

# BUILDING RESILIENT CITIES

Through Urban – Rural partnership



Applying Regional Circular & Ecological Sphere (R-CES) perspectives in Nagpur





# Building Resilient Cities through Urban-Rural Partnership

**Applying Regional–Circular & Ecological Sphere  
(R–CES) perspectives in Nagpur**



**About this Publication:**

This publication is developed as a part of India-Japan Bilateral Research Project funded by Japan Society for the Promotion of Science (JSPS) and Indian Council of Social Science Research (ICSSR). This research was also supported by the Institute of Global Environmental Strategies (IGES) funded Regional Circular & Ecological Sphere (Regional CES) SRF Project. The document provides a brief overview of Nagpur region and explains the ongoing water conflicts from a wider perspective of urban-rural linkage. It presents key findings of the Project work and suggests feasible directions for addressing the identified water-related concerns in Nagpur.

**Team Members:**

Kamakshi Thapa, VNIT, India  
Vibhas Sukhwani, Keio University, Japan  
Harshitha N., VNIT, India  
Sameer Deshkar, VNIT, India  
Bijon Kumer Mitra, IGES, Japan  
Rajib Shaw, Keio University, Japan  
Wanglin Yan, Keio University, Japan

**How to refer this publication:**

Thapa, K., Sukhwani, V., Harshitha, N., Deshkar, S., Mitra, B.K., Shaw, R. and Yan, W. 2020. Building Resilient Cities through Urban-Rural Partnership, Applying Regional-Circular & Ecological Sphere (R-CES) perspectives in Nagpur, India: VNIT. pp 25.

January 2020



This work is licensed under a Creative Commons Attribution-Non Commercial-Share Alike 4.0 International License.

**Disclaimer:**

This report is developed based on research conducted during the India-Japan Bilateral Project. The referred data sources have been duly acknowledged and the complete list of references is provided at the end of report.





## Foreword

This publication addresses a very important topic of urban and rural linkages. The concept has recently gained significant prominence in the wake of growing population, rapid urbanization and changing climatic conditions. Global policy frameworks like Sustainable Development Goals and The New Urban Agenda have also emphasized that strengthening the urban-rural linkages holds the key to achieving sustainable urban development.

While resource demands, like food and water, in Nagpur city are increasing with the proportionate rise in population, it is important to note that these natural resources are limited and are been sourced from distant rural areas. To precisely understand the emerging concerns in the urban-rural interface, this report provides a glimpse into the grass-root level issues in Nagpur.

This report specifically furthers the understanding of water linkages between urban and rural areas in Nagpur Metropolitan Area, that comprises of more than 720 villages. The evidence produced through the Project work is very concrete and has provided new insights onto the urban-rural connections in the region. In addition to the resource flow, this report also showcases the flow analysis of people in urban, rural and forest areas along the Pench corridor. The initiative of stakeholder engagement in water management through decision theatre workshop is first of its kind and holds great potential for bridging the knowledge gaps between decision makers, local communities and other stakeholders

It is particularly interesting to see that the historical timeline of the Pench project has been discussed and specific evidence has been documented to explain the ongoing water conflicts in Nagpur. The report has also discussed the issues of water reallocation and policy issues, while explaining the current shortcomings and the ways to overcome them. The project findings will certainly advance the understanding of these issues at policy and governance levels.

Towards the end, this report summarizes the key findings of the India-Japan Bilateral Project and presents suitable directions for future development of the region. The suggested measures have brought into focus the new areas of interventions and have provided new avenues for collaboration between various stakeholders in India and Japan. The report concludes with specific entry points to address the issue of water conflicts in Nagpur region from urban-rural perspective. In view of the growing importance of linking urban and rural areas, this document shall potentially serve as an important basis for coordinated urban-rural development in Nagpur region.

A handwritten signature in blue ink, which appears to read 'Sandip Joshi'.

**Shri Sandip Joshi**  
Mayor, Nagpur Municipal Corporation, Nagpur

# Contents

1

## **Introduction and Scope of the document**

Need for Urban-Rural Partnership and R-CES

3

## **Nagpur- The geographical center of India**

Key Characteristics and Evolution of Nagpur Metropolitan Area

5

## **Pench Corridor**

Visualizing the water source environment of Nagpur

7

## **Physical Characteristics & Changing Climate**

Geo-climatic features of Nagpur

9

## **Decoding the Demographic Transitions**

Decadal Population change in tehsils of Nagpur Metropolitan Area

11

## **Land Utilization / Land cover change**

Land cover change in Nagpur Metropolitan Area from 2006 to 2018



# C o n t e n t s

## **Water Source Areas of Nagpur**

Water resources of Nagpur and usage pattern

**13**

## **Urban-Rural Water Conflict in Nagpur**

Historical timeline of Pench Project and water utilization

**15**

## **Water-Related Concerns**

Impacts on upstream and downstream rural areas

**17**

## **Water Policy and Governance aspects**

Governance structure at various levels and Water Policy

**19**

## **Finding Avenues for Urban-Rural Partnership**

Project activities, fieldwork and survey analysis

**21**

## **Nagpur City takes a lead in achieving R-CES**

Key initiatives of the Project and entry points for future work

**23**



# Introduction

Nagpur Metropolitan Area (NMA) is one of the fastest growing urban agglomerations of central India. The booming population growth, rapid urbanization and industrialization trends in NMA are paralleled by increased demand of natural resources like food and water, that are mainly sourced from rural areas. With changing climate and declining availability of water resources, situations of water stress in summer and flooding in rainy season have today become the new normal. Since urban and rural areas in NMA are both dependent on shared water resources, enhancing water security in the region requires a collective approach with engagement from all sectors. Accordingly, the need for enhancing and better managing the urban-rural relationships through increased partnerships has gained significance in context of Nagpur.

## Scope of the document

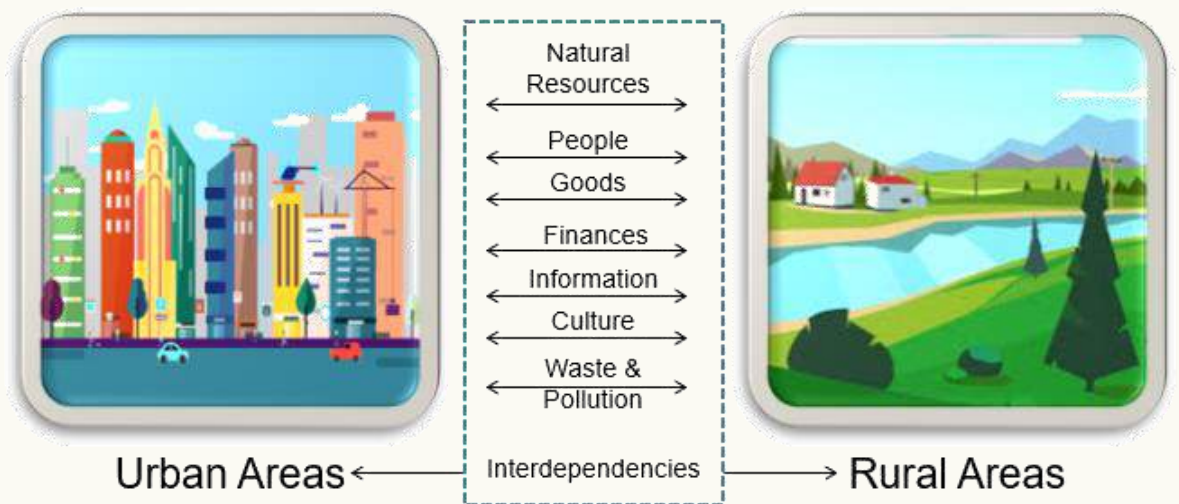
Based on primary research and secondary data, this document presents key findings of the India-Japan Bilateral Project. It presents concrete evidence to explain the reasons behind ongoing water conflicts in Nagpur. While climate change is one significant factor for the present situation of water stress in Nagpur, transboundary urban-rural water conflicts have been identified as the major concern. With declining water availability and the growing demands of water in Nagpur city, a genuine need for effective utilization of available water resources has been realized. The project activities and initiatives taken to mainstream the urban-rural concerns at policy and governance levels have also been discussed. Towards the end, the report highlights key entry points to further the idea of urban-rural partnerships and Regional-Circular and Ecological Sphere in Nagpur region.





# Need for Urban-Rural Partnership

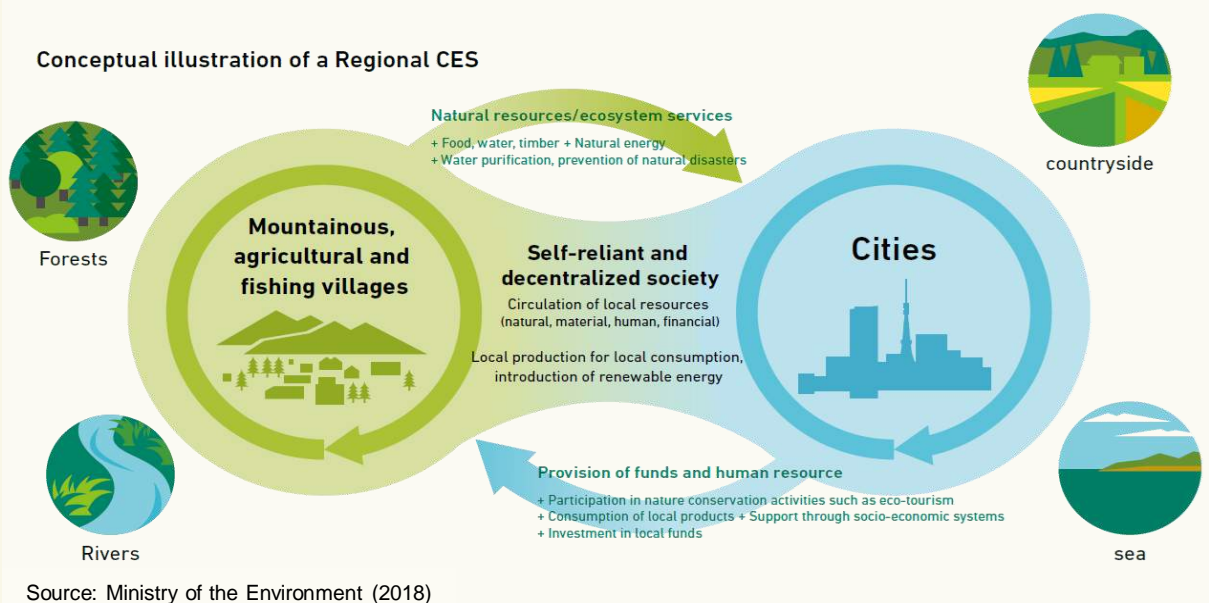
Underlining Urban-Rural linkages



Urban and rural areas have different and often complementary assets which are integrated through a broad set of linkages. A basic definition of rural-urban linkages is that they consist of flows (of goods, people, information, finance, waste, social relations) across space, linking rural and urban areas. It has emerged as one of the core principles of sustainable development in the global development frameworks like Sustainable Development Goals (SDGs), The New Urban Agenda and Sendai Framework for Disaster Risk Reduction (SFDRR). Urban-Rural partnerships are important to ensure the sustainable utilization of shared environmental resources and realizing coordinated development at regional level.

## Regional-Circular and Ecological Sphere (R-CES)

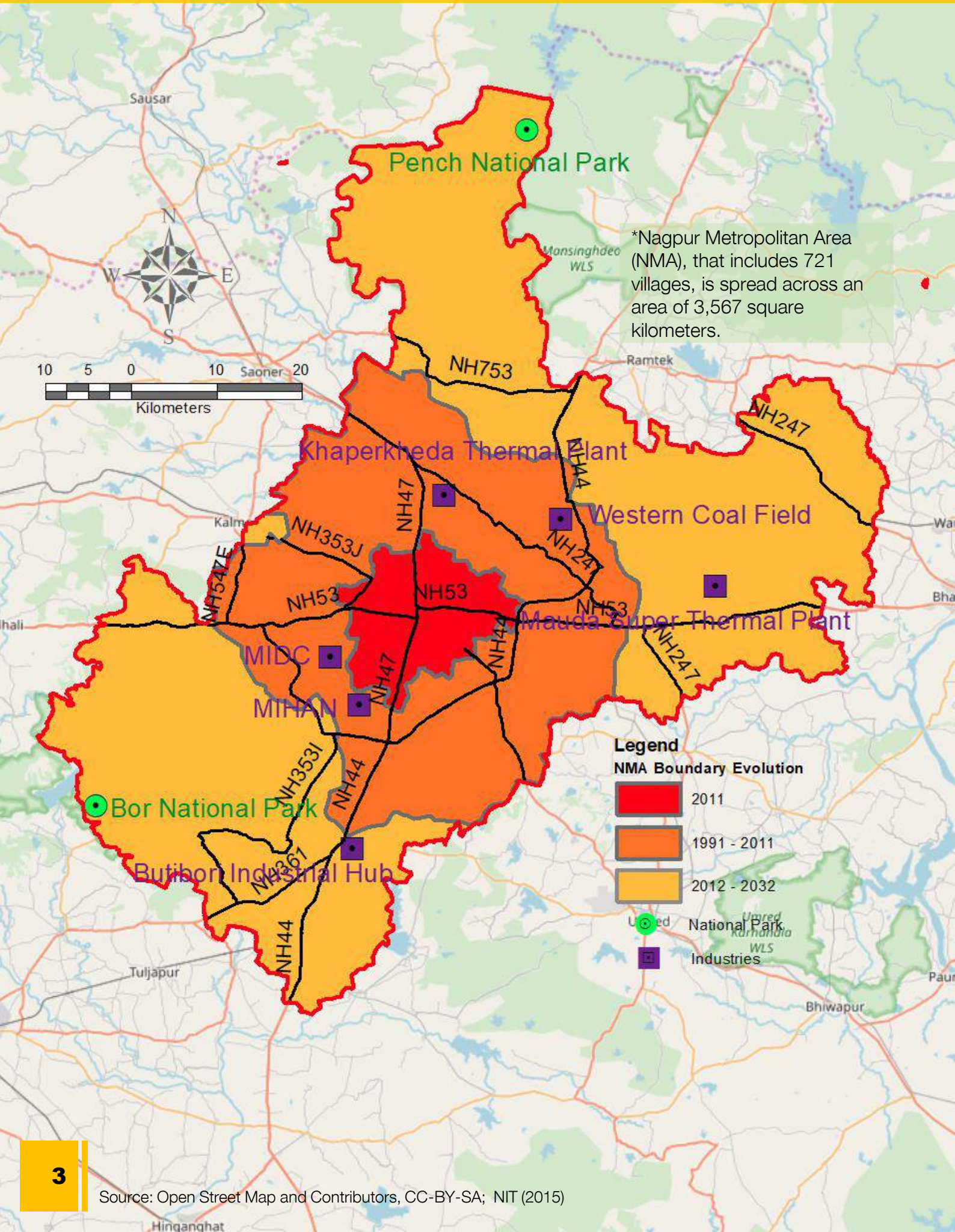
Conceptual illustration of a Regional CES



The concept emerged through deliberations on the 5th Basic Environment Plan of Japan. It was framed based on an integrated policy approach that incorporates the concepts of (a) low-carbon society, (b) resource circulation, and (c) living in harmony with nature. The key to creating R-CES is to re-discover regional resources through a collaborative approach by involving stakeholders, and to make optimum use of resources in a sustainable manner, be it on community level or a larger scale such as a river basin (Takeuchi, 2018). The concept emphasizes on the wise use of locally available natural resources and strengthening urban-rural linkages.



# Nagpur- The geographical center of India



\*Nagpur Metropolitan Area (NMA), that includes 721 villages, is spread across an area of 3,567 square kilometers.

**Legend**

**NMA Boundary Evolution**

- 2011
- 1991 - 2011
- 2012 - 2032

National Park

Industries



A comprehensive long-term plan needs to be developed for Nagpur to balance the supply and demand of water, as it will be one of the key determinants of economic growth.

Nagpur, often called the **heart of India**, is at the geographical center of the country.

Due to its strategic location, it is recognized as a **major commercial and political centre of the Vidarbha region** of Maharashtra.



Nagpur is witnessing an economic boom through the development of the

**'Multi-Modal International Cargo Hub and Airport at Nagpur (MIHAN)'**



The region has a very prominent **power sector** as two major thermal power stations located near Nagpur: **Koradi and Khaparkheda Thermal Power Station**



Nagpur has been selected as one of the 100 smart cities under **The Smart Cities Mission** launched by Government of India in 2015

**Wadoda Cluster from Nagpur district** has been selected as one of the 300 Rurban Clusters under **The National Rurban mission' (NRuM)** launched by Government of India in 2016

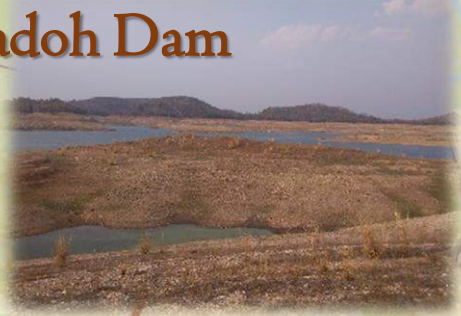
Nagpur is projected to be the fifth fastest growing city in the world from 2019-2035 with an average growth of 8.41% (Oxford Economics, 2018)



# Pench Corridor



Totaladoh Dam



Pench Dam  
(Navegaon Khairy Dam)

Pench Riverbed

Gorewada lake

Nag River

Rehari Barrage



Nagpur city needs to consider the development of alternate water sources such as Rehari barrage on Kanhan river to satisfy the growing water demands, in view of the declining water availability in Totaladoh Dam.

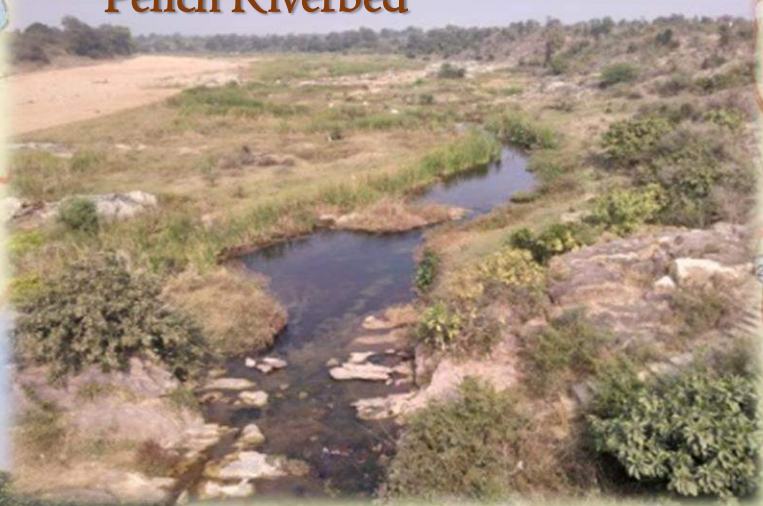
## Pench Dam (Navegaon Khairy Dam)



### Ash ponds



### Pench Riverbed



### Gorewada lake



### Nag River



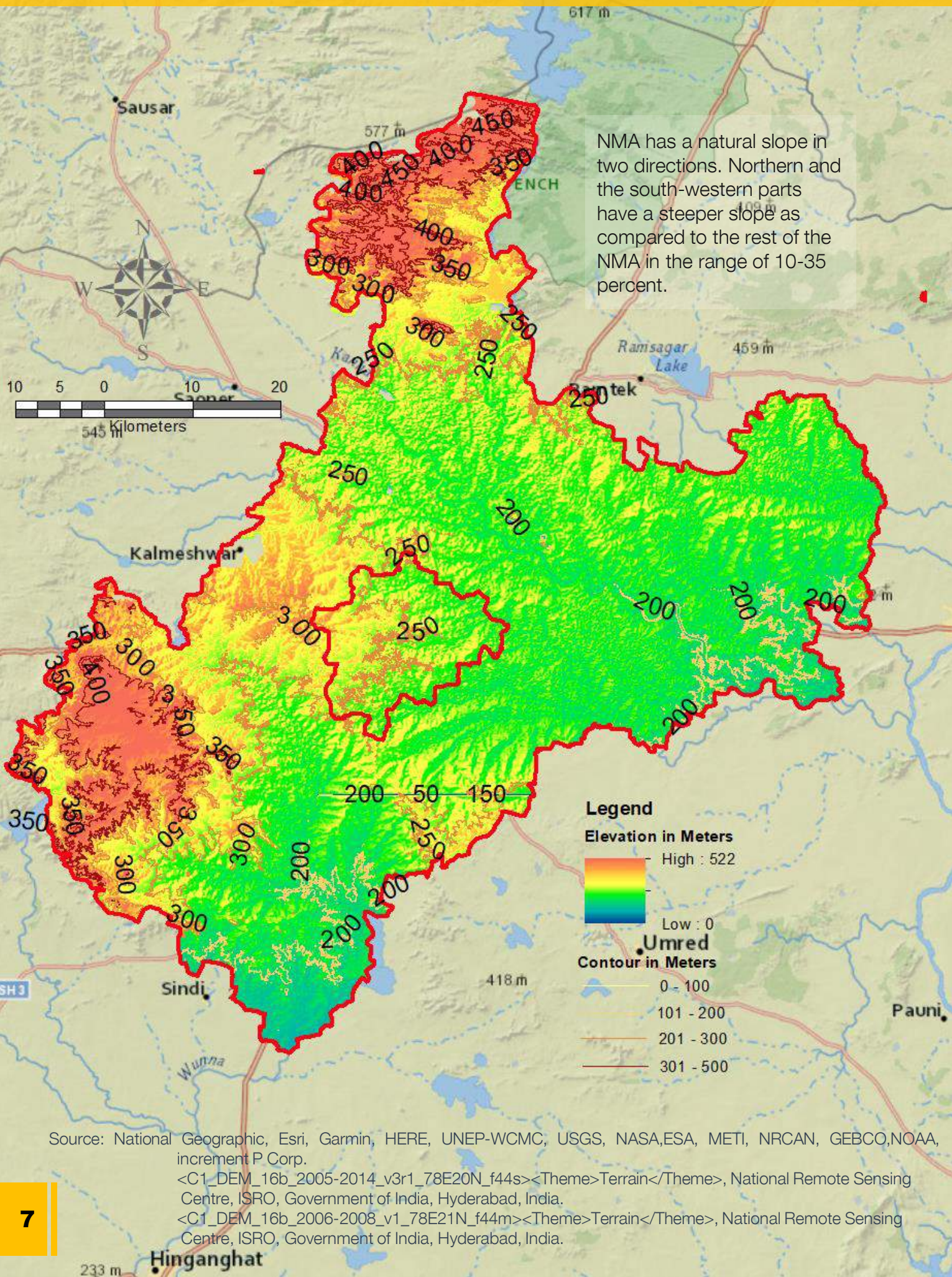
### Kanhan River



More than 70 percent of Nagpur city's water demands are met through Pench dam (NIT, 2015), that receives water from Totladoah dam (a shared reservoir with adjoining state of Madhya Pradesh)



# Physical Characteristics & Changing Climate



Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA,ESA, METI, NRCAN, GEBCO,NOAA, increment P Corp.

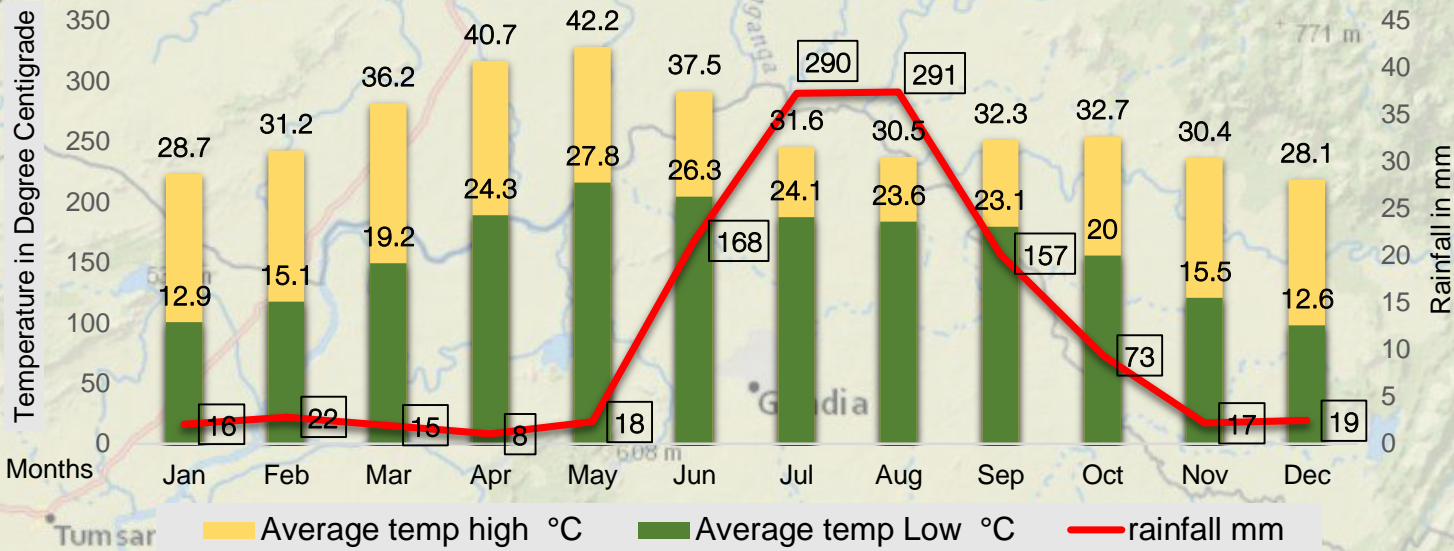
<C1\_DEM\_16b\_2005-2014\_v3r1\_78E20N\_f44s><Theme>Terrain</Theme>, National Remote Sensing Centre, ISRO, Government of India, Hyderabad, India.

<C1\_DEM\_16b\_2006-2008\_v1\_78E21N\_f44m><Theme>Terrain</Theme>, National Remote Sensing Centre, ISRO, Government of India, Hyderabad, India.

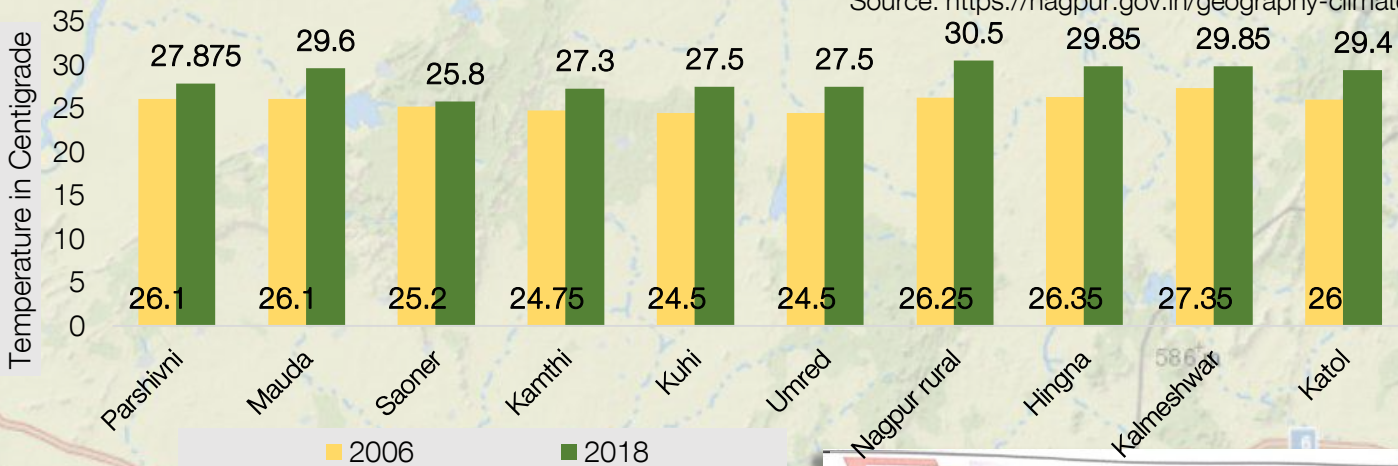


Climate action planning needs to be mainstreamed in various developmental initiatives in Nagpur to enhance the city resilience against the emerging trend of climatic variations.

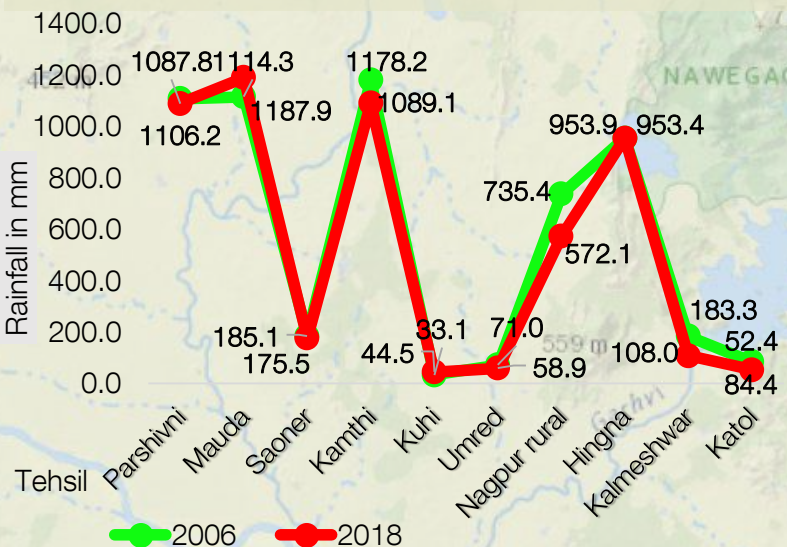
### Maximum-Minimum Temperature & Rainfall in Nagpur Metropolitan Area



Source: <https://nagpur.gov.in/geography-climate/>



### Change in Annual Rainfall & Temperature in NMA from 2006-2018



Source: Rainfall and Temperature Data 2006 - 2018, Maharashtra Remote Sensing Application Centre

**TheHitavada Flashback 2019**

**NMC swings between extreme water cuts and floods**

**Brrr... It's 5.1° Celsius**

City recorded 2nd lowest minimum temperature in last 100 years

Lowest 3.4° C was recorded on December 29, 2018

Staff Reporter

With the minimum temperature dropping to a chilling 1 degree Celsius on Saturday, Nagpur became the coldest place in Vidarbha.

The city turned to a hill station as minimum temperature dipped to the second lowest recorded in last 100 years. The city recorded 3.4 degree Celsius on December 29, 2018, which was the lowest in the last 100 years.

The city was enveloped in haze throughout the day with minimum and maximum temperatures hovering around 5 degrees and 25 degrees Celsius respectively.

On Friday, minimum temperature in Nagpur was 12.6 degree Celsius and sudden drop in temperature in 24 hours by 7.4 degrees forced citizens to don woollens even while under the Sun. A number of people preferred to remain in the cosy comfort indoors.

In the next couple of days, the sky will generally be cloudy and weather will remain pleasant as New Year's Eve. City is expected to receive a light downpour accompanied by thunderstorm from January 1 to 4 in 2019, stated Indian Meteorological Department (IMD). The reason for drop in mercury is due to change in air direction. Hence, cold waves have gripped Vidarbha and the chill is likely to continue for the next few days, added IMD.

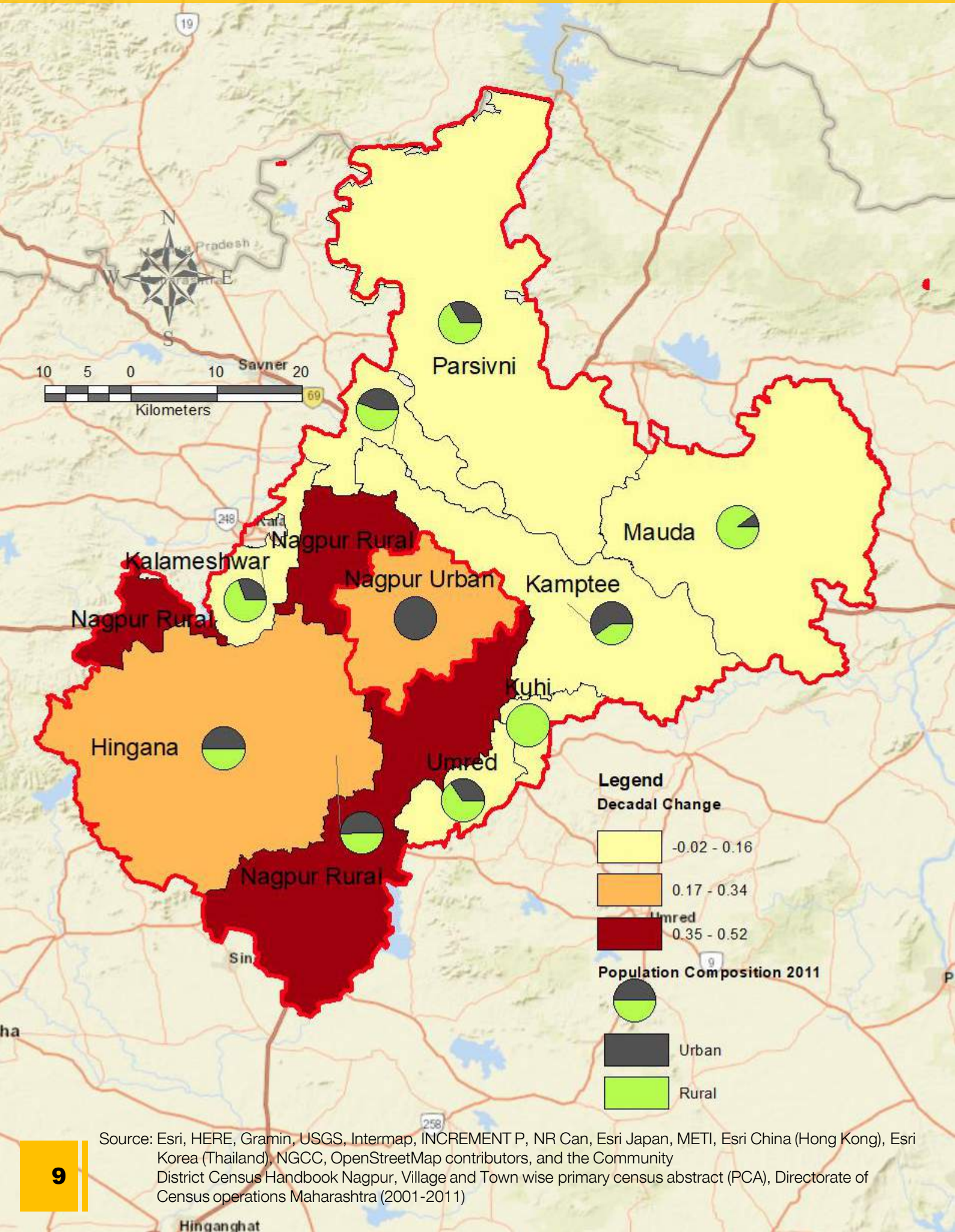
Though the entire Vidarbha region experienced extreme cold on Saturday, there was slight rise in temperatures at some places but there was no respite from cold breeze, the Weather department said.

Northwesterly cold winds are merging with humid southwesterly winds coming from the Bay of Bengal will raise the chance of rains in the first week of New Year. (Contd on page 2)

Nagpur recorded its highest temperature as 48°Celsius on 19th May 2015, while the lowest temperature was recorded on 16th January 2016 as 3.9°Celsius (MPCB, 2019)



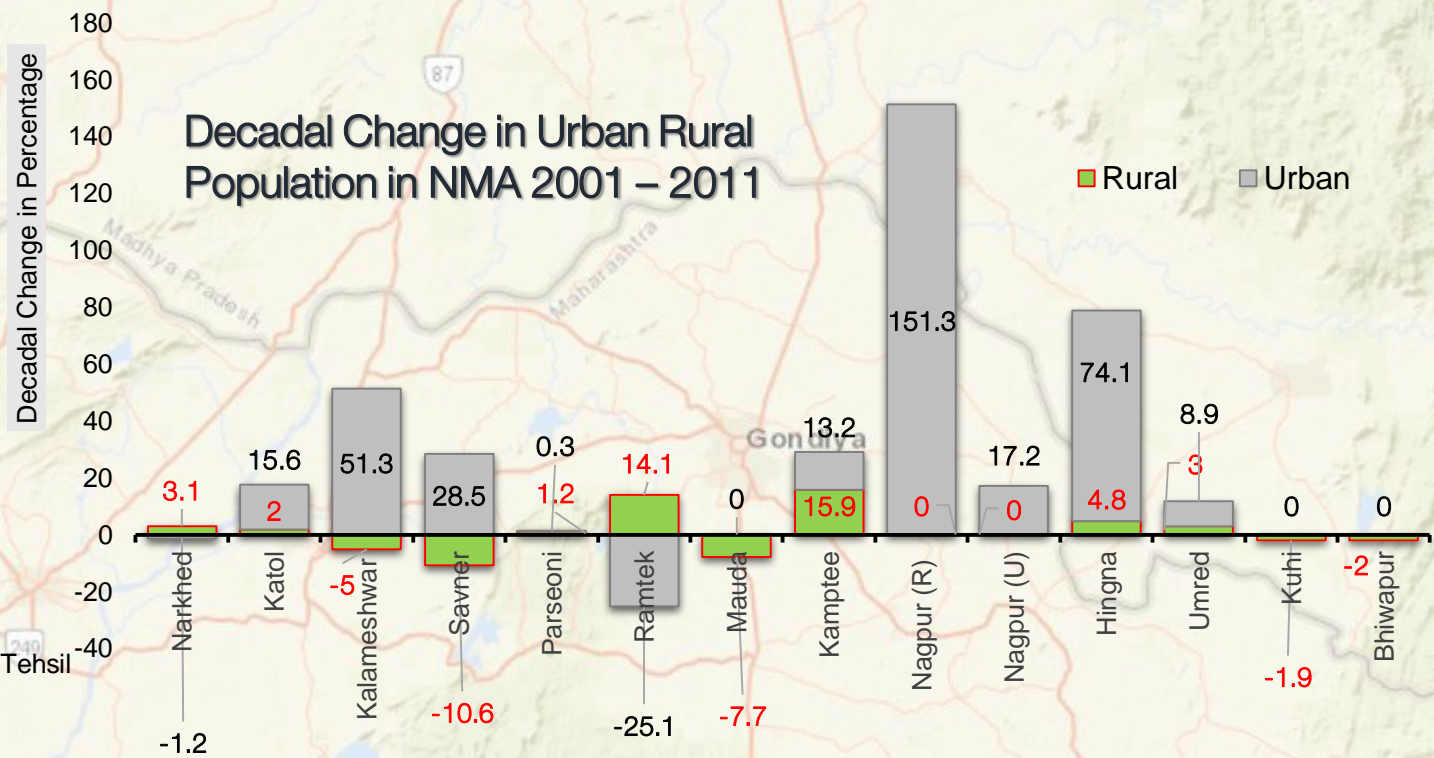
# Decoding the Demographic Transitions



Source: Esri, HERE, Gramin, USGS, Intermap, INCREMENT P, NR Can, Esri Japan, METI, Esri China (Hong Kong), Esri Korea (Thailand), NGCC, OpenStreetMap contributors, and the Community District Census Handbook Nagpur, Village and Town wise primary census abstract (PCA), Directorate of Census operations Maharashtra (2001-2011)

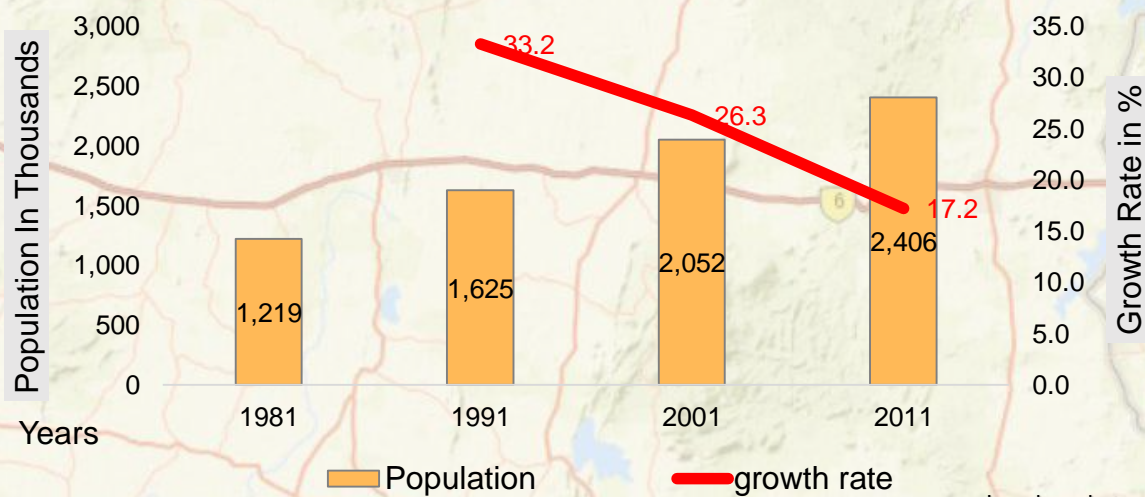


Strengthening urban-rural linkages in South-West Nagpur should be focused to galvanize balanced development and reduce spatial disparities, in view of the changing Urban-Rural composition of NMA.

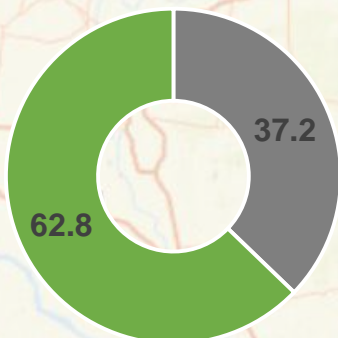


Maximum Urban Rural change has been experienced in areas that are in close proximity to the Nagpur Urban

### Population & Growth rate of Nagpur city 1981 – 2011



In absolute number population of Nagpur urban is increasing at gradual rate but the growth rate is decreasing.



### Urban Rural Composition of NMA

- Urban
- Rural

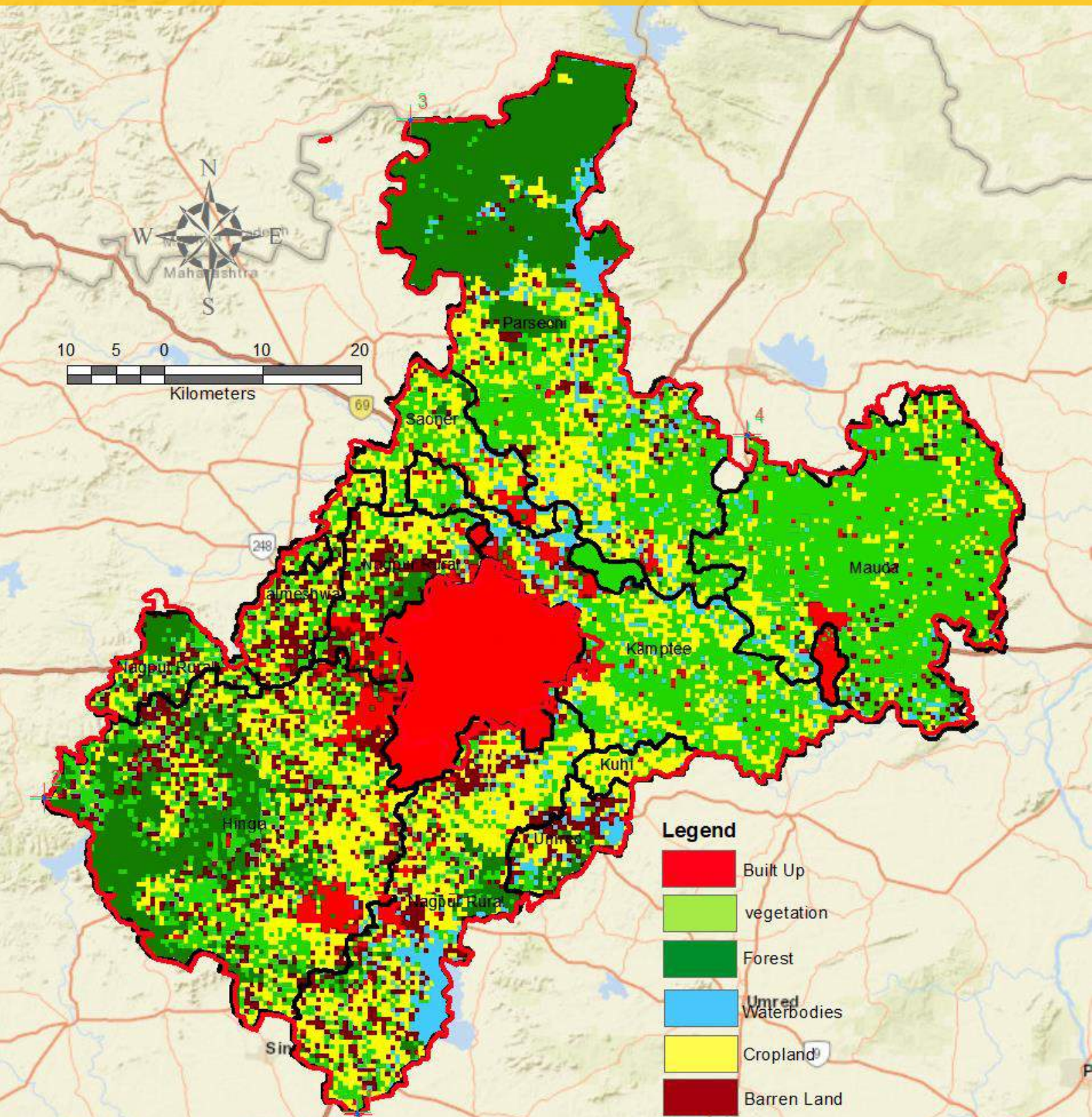
Urban Rural composition, 62.8 % of population is rural which requires a coordinated and planned development.

Source: District Census Handbook Nagpur, Village and Town wise primary census abstract (PCA), Directorate of Census operations Maharashtra (2001-2011)

Nagpur Rural tehsil has witnessed significant decadal population change from 2001 to 2011, followed by Hingna and Kalmeshwar (Census data for 2001 and 2011)



# Land Utilization / Land cover change

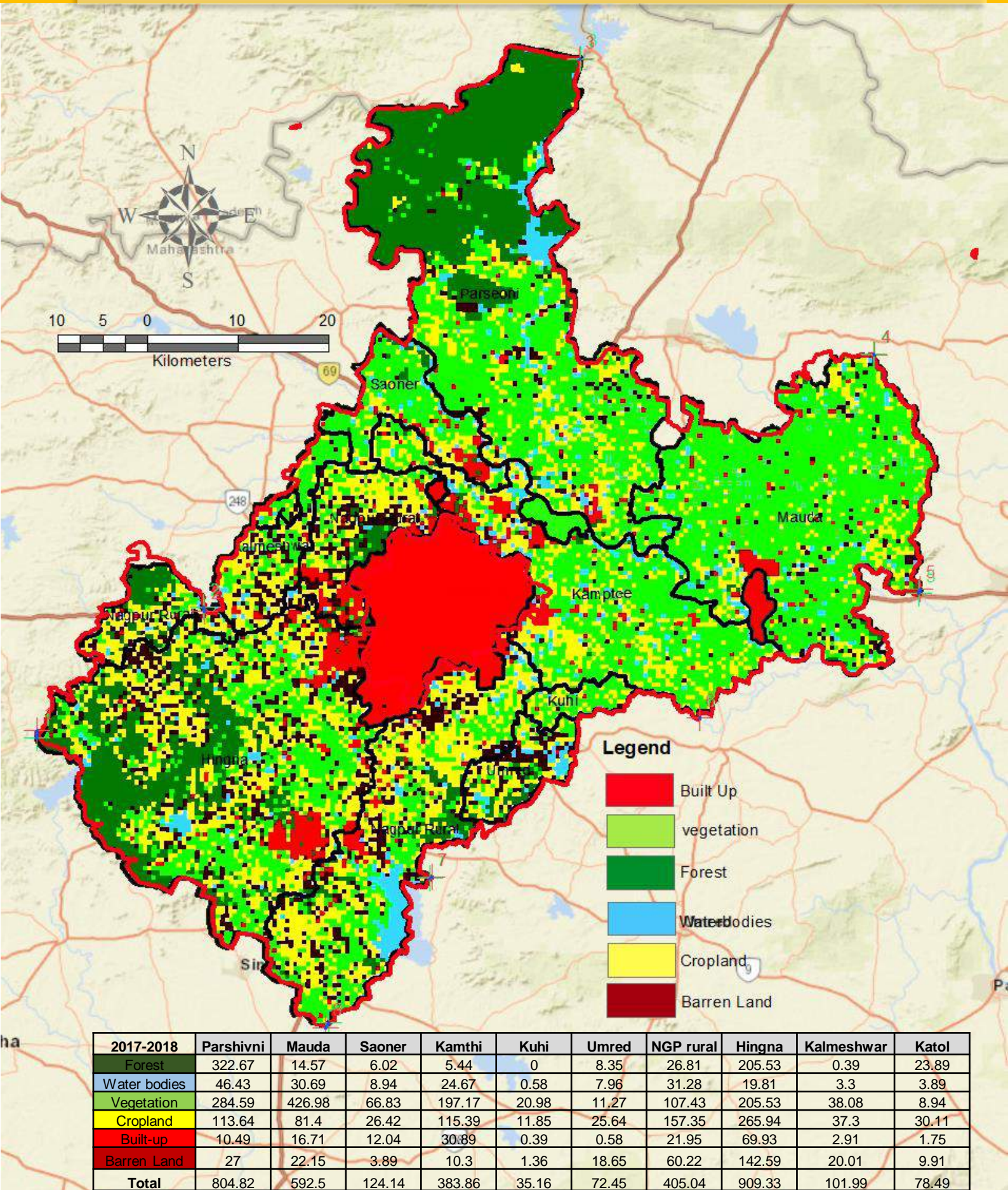


2005-2006	Parshivni	Mauda	Saoner	Kamthi	Kuhi	Umred	NGP rural	Hingna	Kalmeshwar	Katol
Forest	301.69	16.51	6.6	6.22	0	7.96	26.03	201.45	0.58	23.7
Water bodies	118.11	70.52	20.98	73.04	8.55	14.76	89.94	128.79	19.23	15.93
Vegetation	164.93	332.19	20.4	90.72	1.55	5.05	26.81	80.81	7.58	6.02
Cropland	175.81	133.85	57.5	171.14	23.89	23.51	169.59	270.41	44.1	19.43
Built-up	10.88	16.9	11.46	29.92	0.58	0.58	21.95	69.35	2.91	1.75
Barren Land	33.41	22.53	7.19	12.82	0.58	20.59	70.71	158.52	27.58	11.66
<b>Total</b>	<b>804.83</b>	<b>592.5</b>	<b>124.13</b>	<b>383.86</b>	<b>35.15</b>	<b>72.45</b>	<b>405.03</b>	<b>909.33</b>	<b>101.98</b>	<b>78.49</b>

Source: Esri, HERE, Gramin, USGS, Intermap, INCREMENT P, NR Can, Esri Japan, METI, Esri China (Hong Kong), Esri Korea (Thailand), NGCC, OpenStreetMap contributors, and the Community Land Use Land Cover Map (2005-2006; 2017-2018), Maharashtra Remote Sensing Application Centre



Conserving fertile agricultural land in North-East part of NMA should be an urgent priority to ensure food security in the Metropolitan area.



Significant transformations have occurred in North-East part of NMA from 2006 to 2018, as the proportion of productive croplands is found to have declined



# Water Source Areas of Nagpur



Source: Esri, Digital Globe, Geo Eye, Earthstar Geographic, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN and the GIS User community  
 Groundwater Brochure Nagpur District Maharashtra, Central Region Nagpur, Central Ground Water Board 2018



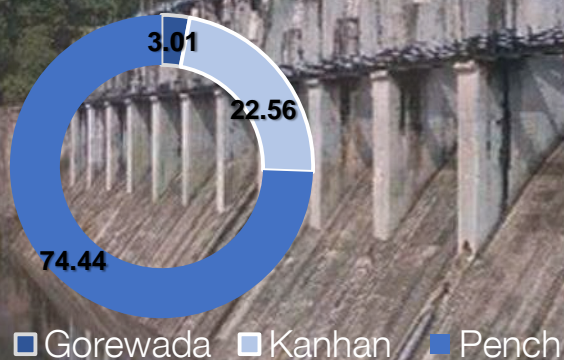
Strategic planning should be done for developing water sources near the city, and actions should be taken to curb water losses from distant Pench source, as it also caters to the Irrigation demands in NMA.

## Development of drinking water sources for Nagpur city (NMC 2011)

Year	City Population	Water Supply (MLD)	LPCD rate	Water Sources
1921	1,45,000	16.50	114	Ambazari + Gorewada
1941	3,02,000	45.00	149	Ambazari + Gorewada + Kanhan
1961	6,44,000	80.00	124	Ambazari + Gorewada + Kanhan
1981	12,17,000	125.00	103	Gorewada + Kanhan
2001	21,50,000	370.00	172	Gorewada + Kanhan + Pench
2004	23,50,000	470.00	200	Gorewada + Kanhan + Pench
2011	24,47,000	651.00	266 (including losses)	Gorewada + Kanhan + Pench

## Water Distribution in NMA

Pench Irrigation Project is a multipurpose project with the objectives of irrigation, domestic and industrial water supply. The dam is located near Navegaon Khairy village in Nagpur district and has left and right bank canals to irrigate 104476 hectares of land.



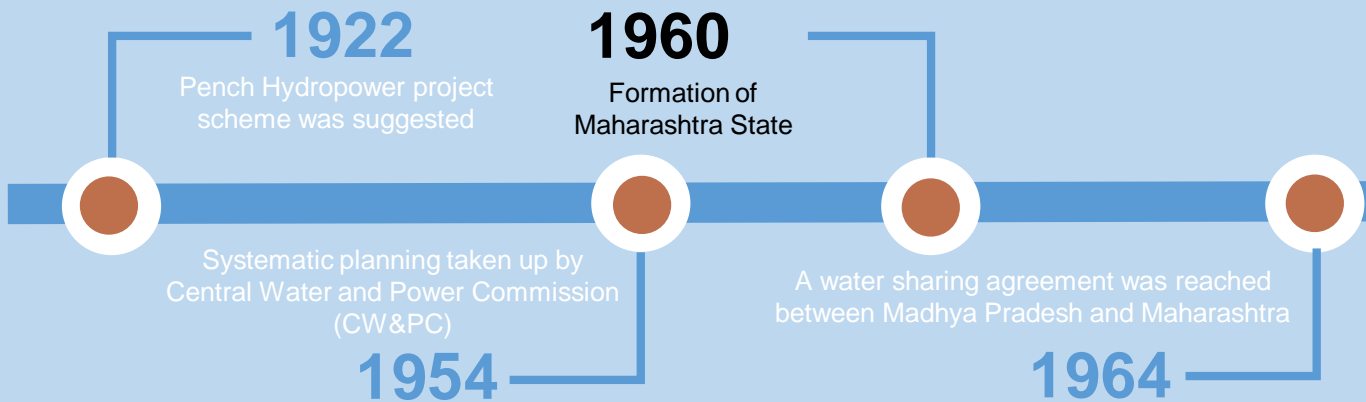
Water for urban areas is sourced from surface water sources like lakes, rivers and reservoirs as well as ground water. In rural areas water is being supplied through the rural water supply schemes which tap ground water by developing tube wells, hand pumps and bore wells (NIT, 2015).

\*MLD- Million Litres per day, \*LPCD- Litres per capita per day

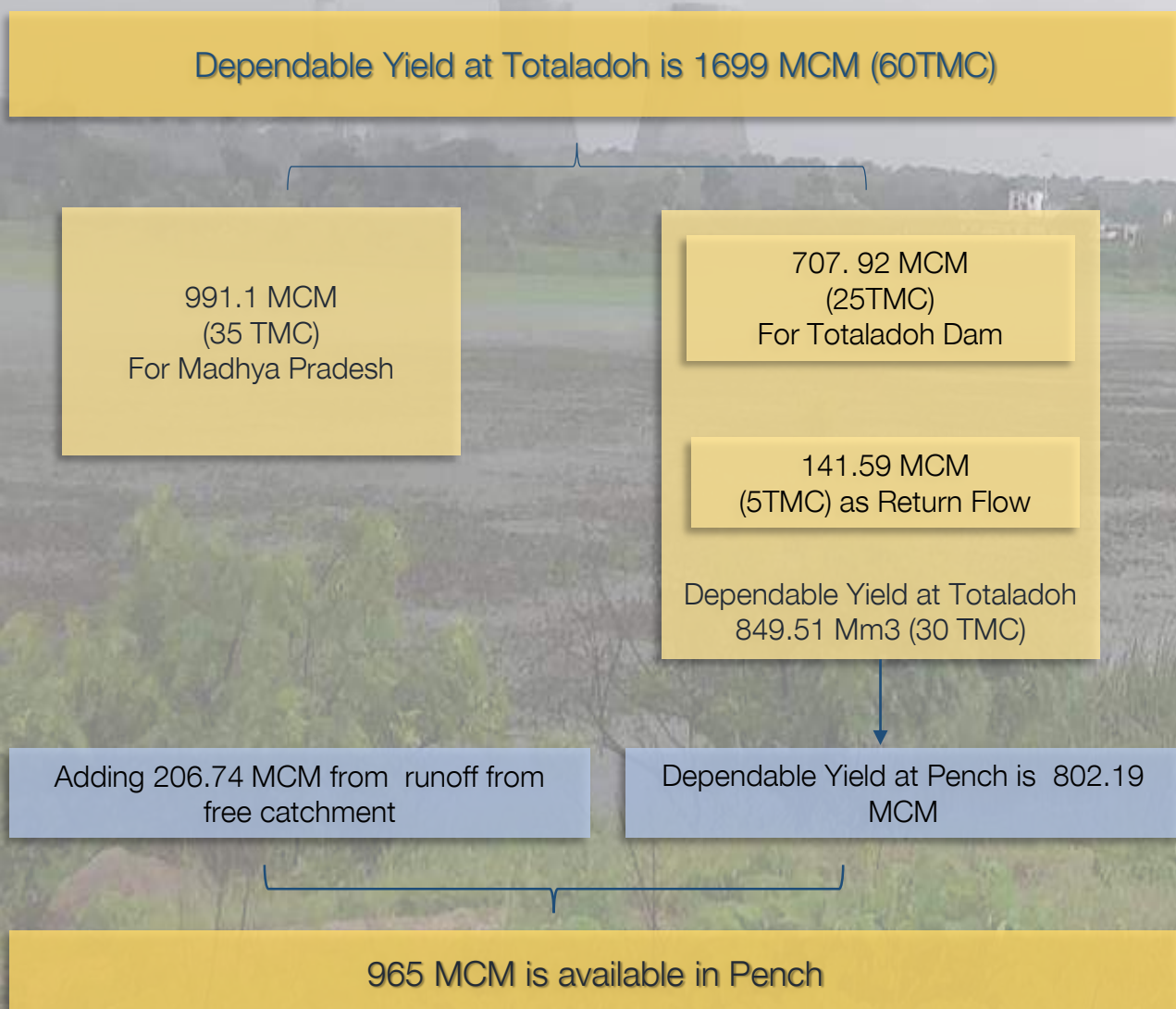
Since 1981, water supply in Nagpur has increased significantly by the introduction of Pench source, however water losses have also increased proportionately due to the long distance



# Urban-Rural Water Conflict in Nagpur

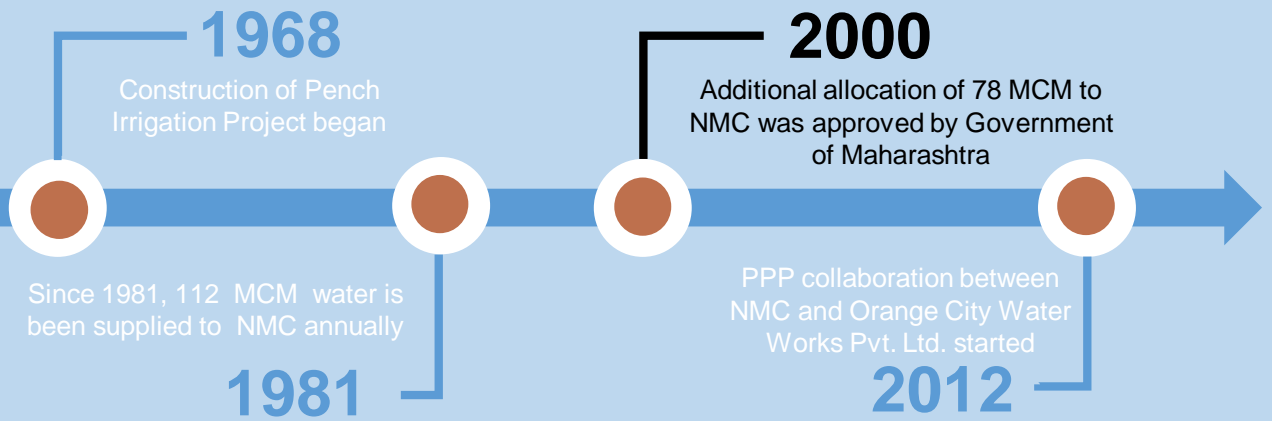


## Inter State Agreement Between Madhya Pradesh and Maharashtra



\*MCM- Million Cubic Metres  
 \*TMC- Thousand Million Cubic Feet  
 \*NMC- Nagpur Municipal Corporation

Benefit sharing mechanisms like 'Payment for Ecosystem Services' should be introduced in Nagpur to ensure sustained drawl of water from Pench and equitable sharing of benefits between urban and rural areas.

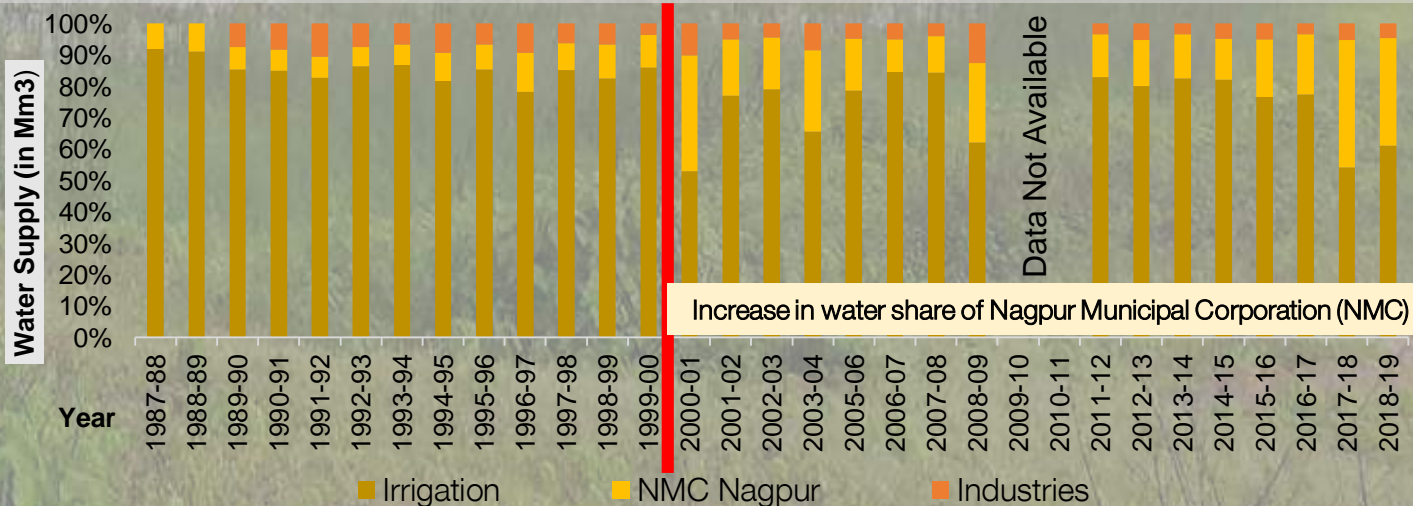


### Water Allocation from Pench Reservoir

S.No.	Description	Utilization (MCM)
1	Irrigation	689
2	Nagpur Municipal Corporation	112
3	Koradi Thermal Power station	67
4	Khaperkheda Thermal Power station	60
5	Fisheries Department	2
6	Sunflad Industries, Bhandara	2
7	Evaporation loss	33
	<b>Total</b>	<b>965 MCM</b>

Pench Irrigation Project is a multipurpose project with the objectives of irrigation, domestic and industrial water supply. The dam is located near Navegaon Khairy village in Nagpur district

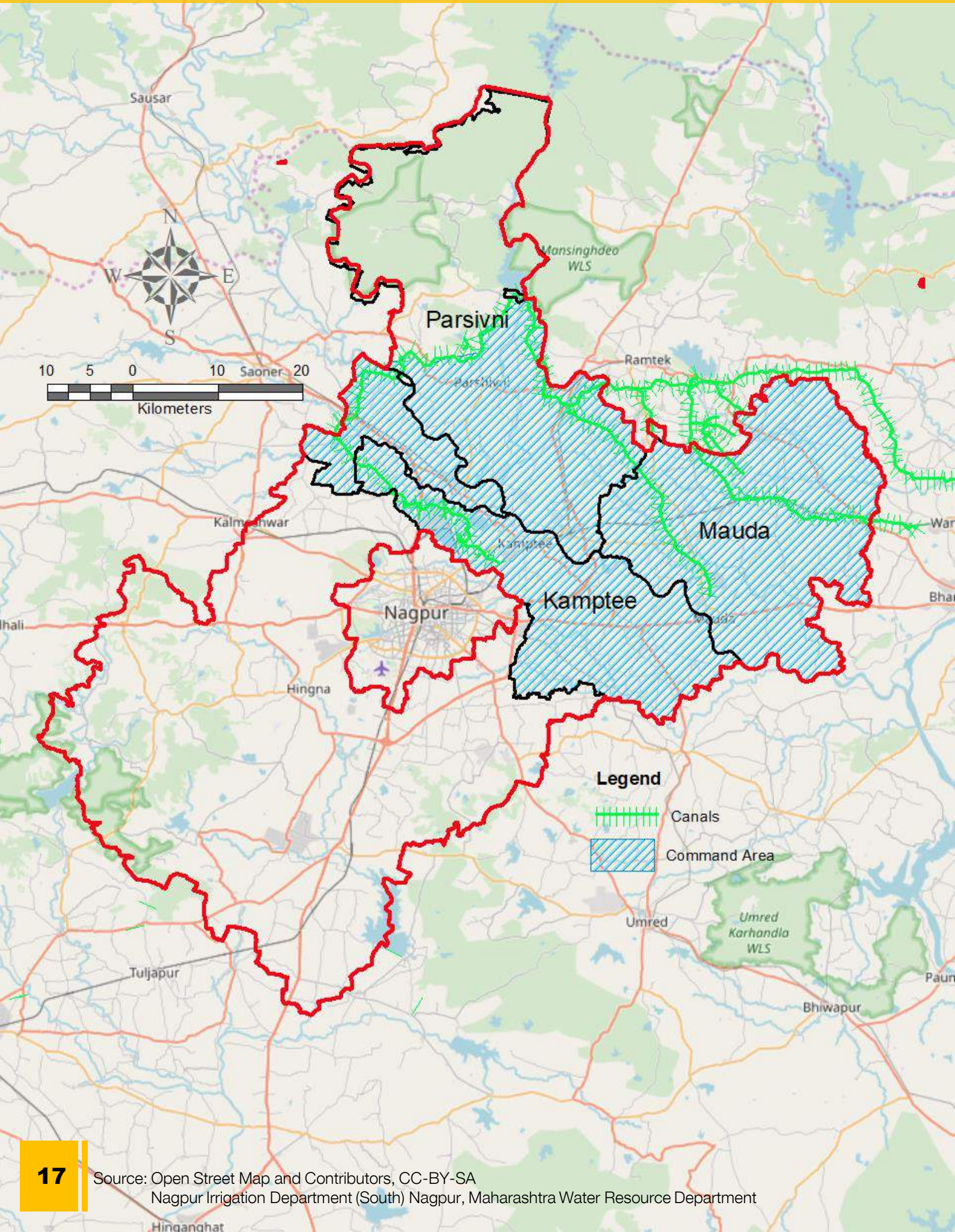
### Water Distribution From Pench Reservoir (1987-2019)



An additional reservation of 78 MCM was made from the Pench Irrigation Project to NMC in the year 2000 on a temporary basis, however the reservation is still continuing to meet the growing water demands in Nagpur city (MWRRA, 2018)

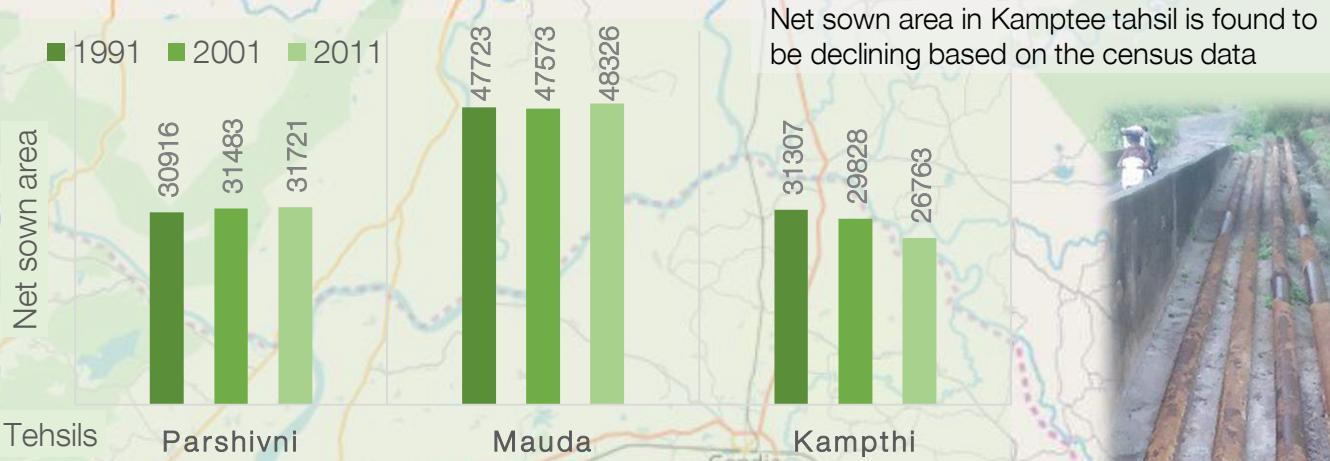


# Water-Related Concerns





A multi-level governance approach among Nagpur city, District Council (Zilla Parishad) and other agencies at regional level is important to address the transboundary water-related concerns emerging due to the rapid urbanization.



Net sown area in Kamptee tahsil is found to be declining based on the census data

Source: District Census Handbook Nagpur, Village and Town wise primary census abstract (PCA), Directorate of Census operations Maharashtra (2001-2011)

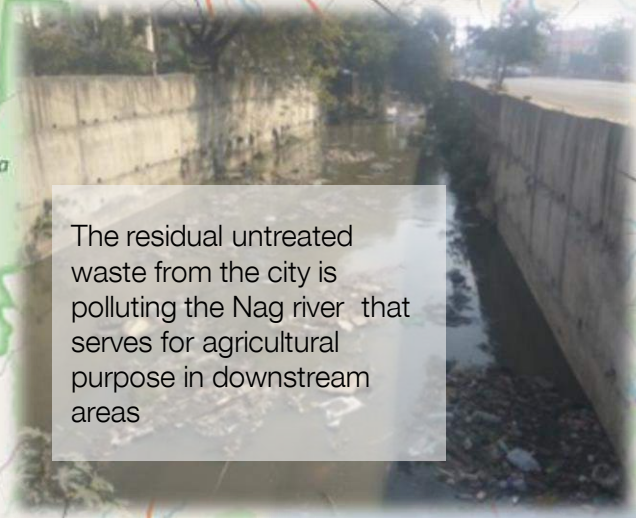


A significant amount of water is lost due to aging infrastructure



Productive agricultural lands around the city are undergoing significant development transformations

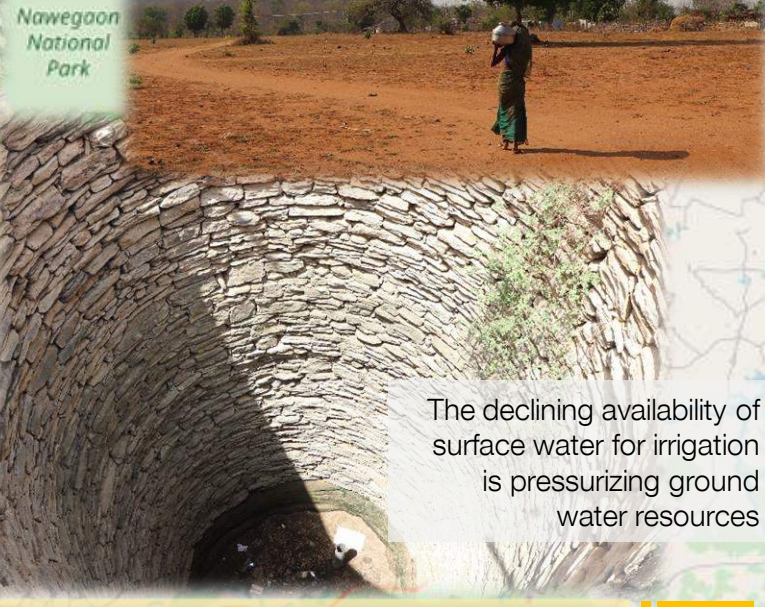
The residual untreated waste from the city is polluting the Nag river that serves for agricultural purpose in downstream areas



Water stress situation is evident in rural areas as ground water levels are going down



Lack of awareness about rainwater harvesting and water conservation practices is worsening the dry summers

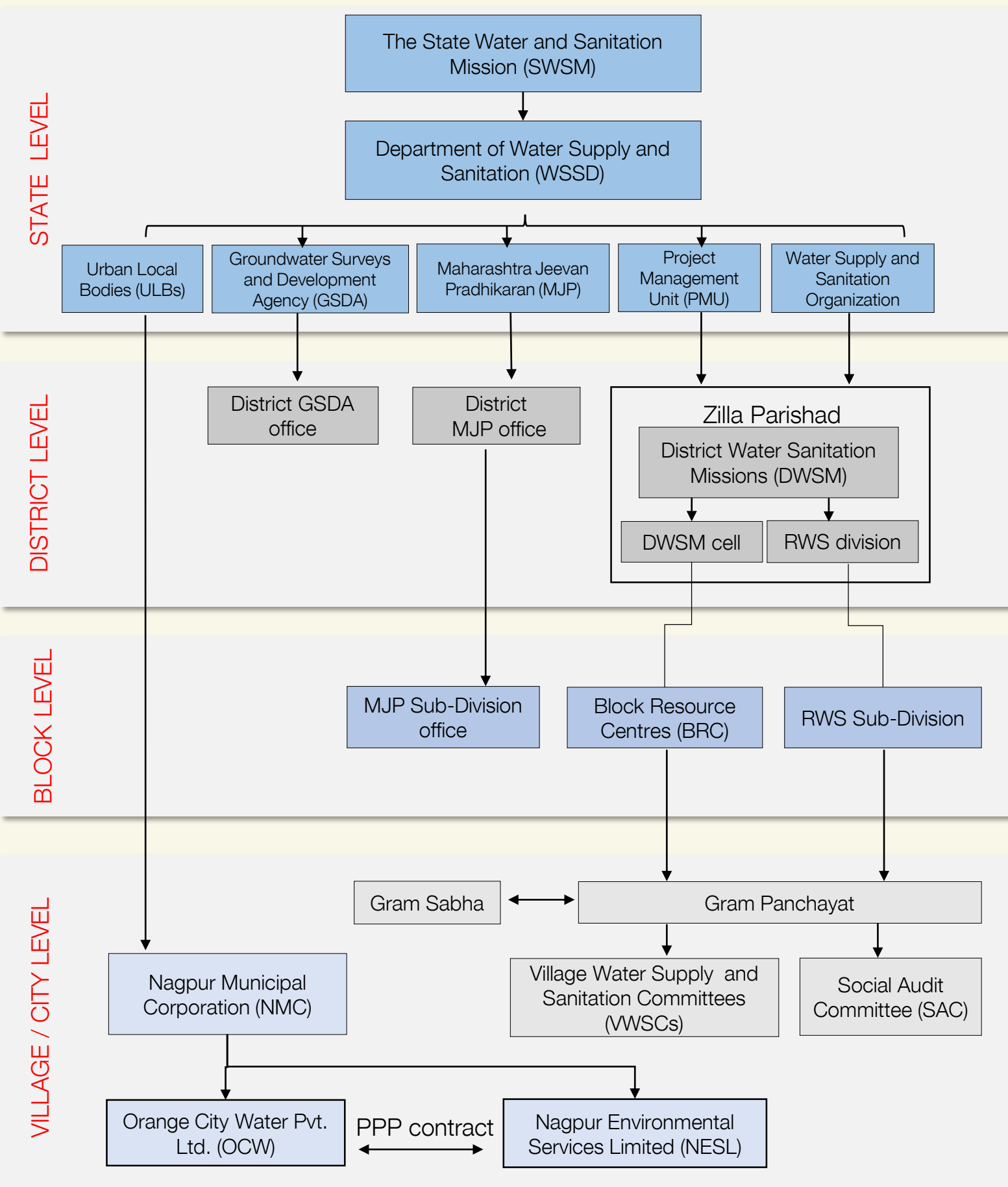


The declining availability of surface water for irrigation is pressurizing ground water resources

The upstream and downstream rural areas in Nagpur are experiencing a range of water-related concerns from decline in water availability to degrading water quality, due to the rapid urbanization and industrialization in the city



# Water Policy and Governance aspects

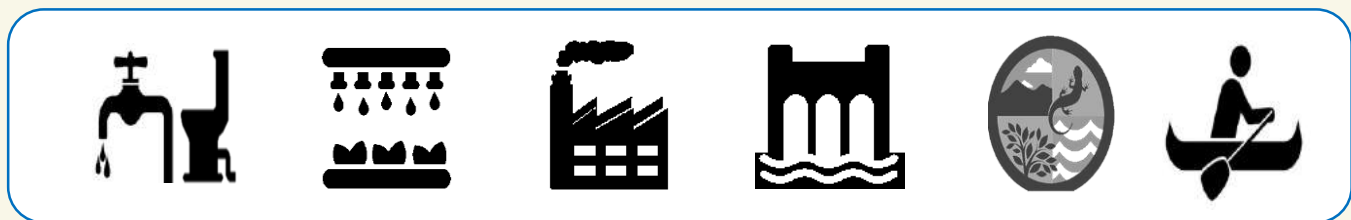




In lines with Maharashtra State Water Policy 2019, more emphasis should be given on enabling multi-stakeholder engagement in Nagpur, including involvement of local communities and private sector in water conservation.

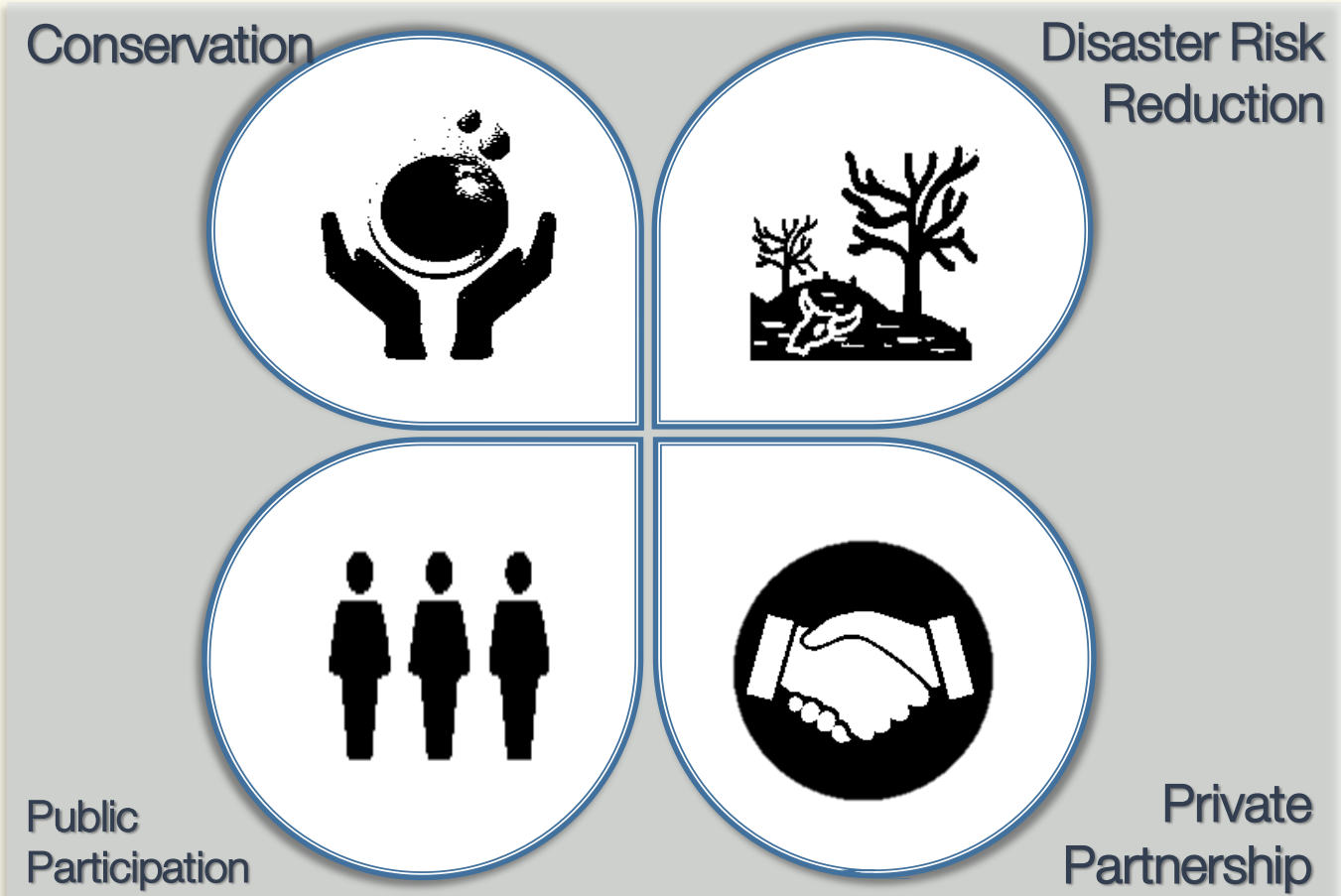
**Section 2 (1) (f)** of Maharashtra Water Resource Regulatory Authority Act, 2005 defines “Category of Use” for different purposes

**Section 8.2 (ii)** of Maharashtra State Water Policy 2019 declares the priority of water usage which are as follows



Drinking & Sanitation   Irrigation   Industries   Hydropower   Ecosystem   Others/ Navigation

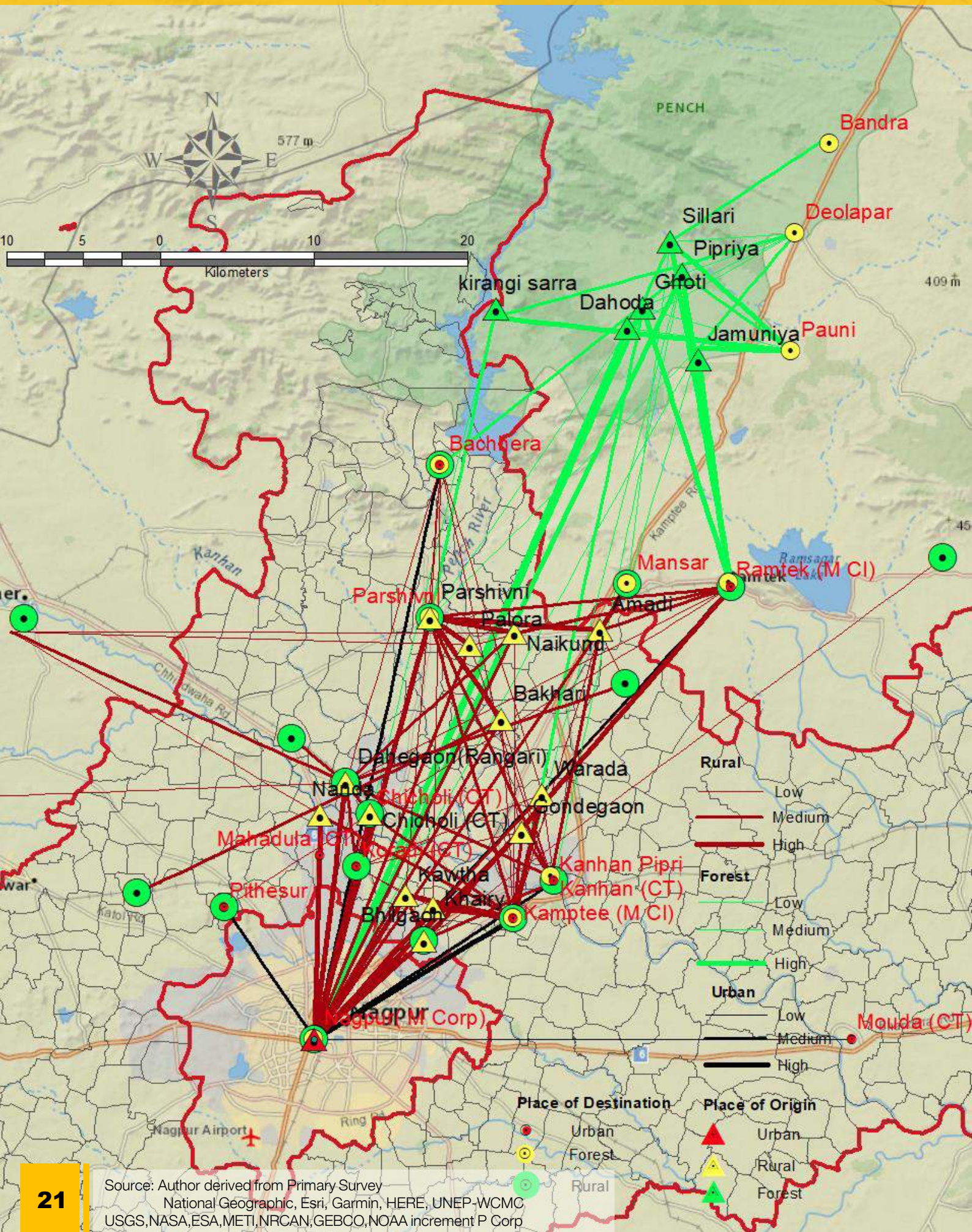
Water management can be achieved through various entry points as mentioned in Maharashtra Water policy Act



‘Domestic and Sanitation’ water needs are given the highest priority in Maharashtra state, followed by Irrigation, Industries, Hydropower, Ecosystem and other needs (Maharashtra State Water Policy 2019)



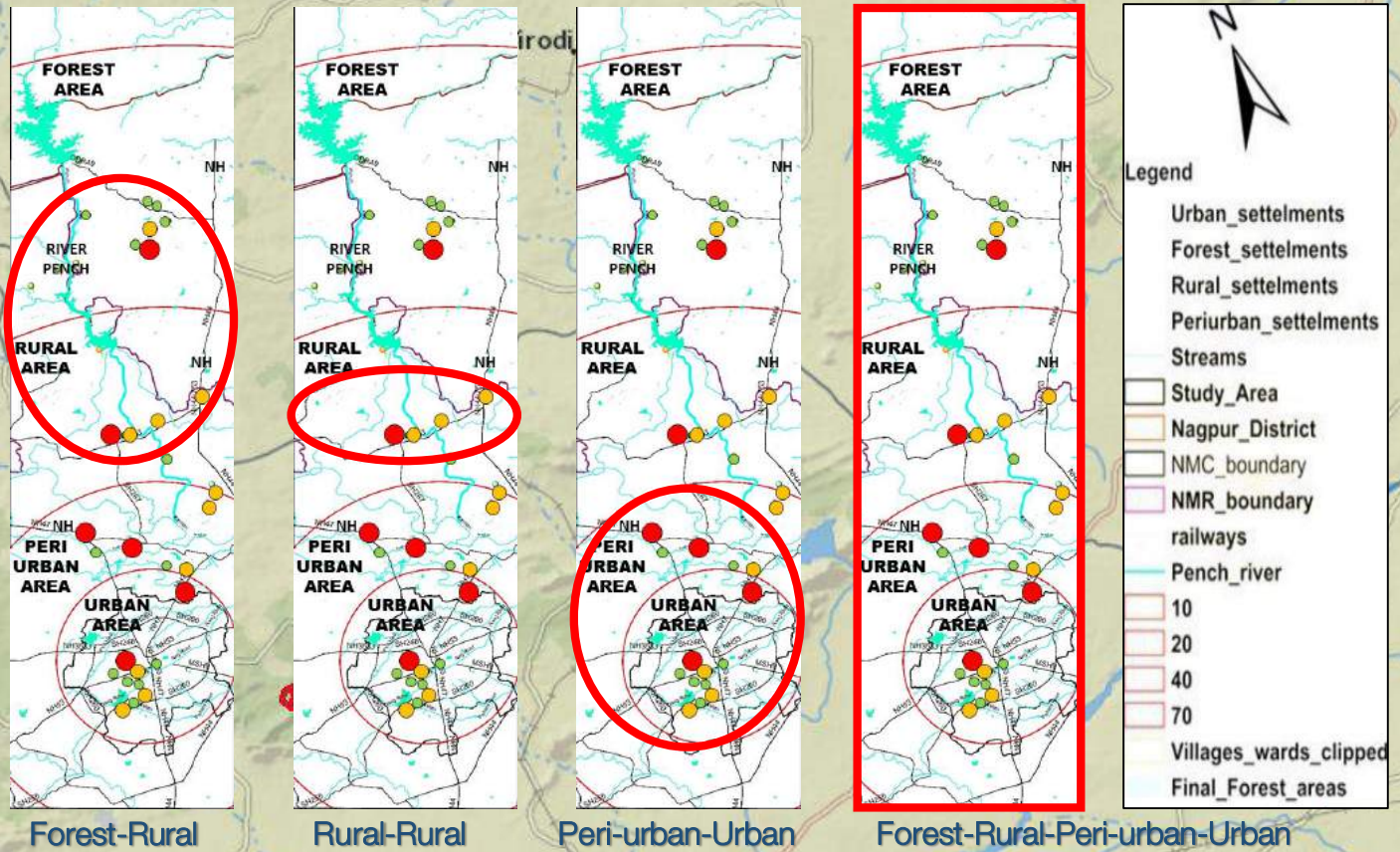
# Finding Avenues for Urban-Rural Partnership



Source: Author derived from Primary Survey  
 National Geographic, Esri, Garmin, HERE, UNEP-WCMC  
 USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA increment P Corp



Coordinated development of small and intermediate towns in Nagpur will not only enhance the urban-rural linkages, but also localize the flow of people, paving way for achieving Regional-Circular and Ecological Sphere.



Field surveys in villages near the water sources areas



Focused Group Discussions to understand the changing urban-rural context



Origin-Destination Surveys to assess the flow of people



Household surveys in rural areas to understand the urban linkages



Through Origin-Destination surveys in urban, rural and forest areas along Pench corridor in Nagpur, the flow of people to far distances is found to correspond with access to urban services like education, healthcare, recreation etc.



# Nagpur City takes a lead in achieving R-CES

India-Japan Bilateral Research Project has opened up new avenues for collaboration in Nagpur, wherein the importance of different stakeholders such as private sector, civil society organization, academia has been recognized. A range of initiatives were taken during the project duration, both in India and Japan, in close collaboration with the local governments, to mainstream the idea of Regional-Circular Ecological Sphere and Urban-Rural partnership. This report provides a brief overview of the project work and will hopefully serve as guiding material for regional level policy making in Nagpur and around the world.



A Decision Theatre Workshop was conducted in VNIT, Nagpur on 12th June, 2019 to initiate regional level dialogue on building urban-rural partnerships. It served as a platform to bring together various stakeholders including local government, Smart city agency, civil society organization, private sector, academic experts etc. to deliberate on possible collaborations between urban and rural areas at policy and governance levels.



A formal dialogue was initiated with Kanagawa Prefectural Government on 30th July 2019, by The Honorable Mayor of Nagpur Municipal Corporation, Smt. Nanda Jichkar for addressing water-related concerns in Nagpur city. The deliberations were a part of a thematic session in International Forum for Sustainable Asia and the Pacific Ocean, that was jointly organized by IGES (Japan) and Keio University (Japan) and VNIT (India).



Establishment of an Urban-Rural coordinating entity at governance level in Nagpur is necessary to promote the idea of resilient growth and Regional-Circular and Ecological Sphere.

KEY ENTRY POINTS TO ACHIEVE R-CES



## Policy Coordination

Numerous agencies are involved in water management in Nagpur region. However, there is need for policy coordination at various levels, as water being a shared resource has to be managed collectively.



## Stakeholder Engagement

A wide range of stakeholders including government agencies, private sector, academic experts etc. play important roles in water management. There is need for engagement from all sectors to address mutual concerns.



## Urban-Rural Partnership

In view of the shared water resources, there is need for collective action by various actors in urban and rural interface. Involvement of private sector demonstrates huge potential in strengthening urban-rural linkages.



## Technological Interventions

For effective management of available water resources, there is need for technological interventions in various fronts like curbing of water losses, enhancing water usage, providing early warnings, irrigation techniques etc.



## Community Awareness

The foremost element to initiate grassroot level action is to raise community awareness about water conservation and management etc. There is need to foster proactive action rather than the need-based approach.



By deriving lessons from selected cases in Japan, a range of initiatives were taken during the Bilateral Project to mainstream the idea of Regional-Circular Ecological Sphere and Urban-Rural partnership in Nagpur











# References

- Central Water Commission (2001). Central Water Commission Monitoring Central Unit Appraisal Directorate . Performance Evaluation Study of Pench Irrigation Project, Maharashtra Nagpur.
- Ministry of the Environment (2018). Creation of a Regional Circular and Ecological Sphere (Regional CES) to Address Local Challenges. Annual Report on the Environment in Japan 2018. Available online: <http://www.env.go.jp/en/wpaper/2018/pdf/04.pdf>
- MPCB (2019). Action Plan to Control Air Pollution in Nagpur City. Maharashtra Pollution Control Board. Available online: [http://www.mpcb.gov.in/sites/default/files/pollution-index/severly-report/Nagpur\\_Action\\_Plan07112019.pdf](http://www.mpcb.gov.in/sites/default/files/pollution-index/severly-report/Nagpur_Action_Plan07112019.pdf)
- MWRRRA (2018). Petition filed by Adv. Ashish Jaiswal at Nagpur bench of Honorable High Court of Bombay as regards Making Provision for Irrigation Purpose by Curtailing the Use of Water from Pench Project Complex by Nagpur Municipal Corporation- Case No. 8 of 2017. Maharashtra Water Resources Regulatory Authority.
- NIT (2015). Nagpur Metropolitan Area Development Plan: 2012-32, Draft Development Plan Report. Available at: [http://www.nitnagpur.org/pdf/Metro\\_Region\\_DP.pdf](http://www.nitnagpur.org/pdf/Metro_Region_DP.pdf)
- NMC (2011). Draft City Sanitation Plan, Nagpur Municipal Corporation, Nagpur. Available online: <https://docplayer.net/62042234-City-sanitation-plan.html>
- Oxford Economics (2018). Global Cities, Which cities will be leading the global economy in 2035? Available online: <https://workplaceinsight.net/wp-content/uploads/2018/12/Global-Cities-Dec-2018.pdf>
- Pench Irrigation Project (2019). State Irrigation Department, Nagpur.
- Takeuchi, K. (2018). Regional Circular and Ecological Sphere (Regional CES), Outline of Speech at the STS Forum (7 October 2018, Kyoto). Available online: <https://www.iges.or.jp/en/sdgs/sts.html>
- Tata Institute of Social Sciences (2015). Status of Rural Water Supply in Maharashtra. Available online: [http://www.indiaenvironmentportal.org.in/files/file/TISS\\_KRC\\_Study\\_Report\\_Status\\_of\\_Water\\_Supply\\_in\\_Maharashtra.pdf](http://www.indiaenvironmentportal.org.in/files/file/TISS_KRC_Study_Report_Status_of_Water_Supply_in_Maharashtra.pdf)









Keio University



IRDR ICoE on Resilient Communities & Settlements (IRDR ICoE-RCS), Visvesvaraya National Institute of Technology, Nagpur, Maharashtra 440010, India  
Website: <http://vnit.ac.in/>

Institute for Global Environmental Strategies (IGES)  
2108-11 Kamiyamaguchi, Hayama,  
Kanagawa, Japan  
Website: <https://www.iges.or.jp>

Graduate School of Media and Governance,  
Keio University Shonan Fujisawa Campus  
5322 Endo, Fujisawa-shi, Kanagawa 252-0882 Japan  
Website: <https://www.sfc.keio.ac.jp/en/>