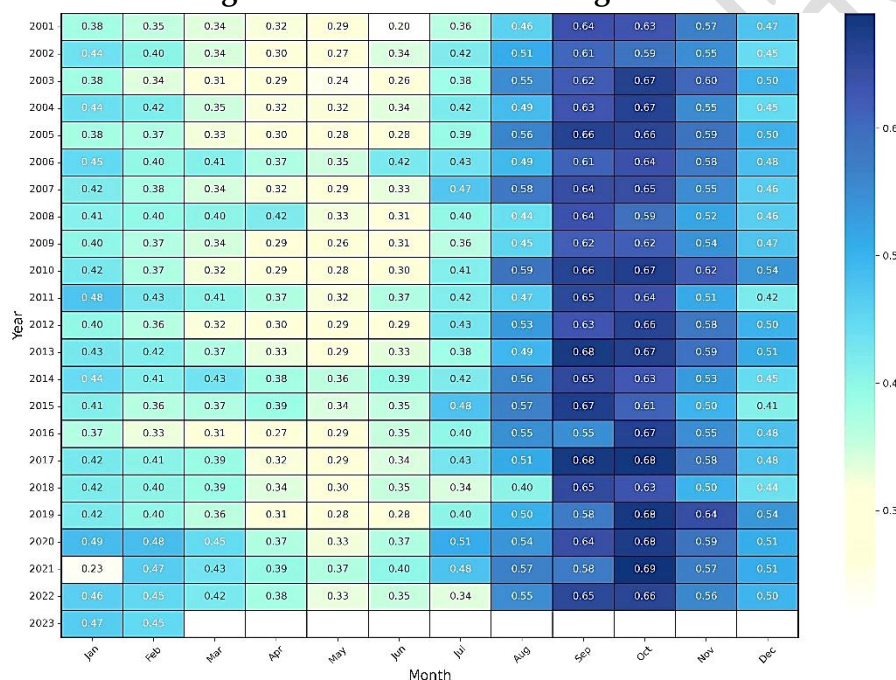
4.3.8. Telangana

The NDVI heatmap for Telangana from 2001 to 2023 reveals a consistent seasonal pattern where NDVI values dip from April to July, reaching their lowest around June and July, indicative of peak summer and pre-monsoon dryness. Post-monsoon months, especially September and October, show relatively high NDVI values, often exceeding 0.65 (Figure 26). While the monsoon-driven rebound is consistent across years, there is no significant upward trend in overall NDVI values. This suggests that vegetation health has remained stable with some inter-annual variability. Notably, values during the early months (January–March) have slightly improved in recent years, indicating potentially better winter cropping or irrigation support.

Telangana benefits from reliable monsoon recovery, its vegetation health has not improved higher over a time. This underscores the importance of strengthening dry-season and pre monsoon vegetation support. The state's flagship Mission Kakatiya program, which focuses on tank water storage, has improved irrigation potential and groundwater

recharge⁹, directly contributing to vegetation resilience. Similarly, the large-scale Mission Bhagiratha initiative has expanded drinking and irrigation water access across rural areas¹⁰, which can support early-season crops. At the national level, PMKSY continues to promote micro-irrigation and watershed development in Telangana, crucial for stabilizing NDVI during summer stress (Government of India, 2016). Integrating NDVI monitoring into district-level planning, expanding micro-irrigation, and promoting drought-tolerant crops will be essential to enhance vegetation health beyond the monsoon cycle.

Figure 26: NDVI Index- Telangana



Source: Indian Space Research Organization (ISRO), Vegetation Condition Dashboard.

Note: The figure presents the monthly Normalized Difference Vegetation Index (NDVI) values for the Telangana region over 2001–2023. The color gradient on the right represents NDVI values ranging from approximately 0.30 (low vegetation cover) to above 0.60 (high vegetation cover). The figure captures apparent seasonal variations in vegetation across months.

Key Observations:

The lowest NDVI values are recorded from March to June.
Peak NDVI levels from August to October
No upward or downward long-term trend
Slight improvement in NDVI in June–July

⁹<https://missionkakatiya.cgg.gov.in/homemission#:~:text=Realizing%20the%20importance%20of%20reclamation,f or%20ensuring%20sustainable%20water%20security.>

¹⁰ <https://medak.telangana.gov.in/mission-baghiratha/#:~:text=Taking%20into%20consideration%20the%20lack,the%20people%20of%20Telangana%20State.>

The NDVI-based spatiotemporal analysis conducted across Andhra Pradesh, Telangana, Chhattisgarh, Maharashtra, Madhya Pradesh, Odisha, and Karnataka highlights the critical need to reinforce vegetation health through targeted interventions. The data reveal a consistent decline in vegetation indices during the pre-monsoon months (April–July), indicating periods of heightened climatic vulnerability due to low soil moisture and water stress. In this context, promoting short-duration and drought-resilient crop varieties and developing alternative cropping systems emerge as key adaptation strategies, particularly for rainfed and semi-arid regions. These measures, already being demonstrated under NICRA and AICRP-IFS platforms, can be effectively scaled to the agro-ecological conditions of the identified states.

Furthermore, the crop diversification approach—central to the Department of Agriculture & Farmers' Welfare's (DA&FW) strategy under the Pradhan Mantri–Rashtriya Krishi Vikas Yojana (PM-RKVY)—is especially pertinent for states like Andhra Pradesh, Karnataka, and Odisha. The shift from water-intensive crops, such as paddy and tobacco, towards less water-demanding alternatives, including pulses, oilseeds, millets, and agroforestry systems, can significantly contribute to sustaining NDVI levels during climatic stress. Extending the tobacco crop diversification program to these states presents an additional opportunity to enhance ecological outcomes and reduce the pressure on groundwater resources (Ministry of Agriculture & Farmers Welfare, 2025).

Given these observations, an integrated intervention framework is proposed to support NDVI enhancement and vegetation sustainability across vulnerable districts. This includes:

- (i) Agro-ecologically aligned crop and land-use diversification, informed by region-specific climate risk profiling, and supported through Integrated Farming Systems models.
- (ii) Water-use optimization, through accelerated implementation of micro-irrigation systems (as supported under the Per Drop More Crop scheme), soil moisture retention techniques, and decentralized rainwater harvesting structures.
- (iii) Institutional strengthening at the grassroots level involves activating Village Climate Risk Management Committees and operationalizing seed and fodder banks.
- (iv) Digital monitoring mechanisms, leveraging NDVI and remote sensing platforms to identify priority districts, assess intervention outcomes, and refine planning at the block and district levels.

When aligned with existing national missions and region-specific Agro climatic policies, such a multidimensional policy framework can substantially enhance vegetation health, increase agricultural resilience, and contribute to long-term environmental sustainability in the Godavari River basin.

4.3. Key Takeaways

Seasonal Recovery Remains Strong

NDVI data shows consistent greening during monsoon and post-monsoon months (August–October), with peak values ranging between 0.60–0.66 across years. This highlights the region’s seasonal ecological resilience and active vegetation response to rainfall.

Persistent Summer Stress

Pre-monsoon months (April–July) consistently exhibit low NDVI values (0.30–0.35), indicating continued vegetation stress, likely driven by water scarcity, high temperatures, and limited irrigation coverage.

No Clear Upward Trend in Vegetation Health

Despite periodic improvements in certain years, there is no significant long-term increase in NDVI values during either dry or wet seasons, reflecting a structurally stagnant vegetation system.

State-Level and Intra-State Variability

District-level differences are evident. Some parts of Andhra Pradesh show slight NDVI improvement in early months, while Telangana and Maharashtra maintain stable but stress-prone summer patterns.

Monitoring Supports Climate-Resilient Planning

NDVI analysis helps identify high-stress zones and seasonal vulnerabilities. It complements land use data and supports evidence-based decision-making for drought mitigation, land restoration, and climate-adaptive agriculture.

5. CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Conclusion

The Godavari River Basin, one of India's most expansive and ecologically diverse river systems, has witnessed dynamic land use transformations over the past two decades. These changes reflect both development pressures and ecological transitions across its sub-regions. The analysis reveals that while forest cover has increased in several parts of the basin—particularly in Andhra Pradesh and Maharashtra—this has not translated into a significant net ecological gain due to simultaneous declines in other categories, such as permanent pastures, tree crops, and culturable wastelands.

Most strikingly, the expansion of fallow land—especially long-term fallows—emerges as a defining feature of agricultural change in the basin. This trend, particularly pronounced in Andhra Pradesh and Telangana, indicates not just cyclical cropping decisions, but potentially deeper shifts in the viability of rainfed farming systems, resource constraints, or land abandonment. In contrast, the net sown area has either stagnated or declined, with modest gains in some districts offset by losses elsewhere.

At the same time, land degradation processes, especially water erosion and vegetation degradation, remain persistent and spatially widespread. Semi-arid districts of Telangana and Maharashtra, along with certain parts of Chhattisgarh and Odisha, continue to face mounting pressures from unsustainable land management, erratic rainfall, and expanding settlements. Degradation hotspots mapped in Section 3 align closely with vulnerable agro-ecological zones, where soil erosion and vegetation loss reinforce each other in a negative feedback loop.

The vegetation health analysis based on NDVI trends from 2001 to 2023 paints a mixed picture. Although seasonal cycles remain stable—showing robust greening during monsoon months—the data shows no significant long-term improvement in vegetation health across most districts. Pre-monsoon months continue to exhibit severe stress, with no discernible shift toward increased resilience. These findings highlight an underlying structural vulnerability: the basin's agriculture and land ecosystems remain heavily monsoon-dependent and weakly buffered against climatic variability.

Together, these insights suggest that the Godavari River Basin is at a critical juncture. Its seasonal resilience coexists with structural fragility. Without targeted, district-level policy interventions, the trends of increasing fallows, stagnant vegetative growth, and expanding degradation could compromise long-term agricultural productivity, ecological health, and rural livelihoods. This calls for an integrated response that goes beyond generic conservation or development models and addresses the specific stressors and geographic disparities evident in the data.

5.2. Policy Recommendations

Restore Long-Term Fallow Lands Through Incentivized Cultivation (AP & Telangana)

- ✚ Use district-level fallow hotspots (e.g., East/West Godavari, Nizamabad) to identify priority zones.
- ✚ Provide input subsidies and tenure security for smallholders to resume cultivation.
- ✚ Promote pulse and millet-based cropping systems with low water and input requirements.

Shift from Area Expansion to Land Productivity (Across Basin)

- ✚ Given the stagnant NDVI trends and reduced net sown area, shift focus from expanding cultivation to intensifying sustainable productivity.
- ✚ Promote zero-budget natural farming and bio-input models to enhance soil health.
- ✚ Expand programs like APCNF (Andhra Pradesh) and similar regenerative agriculture pilots in other states.

Enhance Vegetation Resilience During Pre-Monsoon Months

- ✚ Target afforestation and agroforestry in high summer-stress zones (based on NDVI data), especially in Telangana and Maharashtra.
- ✚ Integrate silvi-pastoral systems in degraded pasture and culturable wasteland categories.
- ✚ Promote farm bund planting and shaded cropping to increase vegetative cover during dry periods.

Strengthen Watershed Management in Degradation-Prone Districts

- ✚ Focus on erosion-prone districts identified in Section 3, such as Nanded, Adilabad, and parts of Chhattisgarh.

- ✚ Align watershed planning with MGNREGS and Jal Shakti Abhiyan to maximize impact.
- ✚ Invest in check dams, percolation tanks, and contour trenching in rainfed zones.

Establish Basin-Level Vegetation and Degradation Monitoring System

- ✚ Use MODIS NDVI and SAC's land degradation layers to create an annual Vegetation Stress Index dashboard.
- ✚ This can be hosted by regional institutions (e.g., APSAC, MRSAC) and inform state planning boards.
- ✚ Incorporate alerts for early drought stress and vegetation anomalies for seasonal planning.

Prevent Further Conversion of Grazing Lands and Agroforestry Patches

- ✚ Enforce zoning regulations to protect remaining pastureland (e.g., in Telangana where losses are >20%).
- ✚ Provide fodder banks and community silage storage to reduce grazing pressure on forests.
- ✚ Incentivize tree crop restoration on fallow and degraded land using MGNREGS and NABARD funds.

District-Level Land Use Action Plans Linked to LDN Targets

- ✚ Translate findings into District Land Management Plans tied to India's Land Degradation Neutrality (LDN) commitments.
- ✚ Include clear land use baselines (2000–2022), restoration targets (e.g., degraded area to be reduced by 2030), and investment needs.
- ✚ Prioritize multi-stakeholder platforms to coordinate between state agriculture, forest, and rural development departments.

5.3. Concluding Note

The Godavari River Basin remains ecologically resilient but increasingly vulnerable to systemic land stress. Without proactive, evidence-based interventions, emerging trends—rising fallows, stagnant vegetation growth, and expanding degradation—could undermine long-term food security and rural livelihoods. By grounding action in spatial diagnostics, encouraging local stewardship, and focusing on vegetation resilience, the region can advance toward sustainable, climate-smart land management.

6. APPENDIX

Appendix 1 : State-wise List of Districts within the Godavari River Basin Considered for Land Utilization (2000 to 2020)

State	Covering Districts
Andhra Pradesh	East Godavari, West Godavari
Chhattisgarh	Balod, Bastar, Bijapur, Dhamtari, Kondagaon, Narayanpur, Rajnandgaon, Sukma, Uttar Bastar Kanker
Karnataka	Bidar, Kalaburagi
Madhya Pradesh	Balaghat, Betul, Chhindwara, Mandla, Seoni
Odisha	Kalahandi, Koraput, Malkangiri, Nabarangapur, Rayagada
Puducherry	Yanam
Telangana	Adilabad, Bhadrachalam, Kothagudem, Jagtial, Jangoan, Jayashankar, Kamareddy, Karimnagar, Khammam, Kumuram Bheem Asifabad, Mahabubabad, Manjeri, Medak, Medchal, Mulugu, Nirmal, Nizamabad, Peddapalli, Rajanna Sircilla, Ranga Reddy, Sangareddy, Siddipet, Vikarabad, Warangal Rural, Warangal Urban

Appendix 2: State-wise List of Districts within the Godavari River Basin Considered for Land Degradation Analysis (2003–05 to 2018–19)

State	Covering Districts
Andhra Pradesh	East Godavari, West Godavari
Chhattisgarh	Balod, Bastar, Bijapur, Dakshin Bastar Dantewada, Dhamtari, Kondagaon, Narayanpur, Rajnandgaon, Sukma, Uttar Bastar Kanker
Karnataka	Bidar, Kalaburagi
Madhya Pradesh	Balaghat, Betul, Chhindwara, Mandla, Seoni
Maharashtra	Ahmadnagar, Akola, Amravati, Aurangabad, Bhandara, Bid, Buldana, Chandrapur, Gadchiroli, Gondiya, Hingoli, Jalgaon, Jalna, Latur, Nagpur, Nanded, Nashik, Osmanabad, Parbhani, Pune, Thane, Wardha, Washim, Yavatmal
Odisha	Kalahandi, Koraput, Malkangiri, Nabarangapur, Rayagada
Puducherry	Yanam
Telangana	Adilabad, Bhadrachalam, Kothagudem, Jagtial, Jangoan, Jayashankar, Kamareddy, Karimnagar, Khammam, Kumuram Bheem Asifabad, Mahabubabad, Manjeri, Medak, Medchal Malkajgiri, Mulugu, Nirmal, Nizamabad, Peddapalli, Rajanna Sircilla, Ranga Reddy, Sangareddy, Siddipet, Vikarabad, Warangal Rural, Warangal Urban

Appendix 2 A: Land Degradation Dynamics in Andhra Pradesh – District Wise

District	Year	Vegetation Degradation (Area in Ha)	Water Erosion (Area in Ha)	Water Logging (Area in Ha)	Settlement (Area in Ha)
East Godavari	2003-05	139	50,967	3,056	2,916
	2011-13	139	52,235	3,056	4,686
	2018-19	139	52,425	3,204	6,607
West Godavari	2003-05	7,080	27	47,373	1,053
	2011-13	7,080	32	47,373	1,160
	2018-19	7,080	32	63,986	2,010

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The Table provides an overview of land degradation categories in selected districts of Andhra Pradesh. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine land degradation categories. for the districts of Andhra Pradesh that fall within the Godavari River Basin, data is available only for a few categories where degradation has occurred. Accordingly, only these categories have been included in the table. The data presented here is for the districts of East Godavari and West Godavari, which are part of the Godavari River Basin in Andhra Pradesh. Although the basin covers a few other districts as well, the analysis is based only on the data available for these two districts from the original source.

Appendix 2 B: Land Degradation Dynamics in Chhattisgarh – District Wise

District	Year	Man Made (Area in Ha)	Vegetation Degradation (Area in Ha)	Water Erosion (Area in Ha)	Settlement (Area in Ha)
Balod	2003-05	506	20,152	1,12,585	NA
	2011-13	506	20,152	1,12,585	NA
	2018-19	915	20,152	1,34,300	410
Bastar	2003-05	396	35,088	39,196	814
	2011-13	396	35,088	39,196	814
	2018-19	552	35,028	40,039	814
Bijapur	2003-05	NA	95,341	3,892	NA
	2011-13	NA	95,334	3,892	NA
	2018-19	NA	95,334	5,879	NA
Dakshin Bastar Dantewada	2003-05	NA	1,694	6,344	NA
	2011-13	NA	1,694	6,344	NA
	2018-19	NA	1,694	6,344	NA
Dhamtari	2003-05	NA	41,026	30,045	9.26
	2011-13	NA	41,026	31,249	926
	2018-19	NA	55,662	31,249	926
Kondagaon	2003-05	NA	15,439	9,674	926
	2011-13	NA	14,235	9,674	262
	2018-19	NA	14,235	9,674	262
Narayanpur	2003-05	NA	26,919	16,277	NA
	2011-13	NA	32,012	22,857	NA
	2018-19	NA	32,013	22,856	NA
Rajnandgaon	2003-05	NA	59,219	1,346	1,191
	2011-13	NA	57,545	1,346	1,931
	2018-19	4.25	57,796	20,766	1,931
Sukma	2003-05	NA	2,32,362	1,318	NA
	2011-13	NA	2,32,362	1,318	NA
	2018-19	NA	2,28,345	1,481	NA
Uttar Bastar Kanker	2003-05	NA	38,946	1,12,585	NA
	2011-13	NA	38,220	1,12,585	NA
	2018-19	NA	38,220	1,34,300	NA

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The Table provides an overview of land degradation categories in selected districts of Chhattisgarh. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine land degradation

categories. for the districts of Chhattisgarh that fall within the Godavari River Basin, data is available only for a few categories where degradation has occurred. Accordingly, only these categories have been included in the table. NA indicates data not available for the particular degradation category.

Appendix 2 C: Land Degradation Dynamics in Karnataka – District Wise

District	Year	Mass Movement (Area in Ha)	Vegetation Degradation (Area in Ha)	Water Erosion (Area in Ha)	Settlement (Area in Ha)
Bidar	2003-05	NA	7,485	3,41,869	NA
	2011-13	NA	7,515	3,41,609	NA
	2018-19	NA	7,515	3,42,797	735
Kalaburagi	2003-05	10,376	21,210	2,70,991	4,966
	2011-13	10,673	21,766	2,70,107	5,227
	2018-19	11,268	21,766	2,69,543	6,067

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The Table provides an overview of land degradation categories in selected districts of Karnataka. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine land degradation categories. for the districts of Karnataka that fall within the Godavari River Basin, data is available only for a few categories where degradation has occurred. Accordingly, only these categories have been included in the table. NA indicates data not available for the particular degradation category.

Appendix 2 D: Land Degradation Dynamics in Madhya Pradesh – District Wise

District	Year	Man Made (Area in Ha)	Vegetation Degradation (Area in Ha)	Water Erosion (Area in Ha)	Settlement (Area in Ha)
Balaghat	2003-05	483	15,969	1,05,335	514
	2011-13	831	16,304	1,05,814	592
	2018-19	1,292	16,304	1,05,814	592
Betul	2003-05	964	57,780	3,477	1,390
	2011-13	935	58,798	3,477	1,318
	2018-19	935	58,816	3,626	1,318
Chhindwara	2003-05	327	59,381	15	1,507
	2011-13	613	56,179	12	1,849
	2018-19	613	56,250	12	1,849
Mandla	2003-05	NA	543	20,899	NA
	2011-13	NA	543	20,899	NA
	2018-19	NA	543	20,899	702
Seoni	2003-05	NA	18,040	46,426	683
	2011-13	NA	16,716	46,226	805
	2018-19	NA	16,716	46,426	805

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The Table provides an overview of land degradation categories in selected districts of Madhya Pradesh. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine land degradation categories. for the districts of Madhya Pradesh that fall within the Godavari River Basin, data is available only for a few categories where degradation has occurred. Accordingly, only these categories have been included in the table. NA indicates data not available for the particular degradation category.

Appendix 2 E: Land Degradation Dynamics in Maharashtra – District Wise

District	Year	Man Made (Area in Ha)	Vegetation Degradation (Area in Ha)	Water Erosion (Area in Ha)	Salinity / Alkalinity (Area in Ha)	Barren (Area in Ha)	Rocky (Area in Ha)	Settlement (Area in Ha)
Ahmadnagar	2003-05	NA	2,41,880	4,75,416	2,451	31,731	62,651	5,736
	2011-13	NA	2,41,880	5,15,472	2,451	31,731	62,651	5,736
	2018-19	NA	2,41,880	5,15,472	2,451	31,731	62,651	5,736
Akola	2003-05	NA	47,125	1,36,357	NA	3,144	NA	4,927
	2011-13	NA	46,488	1,29,830	NA	3,144	NA	5,565
	2018-19	NA	50,075	1,29,450	NA	3,144	NA	5,977
Amravati	2003-05	NA	1,23,984	2,20,200	NA	4,096	NA	9,397
	2011-13	NA	1,22,019	2,20,200	NA	4,096	NA	10,098
	2018-19	629	2,07,532	2,28,702	NA	4,096	NA	10,098
Aurangabad	2003-05	NA	1,50,614	2,38,210	NA	16,978	987	6,888
	2011-13	NA	1,49,621	3,19,242	NA	15,829	987	10,489
	2018-19	NA	1,48,149	3,17,920	NA	15,829	987	14,372
Bhandara	2003-05	NA	5,897	85,333	NA	NA	NA	919
	2011-13	NA	5,897	85,333	NA	NA	NA	919
	2018-19	283	6,391	85,803	NA	NA	NA	2,172
Bid	2003-05	NA	1,30,597	3,21,060	NA	17,025	552	2,734
	2011-13	NA	1,30,597	3,47,797	NA	17,025	552	2,734
	2018-19	654	1,30,697	3,47,198	NA	17,025	552	2,734
Buldana	2003-05	NA	1,11,696	2,99,769	NA	11,763	NA	3,855
	2011-13	NA	1,11,696	3,36,664	NA	11,763	NA	3,855
	2018-19	537	1,28,286	3,38,704	NA	11,275	NA	5,896
Chandrapur	2003-05	10,311	93,111	1,71,358	NA	2,201	NA	4,839
	2011-13	10,311	93,111	1,70,695	NA	2,201	NA	5,501
	2018-19	23,608	1,06,072	2,12,373	NA	2,201	NA	5,501
Gadchiroli	2003-05	NA	2,12,494	1,38,822	NA	578	NA	395
	2011-13	NA	2,12,412	1,27,574	NA	578	NA	395
	2018-19	NA	2,12,412	1,27,574	NA	578	NA	395
Gondiya	2003-05	556	7,209	2,20,326	NA	377	NA	1,259
	2011-13	556	7,209	2,22,648	NA	377	NA	1,259
	2018-19	556	7,209	2,22,648	NA	377	NA	1,259
Hingoli	2003-05	NA	82,008	1,10,001	NA	12,671	NA	1,388
	2011-13	NA	82,008	1,10,001	NA	12,671	NA	1,383
	2018-19	NA	82,008	1,10,001	NA	12,671	NA	1,383
Jalgaon	2003-05	NA	2,09,469	2,82,320	NA	13,951	576	9,105
	2011-13	NA	2,09,469	4,12,469	NA	13,630	576	10,265
	2018-19	NA	2,10,012	4,12,794	NA	13,630	576	10,265
Jalna	2003-05	NA	13,682	2,98,126	NA	15,849	NA	2,095
	2011-13	NA	13,682	3,49,746	NA	15,849	NA	2,095
	2018-19	NA	13,682	3,49,016	NA	14,825	NA	3,951
Latur	2003-05	NA	7,755	3,11,846	NA	NA	NA	4,307
	2011-13	NA	7,755	3,12,969	NA	NA	NA	4,307
	2018-19	248	7,755	3,12,721	NA	NA	NA	4,307

Nagpur	2003-05	4,911	1,14,825	1,42,828	NA	11,016	2,087	18,975
	2011-13	4,911	1,11,718	1,40,981	NA	11,016	2,087	23,195
	2018-19	8,967	1,34,145	2,13,186	NA	6,509	NA	46,228
Nanded	2003-05	NA	1,26,276	2,77,133	NA	4,746	NA	4,797
	2011-13	NA	1,26,276	2,77,133	NA	4,746	NA	7,594
	2018-19	NA	1,26,276	2,77,133	NA	4,746	NA	7,594
Nashik	2003-05	NA	4,81,054	3,96,913	NA	28,279	2,317	12,670
	2011-13	NA	4,80,836	5,02,434	NA	28,279	2,317	14,358
	2018-19	NA	5,38,200	4,99,843	NA	28,279	2,317	15,483
Osmanabad	2003-05	NA	37,983	3,06,202	NA	9,401	NA	1,363
	2011-13	NA	37,983	3,13,689	NA	9,401	NA	1,363
	2018-19	NA	37,983	3,13,689	NA	9,401	NA	1,907
Parbhani	2003-05	NA	17,439	1,16,976	NA	9,763	NA	3,543
	2011-13	NA	17,439	1,18,357	NA	9,763	NA	3,543
	2018-19	NA	17,439	1,18,357	NA	9,763	NA	3,543
Pune	2003-05	NA	4,10,219	2,60,358	NA	53,347	13,246	51,193
	2011-13	NA	4,09,669	2,53,669	NA	51,193	13,246	61,364
	2018-19	1,492	4,08,928	2,51,112	NA	49,489	13,246	64,873
Thane	2003-05	NA	1,46,341	1,07,439	583	8,346	NA	30,893
	2011-13	NA	1,46,341	1,04,179	583	8,346	NA	35,309
	2018-19	825	1,71,427	1,03,098	583	8,346	NA	35,565
Wardha	2003-05	NA	1,29,374	93,267	NA	2,152	NA	5,863
	2011-13	NA	1,29,374	93,267	NA	2,152	NA	5,863
	2018-19	251	1,33,458	1,02,204	NA	2,154	NA	7,640
Washim	2003-05	NA	78,650	2,08,189	NA	1,616	NA	1,333
	2011-13	NA	78,650	2,06,217	NA	1,616	NA	1,333
	2018-19	NA	78,417	2,01,973	NA	1,297	NA	2,297
Yavatmal	2003-05	3,784	3,75,487	2,49,103	NA	12,842	NA	7,081
	2011-13	3,784	3,75,487	2,49,103	NA	12,842	NA	7,081
	2018-19	5,854	3,88,802	2,54,269	NA	12,842	NA	8,912

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The Table provides an overview of land degradation categories in selected districts of Maharashtra. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine land degradation categories. for the districts of Maharashtra that fall within the Godavari River Basin, data is available only for a few categories where degradation has occurred. Accordingly, only these categories have been included in the table. NA indicates data not available for the particular degradation category

Appendix 2 F: Land Degradation Dynamics in Odisha – District Wise

District	Year	Man Made (Area in Ha)	Vegetation Degradation (Area in Ha)	Water Erosion (Area in Ha)	Barren (Area in Ha)
Kalahandi	2003-05	346	32,812	3,60,466	1,150
	2011-13	346	28,205	3,60,535	1,150
	2018-19	346	28,205	3,87,447	1,150
Koraput	2003-05	507	61,405	2,62,574	791
	2011-13	507	61,593	2,62,574	791
	2018-19	507	61,593	2,62,538	791
Malkangiri	2003-05	NA	8,802	1,90,994	NA

	2011-13	NA	8,510	1,90,996	NA
	2018-19	NA	8,502	1,90,993	NA
Nabarangapur	2003-05	NA	20,231	3,78,078	NA
	2011-13	NA	20,230	3,80,018	NA
	2018-19	NA	20,230	3,82,711	NA
Rayagada	2003-05	NA	40,650	1,14,829	1,858
	2011-13	NA	40,150	1,14,827	1,933
	2018-19	NA	40,150	1,14,827	1,933

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The Table provides an overview of land degradation categories in selected districts of Odisha. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine land degradation categories. for the districts of Odisha that fall within the Godavari River Basin, data is available only for a few categories where degradation has occurred. Accordingly, only these categories have been included in the table. NA indicates data not available for the particular degradation category.

Appendix 2 G: Land Degradation Dynamics in Telangana – District Wise

District	Year	Man Made (Area in Ha)	Vegetation Degradati on (Area in Ha)	Water Erosion (Area in Ha)	Salinity / Alkalinity (Area in Ha)	Rocky (Area in Ha)	Settlement (Area in Ha)
Adilabad	2003-05	2,285	51,477	65,921	286	1,401	2,285
	2011-13	2,285	50,745	65,921	286	1,401	2,285
	2018-19	2,285	50,745	65,921	286	1,401	2,285
Bhadradri Kothagudem	2003-05	2,473	NA	22,671	NA	NA	2,473
	2011-13	2,473	NA	28,219	NA	NA	2,473
	2018-19	5,628	NA	28,219	NA	NA	5,628
Jagitial	2003-05	NA	7,324	NA	NA	NA	NA
	2011-13	NA	7,324	NA	NA	NA	NA
	2018-19	NA	8,497	NA	NA	1,735	NA
Jangoan	2003-05	NA	2,089	74,615	NA	NA	NA
	2011-13	NA	2,089	1,07,268	NA	NA	NA
	2018-19	NA	2,089	1,07,268	NA	NA	NA
Jayashankar	2003-05	NA	4,591	NA	743	NA	NA
	2011-13	NA	4,672	NA	743	NA	NA
	2018-19	2,290	5,190	NA	743	NA	2,290
Kamareddy	2003-05	NA	17,370	80,158	NA	NA	NA
	2011-13	NA	17,147	55,698	NA	NA	NA
	2018-19	NA	17,147	55,698	NA	NA	NA
Karimnagar	2003-05	NA	792	NA	NA	3,102	NA
	2011-13	NA	792	NA	NA	3,102	NA
	2018-19	NA	792	NA	NA	3,102	NA
Khammam	2003-05	NA	NA	31	NA	3,064	NA
	2011-13	NA	NA	31	NA	5,713	NA
	2018-19	865	NA	990	NA	6,658	865
Kumuram Bheem Asifabad	2003-05	673	20,067	42,538	NA	NA	673
	2011-13	2,418	22,796	35,860	NA	NA	2,418
	2018-19	2,824	24,460	35,860	NA	NA	2,824
Mahabubabad	2003-05	NA	3,271	7,312	NA	NA	NA
	2011-13	NA	3,271	7,312	NA	NA	NA

	2018-19	NA	3,271	7,312	NA	NA	NA
Mancherial	2003-05	1,435	15,711	56,403	NA	NA	1,435
	2011-13	1,435	15,711	54,487	NA	NA	1,435
	2018-19	1,435	12,973	53,954	NA	NA	1,435
Medak	2003-05	NA	30,693	33,722	NA	NA	NA
	2011-13	NA	30,693	97,210	NA	NA	NA
	2018-19	NA	31,201	97,210	NA	NA	NA
Medchal Malkajgiri	2003-05	14,374	NA	65	NA	20,634	14,374
	2011-13	14,439	NA	20,621	NA	25,022	14,439
	2018-19	875	13,014	15,290	NA	31,789	875
Mulugu	2003-05	NA	2,654	2	NA	NA	NA
	2011-13	NA	2,706	2	NA	NA	NA
	2018-19	NA	4,938	2	NA	NA	NA
Nirmal	2003-05	1,221	22,772	18,621	NA	1,154	1,221
	2011-13	1,221	22,772	17,993	NA	1,154	1,221
	2018-19	1,221	22,772	17,993	NA	1,260	1,221
Nizamabad	2003-05	NA	17,921	75	NA	1,591	NA
	2011-13	NA	17,921	75	NA	1,591	NA
	2018-19	NA	17,921	75	NA	2,531	NA
Peddapalli	2003-05	4,031	18,192	NA	956	NA	4,031
	2011-13	4,687	19,371	NA	956	NA	4,687
	2018-19	6,355	19,371	NA	956	NA	6,355
Rajanna Sircilla	2003-05	NA	5,884	32,593	NA	NA	NA
	2011-13	NA	5,884	1,255	NA	NA	NA
	2018-19	515	5,884	1,255	NA	NA	515
Ranga Reddy	2003-05	859	32,370	3,57,351	NA	9,908	859
	2011-13	859	32,370	3,52,304	NA	25,224	859
	2018-19	1,378	32,370	3,49,056	NA	28,540	1,378
Sangareddy	2003-05	NA	10,695	1,66,092	NA	2,084	NA
	2011-13	NA	10,694	2,12,500	NA	5,288	NA
	2018-19	927	10,702	2,11,416	NA	7,458	927
Siddipet	2003-05	NA	20,384	51,773	NA	NA	NA
	2011-13	NA	20,384	95,736	NA	NA	NA
	2018-19	3,620	20,384	93,257	NA	1,514	3,620
Vikarabad	2003-05	1,652	31,648	1,71,165	NA	266	1,652
	2011-13	1,652	31,252	1,72,135	NA	266	1,652
	2018-19	1,652	31,252	1,73,155	NA	266	1,652
Warangal Rural	2003-05	NA	142	6,601	NA	301	NA
	2011-13	NA	142	6,601	NA	301	NA
	2018-19	NA	142	6,601	NA	301	NA
Warangal Urban	2003-05	NA	1,084	1,754	NA	5,713	NA
	2011-13	NA	NA	1,084	NA	5,713	NA
	2018-19	NA	NA	1,084	NA	5,713	NA

Source: Data derived from SAC-ISRO's Desertification and Land Degradation Dashboard.

Note: The Table provides an overview of land degradation categories in selected districts of Telangana. The SAC-ISRO Desertification and Land Degradation Dashboard provides data on nine land degradation categories. for the districts of Telangana that fall within the Godavari River Basin, data is available only for a few categories where degradation has occurred. Accordingly, only these categories have been included in the table. NA indicates data not available for the particular degradation category.

Appendix 3: State-wise List of Districts within the Godavari River Basin Considered for NDVI Analysis (2001 to 2023)

State	Covering Districts
Andhra Pradesh	East Godavari, West Godavari
Chhattisgarh	Balod, Bastar, Bijapur, Dakshin Bastar Dantewada, Dhamtari, Kondagaon, Narayanpur, Rajnandgaon, Sukma, Uttar Bastar Kanker
Karnataka	Bidar, Kalaburagi
Madhya Pradesh	Balaghat, Betul, Chhindwara, Mandla, Seoni
Maharashtra	Ahmadnagar, Akola, Amravati, Aurangabad, Bhandara, Bid, Buldana, Chandrapur, Gadchiroli, Gondiya, Hingoli, Jalgaon, Jalna, Latur, Nagpur, Nanded, Nashik, Osmanabad, Parbhani, Pune, Thane, Wardha, Washim, Yavatmal
Odisha	Kalahandi, Koraput, Malkangiri, Nabarangapur, Rayagada
Puducherry	Yanam
Telangana	Adilabad, Karimnagar, Khammam, Mahabubabad, Medak, Nizamabad, Ranga Reddy, Warangal Rural, Warangal Urban

Appendix 4: Government Programs Influencing Land Use in the Godavari River Basin

State	Program	Focus Area	Relevance to Land Use	Source
Andhra Pradesh	Andhra Pradesh Community Managed Natural Farming (APCNF)	Promotes chemical-free cultivation, soil regeneration, and water-efficient farming practices.	May reduce fallow lands, improve soil quality, and enhance sustainable crop production.	Socio – Economic Survey, 2024-25, Accessed at http://www.apsdps.ap.gov.in/assets/publications/Socio-Economic-Survey-2024-25.pdf
	Rainfed Area Development (RAD) – National Mission for Sustainable Agriculture	Supports integrated farming systems in rain-dependent areas; includes soil and water conservation.	Can bring culturable wastelands and degraded lands under productive use.	
Chhattisgarh	Rajiv Gandhi Kisan Nyay Yojana (RGKNY)	Encourage crop diversification, enhance crop cover, and improve overall production and productivity. Increase farmers' net income by reimbursing the cost of cultivation and promoting greater investment in agriculture.	Strengthens farm incomes, encouraging return of current fallows to cultivation and reducing long-term idling (fallows other than current). Boosts net area sown.	Accessed at https://kanker.gov.in/en/scheme/rajiv-gandhi-kisan-nyay-yojana/
	Tribal Livelihood Business Incubation Center	Capacity building and skill development for untrained farmers in agriculture and non-agriculture sectors through structured training	Improves work efficiency and productivity, enabling better utilization of existing land and resources, thus potentially reducing underutilized and fallow lands.	Accessed at https://bastar.gov.in/en/departments/agriculture/
	Performance of Advanced Agricultural Techniques in Clusters (District Mineral Trusts Institute, 2015)	Expansion of irrigation facilities and provision of advanced agricultural machinery in non-irrigated areas (e.g., 10-hectare clusters in Turgangur – Block Bastanar and Maamadpal – Block Darbha).	Converts non-irrigated or low-productivity lands into cultivable areas, improving net area sown and reducing current/fallow land.	
	Harihar Bastar Market	Formation of Farmer Producer Organisations (FPOs) for organic farming groups; establishment of a	Encourages sustainable, organic cultivation, strengthens market linkages, and incentivizes continuous	

		market via self-help groups for direct marketing	cultivation, reducing fallow lands and promoting crop diversification.	
Karnataka	RashtriyaKrishiVikasYojana (RKVY)	Original Green Revolution in few states to divert the area of paddy crop to alternate crops and in tobacco growing states to encourage tobacco farmers to shift to alternate crops/cropping system.	Supports reduction of fallow lands, fosters more resilient cropping patterns—relevant to the fallow land trends	Accessed at https://www.pib.gov.in/PressReleaseIframePage.aspx? PRID=1605057&Utm.
	Micro Irrigation Subsidies	Subsidies (up to 90%) for drip/micro irrigation on horticultural farms	Promotes efficient water use, expansion of horticulture—aligns with improved cultivation intensity and use of previously idle land	Accessed at https://ramanagara.nic.in/en/horticulture-department/
	Pradhan Mantri Fasal Bima Yojana (PMFBY)	Crop insurance coverage for notified crops against adverse climatic conditions;	Stabilizes farm income during disaster years, reduces risk aversion, and encourages sustained cultivation, impacting current fallow and net sown area positively.	Accessed at https://des.karnataka.gov.in/storage/pdf-files/Economic%20Survey%202022-23%20English.pdf .
	Organic Farming Adoption & Certification / Raitha Siri / Savayava Siri	Organic certification of lands, subsidies for millet processing, value addition, packing, and branding	Promotes sustainable land use, encourages crop diversification, reduces chemical input dependency, and can rehabilitate degraded lands.	
Madhya Pradesh	Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)	Direct income support of to all eligible farmers to purchase inputs before sowing.	Improves liquidity for timely sowing, reducing seasonal idling and supporting increased net area sown.	Accessed at https://www.slbcmadhyapradesh.in/docs/Agriculture.pdf .
	National Mission on Agricultural Extension (ATMA)	Farmer-driven agricultural extension reforms; district-level committees for outreach.	Enhances adoption of modern practices, mechanization, and diversification, improving cultivation intensity.	

	Pradhan Mantri Krishi Sinchai Yojana (Micro Irrigation)	Expands irrigation coverage and efficiency	Improves water availability, enabling cultivation of previously fallow or waste land and sustaining net sown area increases.	
	Soil Health Card Scheme	Provides nutrient status and soil management recommendations	Improves soil fertility management, sustaining productivity and reducing land abandonment.	
Maharashtra	Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan (PM-KUSUM)	Installation of 3HP–7.5HP off-grid solar agricultural pumps	Provides assured irrigation in non-grid areas, enabling cultivation of previously fallow or barren land, reducing dependence on rain-fed agriculture.	Accessed at https://cdnbbsr.s3waas.gov.in/s349d4b2faeb4b7b9e745775793141e2b2/uploads/2025/01/2025030788773769.pdf .
	MahaAGRITECH Project	Satellite & drone-based crop monitoring, yield estimation, integrated agri-advisory portal.	Improves farm decision-making and climate resilience, helping optimize land use and reduce degradation.	
	Rainfed Area Development Programme (RAD)	Risk minimization and sustainable farming in rainfed areas; promotes income diversification.	Supports cultivation in semi-arid districts, helping reduce seasonal fallows and prevent land degradation.	
	MahaDBT Farmer Portal	Unified platform for over 25 schemes;	Streamlines subsidy delivery for irrigation, mechanization, and soil health—encouraging productive land use.	
	Electronic National Agricultural Market (e-NAM)	133 APMCs connected; ₹18,073 crore worth of produce e-auctioned by Oct 2024; quality labs in 118 APMCs.	Improves market access, incentivizes sustained cultivation, and reduces crop losses—supporting net sown area stability.	
Odisha	SAMRUDHI: Agriculture Policy 2020	Revised and market-oriented state agriculture policy (earlier policies in 1996, 2008, 2013). Focus on market linkage, better price	Promotes crop diversification, agribusiness, and efficient land use; can encourage bringing fallow and degraded lands under cultivation.	Accessed at https://krushi-odisha.in/Agriculture-Farmers.pdf .

		realization, and higher farmer incomes.		
	Mukhyamantri Krushi Udyog Yojana (MKUY)	Single-window online system for establishment of Agri-enterprises	Encourages investment in Agri-infrastructure (processing, storage, irrigation), improving land productivity and preventing land abandonment.	
	Paramparagat Krishi Vikas Yojana (PKVY)	Organic farming clusters with end-to-end support; national scheme implemented in Odisha.	Improves soil fertility, reduces chemical load, supports reclamation of degraded land, and enhances tree crop systems.	Accessed at https://agri.odisha.gov.in/node/193837 .
	Forest Restoration Campaign – One Tree One Name	Plantation drive targeting 7.5 crore saplings in a year; 560 sq. km forest cover increase.	Helps in severe forest loss, aids biodiversity and soil conservation.	Accessed at https://csr.odisha.gov.in/ViewProjectDetails.aspx?enc=7muLnxqgABq2jdpP7cjiQmtKc1btcs0UGcgjlli+AQ=
Telangana	Pradhan Mantri Krishi Sinchai Yojana (PMKSY)	Watershed management, minor & micro-irrigation, rejuvenation of traditional water bodies, “Per Drop More Crop” water efficiency.	Strengthens irrigation infrastructure—directly supports the large net area sown increase and reduction in current fallow and long-term fallow.	Accessed at https://nirdpr.org.in/nird_docs/sagy/Telangana.pdf .
	Multi-Sectoral Development Programme (MSDP)	Supports watershed management, micro-irrigation, and rejuvenation of traditional water bodies in minority-concentrated areas.	Improves water access in targeted regions, enabling year-round cropping and reclaiming culturable waste land.	
	MGNREGA – Water & Land Development Works	Creation/renovation of water bodies, land development, drainage improvements, flood protection.	Enhances rural infrastructure for irrigation and land productivity; reduces seasonal idling and improves resilience in rain-fed districts.	

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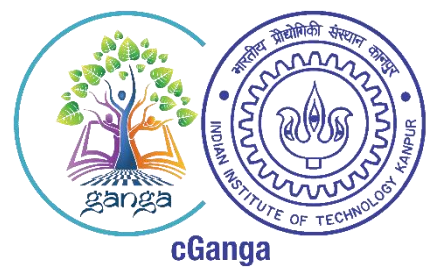
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