Promoting Regional Circular Ecological Sphere Concept for Sustainable Resource Management and Collective Resilience of Urban and Rural Regions in Nagpur Metropolitan Area

VNIT NAGPUR

IGES Institute for Global Environmental Strategies

慶應義塾 Keio University

IRDR ICoE Integrated Research on Disaster Risk International Centre of Excellence

irdr rcs Resilient Communities & Settlements

About this publication:

This publication is based on research project titled 'Promoting Regional Circular and Ecological Sphere Concept for Sustainable Resource Management and Collective Resilience of Urban and Rural Regions in Nagpur Metropolitan Areas' coordinated by Integrated Research on Disaster Risk (IRDR) International Centre of Excellence (ICoE) at Visvesvaraya Institute of Technology (VNIT), Nagpur. It was funded by Institute for Global Environment Strategies (IGES), Japan. This publication attempts to understand the linkages between urban and rural areas in Nagpur Metropolitan Area (NMA) and suggest feasible strategies for building urban-rural partnership along the notion of Regional Circular and Ecological Sphere.

Team Members:

India: Visvesvaraya National Institute of Technology 'VNIT', India

1. Dr. Sameer Deshkar, Assistant Professor
2. Shruthi Dakey, PhD Student
3. Harshitha N., M.Tech Student
4. Karumoju L N Sridhar Achari, M.Tech Student
5. Manish Kulkarni, M.Tech Student
6. Rupal Nandanwar, M.Tech Student
7. Shreya Jaiswal, M.Tech Student
8. Abhishek C., M.Tech Student

Japan: Institute for Global Environment Strategies 'IGES' and Keio University, Japan

1. Bijon Kumer Mitra, Senior Policy Researcher, IGES
2. Rajib Shaw, Professor at Keio University and Senior Fellow at IGES
3. Vibhas Sukhwani, PhD Student, Keio University

Disclaimer

This report is developed based on primary surveys conducted in selected urban and rural settlements of Nagpur Metropolitan Area in India. The report also builds on available literature and photographs from many different sources. The complete list of referred sources have been mentioned at the end of the report.

ACKNOWLEDGEMENT

The project team expresses sincere gratitude towards everyone who contributed for the successful completion of the project. The team is indebted to Institute for Global Environment Strategies (IGES) for providing the financial support to execute this project. The grants helped to build upon the core project activitries in the remote settlements with additional resources, community participation and synthesis activities.

Our sincere thanks to all key stakeholders involved in project activities including the community members, civil society organizations, private companies and academic experts. We particularly would like to express our gratitude to the village heads from the selected rural settlements for providing thorough support and engaging attitude towards project activities that helped in understanding the criticalities at grass-root level.

We are extremely thankful to Mayor pf Nagpur city Smt. Nanda Jichkar and CEO Nagpur Smart and Sustainable City Development Corporation Ltd. for valuable support.

Last but not the least we would like to express our sincere gratitute to Dr. P.M. Padole, Director, VNIT Nagpur for his fortitude and in-kind support to the project.

Contents

List of Figures

List of Tables

1. INTRODUCTION

In the wake of growing population, rapid urbanization and industrialization, the demands for natural resources like food, water etc. are constantly on the rise. While more than half of current world population lives in urban areas, it is important to note that the required resources are mainly sourced from rural areas. The growing urban population is further pushing the natural systems towards critical thresholds which if not sustained now would be damaged beyond repair. Against the growing resource demands in urban areas, the concept of urban-rural linkages has recently gained high prominence at global policy level and is proposed to safeguard resource demands of both urban and rural communities. This approach emphasizes on the holistic development of urban and rural areas with an integrated approach to manage shared natural resources.

As rural and forest areas are primarily the source of natural resources for urban areas, it is very important to understand their interlinkages and correspondingly enhance their relationships through partnerships between the key stakeholders. This report will serve as a guide for policy makers in addressing the issue of resource management at regional level where urban-rural partnership is required.

1.1. Scope of the report

This report is mainly divided into six sections. Section 2 provides a brief overview of key concepts like urban-rural linkage, R-CES etc. and explains selected case study examples of India and Japan. Section 3 explains the case study area of Nagpur Metropolitan Area in India. This section details out the core characteristics of NMA and the changing dynamics between urban and rural areas. Section 4 explains about the survey methodology adopted for the study, selection of settlements and linkages identified through primary survey. It is important to note that this project builds on Field surveys as well as a Decision theatre workshop conducted for understanding stakeholder perception regarding potential urban-rural partnerships in NMA. Section 5 elaborates on the survey results and the findings of the stakeholder consultation workshop conducted to understand their opinion on Urban-Rural partnership in terms of resource management and building upon the avenues for partnership. The last section 6 talks about the conclusion, proposals and recommendations drawn out of the analysis.

2. LITERATURE REVIEW

2.1 Resilience and Urbanization

Resilience is the ability of a system to cope up with the external shocks and stresses and in case of a disaster hit, its in-built capacities help to retrieve initial or stable equilibrium position (OECD, 2014). In other words, resilience is about addressing the DPSIR (Drivers, pressure, impact, state and response) of the system in the face of shocks and stresses. Based on that building and strengthening the natural, social, financial and human capital so that system can withstand to any natural or manmade uncertainties (Urban Land Institute, 2015). It is one of the most important factors for planning in a country like India where growth rate is high. Urbanization on the other hand refers to the process by which more and more people leave the countryside to live in the cities, a population shift away from rural villages. Due to the continued trend of urbanization and climate change, risk of disaster has increased by leaps and bounds and the need to recover from it quickly without much disruption have become the need for the hour.

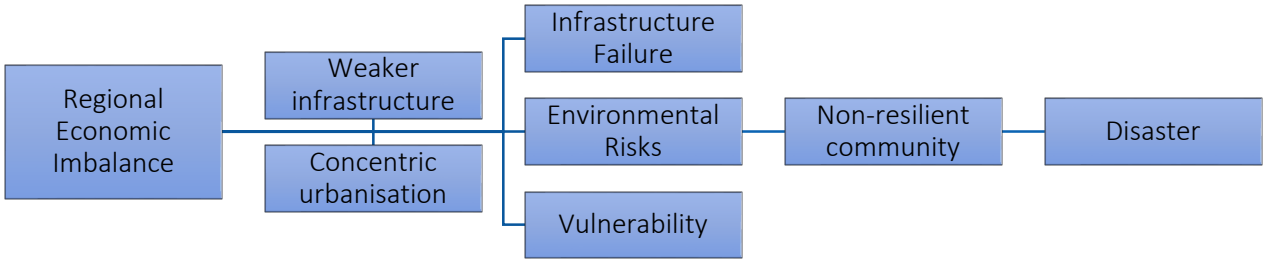


Figure 1: Urbanization as a risk generator (Image source: Author)

Urbanization can lead to a disaster risk and make a place vulnerable by generating non-resilient communities. The formation of concentric urbanization leads to urban functions involving various levels of complexity which results in Infrastructure failure. The shortage of developed and safe land also generates hazardous areas and degrades the environmentally valuable areas developing environmental risks and disasters. The most vulnerable areas, informal settlements, slums and squatters are the most hit at the time of disaster, having a greater chance of creating non-resilient communities ultimately leading to weaker infrastructure and weaker institutions (Figure 1).

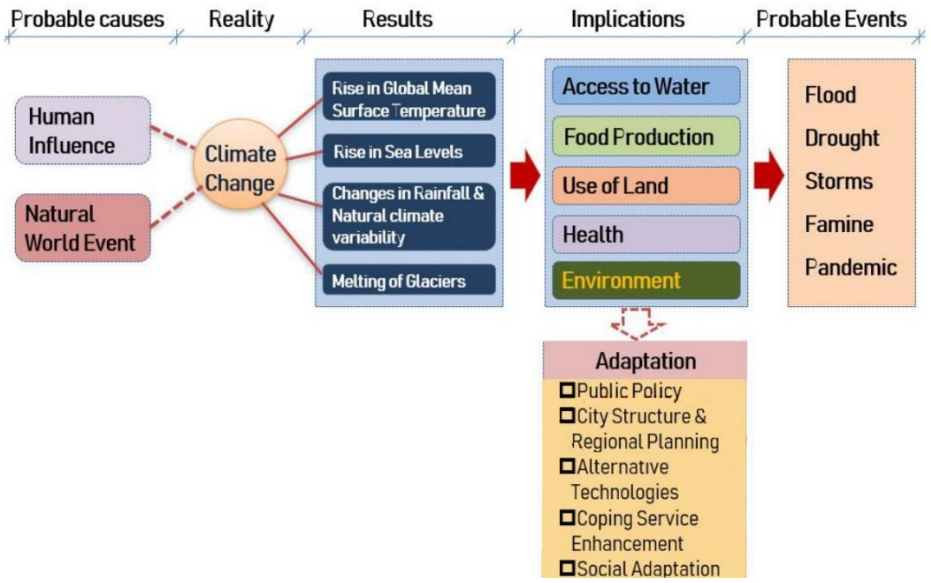


Figure 2: Need for Adaptive Urbanization (Image Source: Author)

The probable causes of climate change such as human influence and natural events have resulted in rise in the global mean surface temperature, sea levels, changes in rainfall patterns and melting of the glaciers (Figure 2). These factors have led to uncontrollable conditions where access to water, production of food, and effective utilization of land, human health and access to good environments is much more difficult to achieve. Such difficulties make the settlements vulnerable to probable events such as floods, drought, storms, famine and pandemic situations. For sustaining these or building a resilient community appropriate adaptation in the form of public policy, city structure planning, alternative technologies, coping service enhancement or social adaptations are necessary to tackle the implications of the changes seen in recent past.

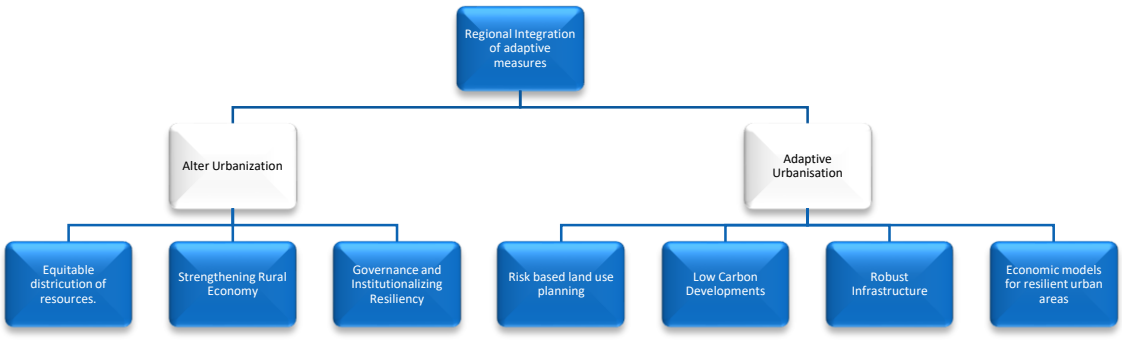


Figure 3: Path to Resilient Urbanization (Image source: Author)

Adaptive path for resilient urbanization, Regional integration of adaptive measures are must. This includes planning for equitable resource distribution, strengthening rural economy, institutionalizing resiliency in urban and rural governance (Figure 3). For adaptive resilient urbanization, it is important to incorporate risk-based land use planning, planning for low carbon development with robust

infrastructure facilities catering to urban-rural regions and developing economic models for resilient urban areas which in turn supports rural areas

2.2 Urban-Rural Linkage

Urban and Rural areas possess different features and functions which they share to complete and sustain their livelihoods. Functional links between urban and rural areas are determined by market forces and demographics. Administrative borders are becoming less and less pertinent when trying to address development challenges at the local level. Both rural and urban areas are subject to dynamic change, disregarding administrative borders (CCMR, 2013). There has always been direct as well as indirect dependency on each other in the form of social, economic, technological, environmental aspects. There is a flow of people, goods and information (ideas and innovations) between these areas which is seen as a potential area for research to integrate development of these areas (Foster T. 2015) Physical linkages, Economic linkages, Population movement linkages, Technological linkages, Social interaction linkages, Service delivery linkages, Political and administrative linkages are identified between an urban area with its surroundings (Rondinelli, 1976).

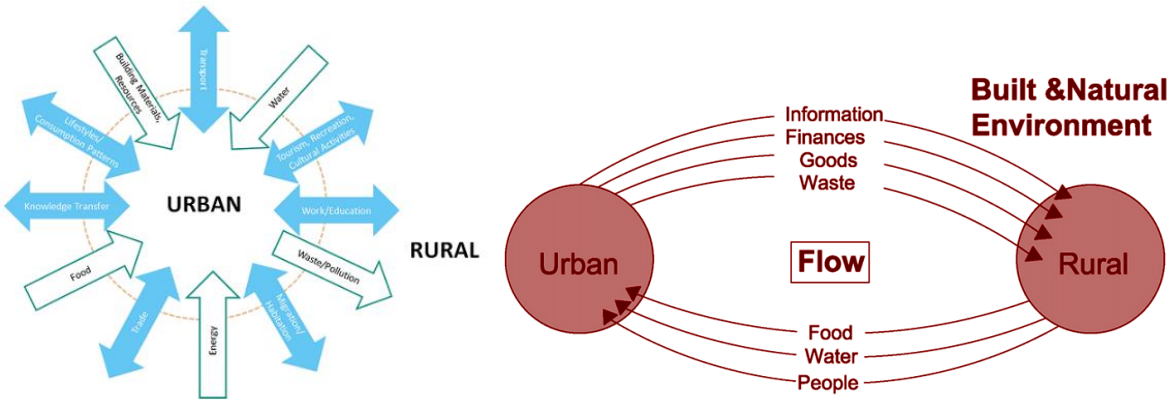


Figure 4: Highlighting urban-rural interactions (Source: RuralUrbanNexus 2016)

The major developmental policies are dominantly devised for urban settlements. Though the dependencies are almost equally important, yet urban areas are more benefited than rural areas. The vulnerability factor in terms of food and water security is higher in rural areas than urban areas. In the process of urbanization or during natural hazards such as drought and flood, people move from rural areas to urban for the sake of employment opportunity to survive in shocks (Srivastava N., 2016). In such cases the agriculture production goes down in rural areas while pressure increases on the infrastructure and basic services in urban areas (Figure 4). The secured supply of natural resources may only be guaranteed by urban-rural tradeoffs, handling the calamities or demands together by urban-rural stakeholders. Hence, preparedness for surviving any calamity shall be done at both rural and urban areas by identifying the linkages between these two crucial regions so that the communities can fight back on their own to achieve a sustainable and resilient future.

2.3 Regional Circular and Ecological Sphere (RCES)

The key aspects behind this concept is to create a low-carbon society, resource circulation and living in harmony with nature. It means to achieve de-carbonization along with circulation of resources and conducting non-destructive type of livelihood by the local communities. It is one of the major guiding principles for policy makers of Japan. It is based on sustainable production of natural capital and ecosystem services and growing stronger linkages between urban consumers and rural producers (Takeuchi, P. K. 2018). Harnessing regional renewable energy from low carbon society is one of the major concerns of the concept. This concept also supports the Sustainable Development Goals (SDGs) of addressing environmental, economic and social issues together which helps in identifying and strengthening the linkages at local level.

Building broader natural connections - linkages among forests, rural areas, cities, rivers, and ocean - and economic connections composed of human resources, financial capital, and commodity supply is the type of new value chain that is intended by RCES (Figure 5). It also aims to rejuvenate and revisit the local communities for economic benefits and collaborative approach involving multiple stakeholders to harness the country from its roots (Takeuchi, P. K. 2018). It will ultimately fetch economic benefits by providing employment opportunities, social benefits, and use of alternative energy resources such as wind, solar, bio-mass thereby, de-polluting the environment, reducing carbon footprint and heading towards a sustainable and resilient future.

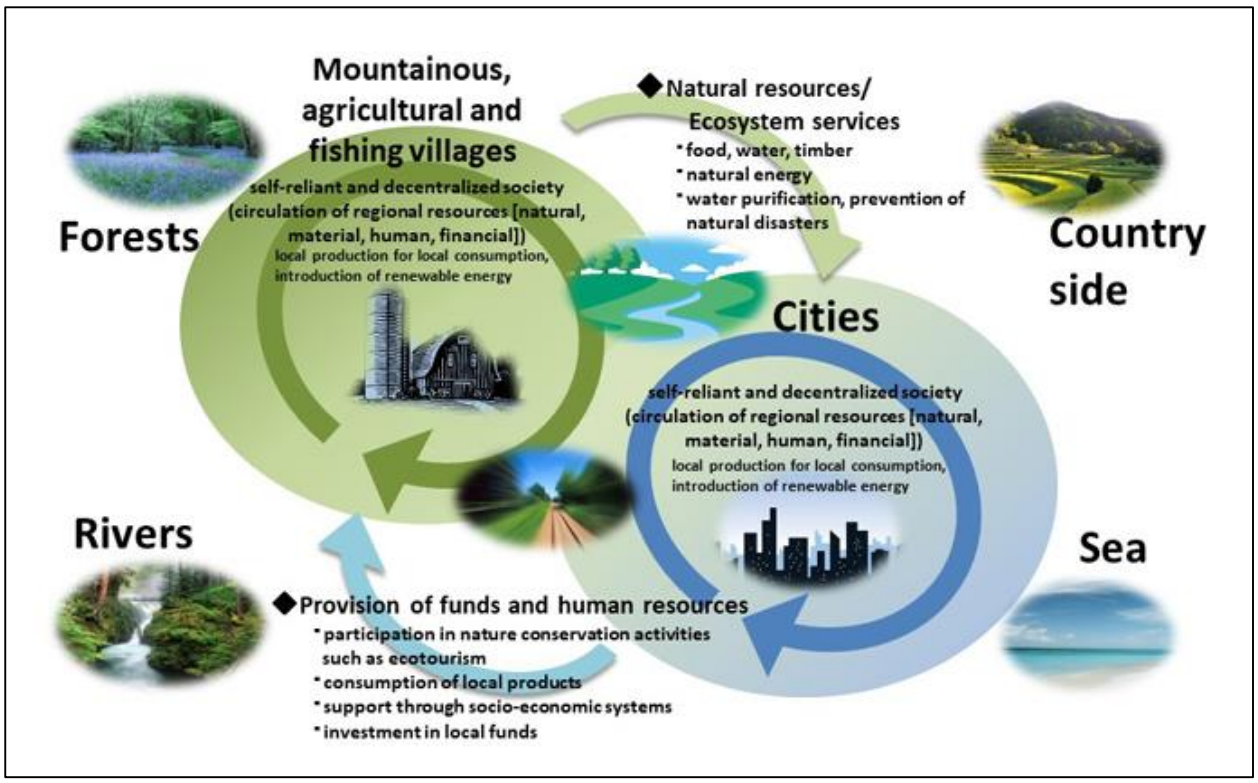


Figure 5: RCES Concept and Benefits (Image source: www.iges.or.jp/en/sdgs/sts.html)

2.4 Case study of Kanagawa Prefecture, Japan

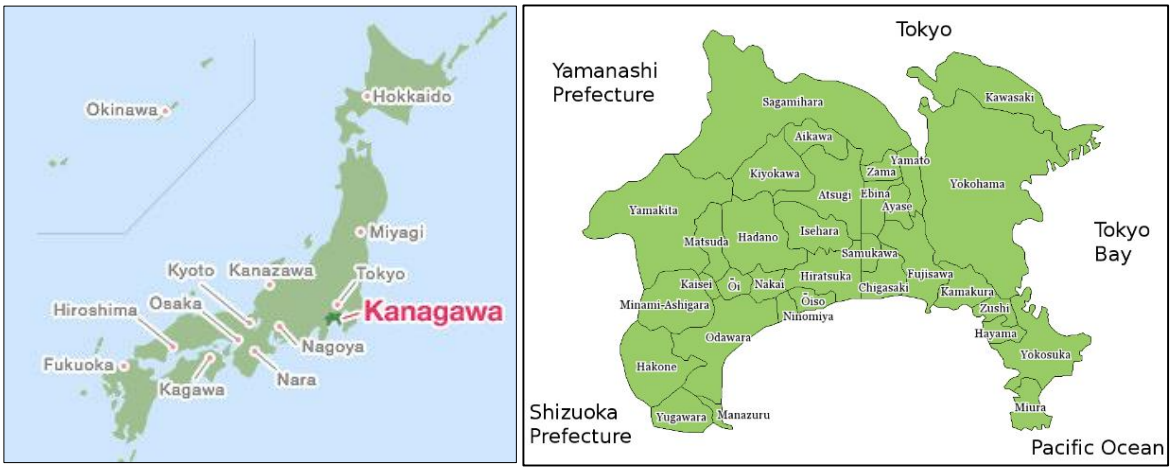


Figure 6: Japan and Kanagawa key map (Source: www.wikiand.com)

Kanagawa is a coastal prefecture just south of Tokyo (Figure 6). Sagami River and Sakawa River are the source of 90% of water in Kanagawa Prefecture. Notably, 80% of the catchment area of these rivers lies in Yamanashi and Shizuoka prefectures. 70% of the total catchment forests for Sagami River and Sakawa River are privately owned and deteriorated due to various constraints on forestry which has resulted in depletion of water sources. In our case, some of the settlements were chosen for the study which lie in the catchment area of Pench River. Natural resources are depleting drastically framing similar conditions in the region due to excessive deforestation, water and agriculture exploitation.

Kanagawa Prefecture laid out a long-term plan for conserving and restoring the water sources, for adopting the Basic Policy for Kanagawa Water Source Environment Conservation and restoration (2005-2025). In line with this policy, a Five-Year Action Plan for Conservation and Restoration of Water Source Environment was introduced (in its third phase as of 2019). The Indian forest Act 1977 was introduced to protect the biodiversity from further depletion. Environment Protection Act and other plans further save water bodies and aqua systems but not much improvement have been seen and further due to Pench IV and construction of canals, water levels have dropped and now only 30% of water is left in the water systems for supply to the city. While in Kanagawa, policy consultations include stakeholder involvement wherein, the participating civil society organizations and local citizens are duly considered for decision making and complete transparency in project spending is maintained. Similarly, we propose to involve stakeholders from all levels and driving practical and effective solution to the problems, including bridging the urban-rural gap and aiming at holistic development of all the sectors. (Source: Urban-Rural Partnerships Report, Feb 2019)

2.5 Case of Nagpur Metropolitan Area, India

One specific feature of India's urbanization is its increasing metropolitan growth leading to an increase in the number and size of cities with more than a million population. Maharashtra has the highest level of urbanization in India at 42 percent as against the national average of 25.7 percent (Table1). Due to artificial engrafted urbanization, it has proved to be devastation for the people and agriculture (Bhonsle, 2010).

Table 1: Comparison of urbanization levels

Census Year	Maharashtra	India	Andhra Pradesh	Gujarat
1981	35.0	23.2	23.3	31.1
1991	38.7	25.5	26.9	34.5
2001	42.4	27.8	27.1	37.4

Source: ITPI 2010, Kirti D. Bhonsle

Nagpur is one of the major cities in Central India, most urbanized district of Vidarbha region which is currently emerging as the largest trading center for certain goods and services with excellent connectivity offering an opportunity to enhance its economic significance. The network of highways connects Nagpur with other important Indian cities in the north, south, east and west. The Central Railway and the South Eastern Railway network also intersect at Nagpur resulting in potential railway hub related activities for passengers and goods. Through development, along with its richness in natural resources, Nagpur serves as a major developmental hub in terms of infrastructure, industries, settlements, etc. This has resulted in population congestion in core areas, the emergence of high-rise buildings, indiscriminate invasion of greenery, haphazard and accelerated urban sprawl, disorderly development, etc. (Nagpur Improvement Trust, 2015).

In the recent period, state and central government offices have become the principal source of employment. Multimodal International Hub Airport at Nagpur (MIHAN) now houses heavy cargo ships from South East and Middle East Asia. Nagpur is also known as the educational hub housing oldest and renowned universities of the era. In terms of sector of employment, the percent of agricultural labor to total workers population is just 15.7 percent as per the 2001 census. Nagpur district is known for its soya bean, forest and mineral resources. Teakwood and grass were the main forest products. It has manganese ore and dolomite as the main depositions in the area. Fertile soils and network of canals of the Pench irrigation command area under Parshivani and Mauda tehsils are rich in agricultural productivity with two-three crops per annum. (Bhonsle, 2010).

3. CASE STUDY AREA-NAGPUR

Nagpur Metropolitan Area (NMA) comprises of areas outside and inside of Nagpur city. It includes 721 villages under 9 tehsils of the Nagpur District spreading across an area of 3,567 km2 with a population of 1.03 million, literacy rate of 86% (Figure 7). Compared to other similar sized cities in the Country the present migration rate is found to be relatively low (6-8%) (Sekhar P. 2017). Non-Agricultural Permissions granted in the past has resulted in conversion of large tracts of agricultural land into urban spaces. Protected and Reserved Forests (14 percent) includes – Pench National Park in the north and Bor Wildlife Sanctuary in the southwest. The growing pressures of urbanization pose a significant threat to this rich biodiversity of the area. (Nagpur Improvement Trust, 2015). (Figure 8).

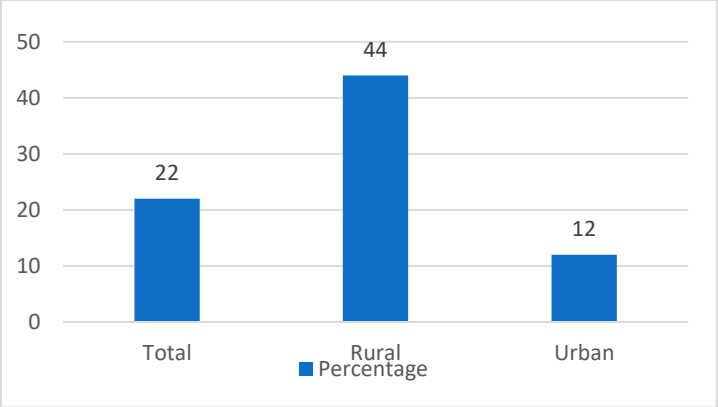


Figure 7: Urban-Rural Distribution in NMA (Source: NIT Draft Development Plan Report 2012-32)

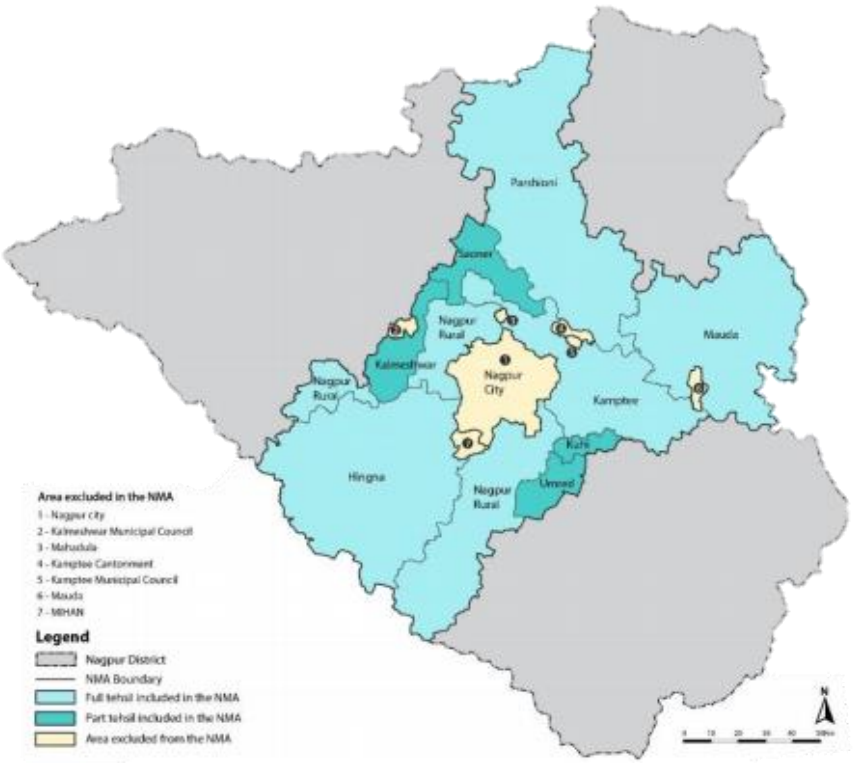


Figure 8: Extents of the NMA (Source: NIT Draft Development Plan Report 2012-32)

3.1 Nagpur Metropolitan Area

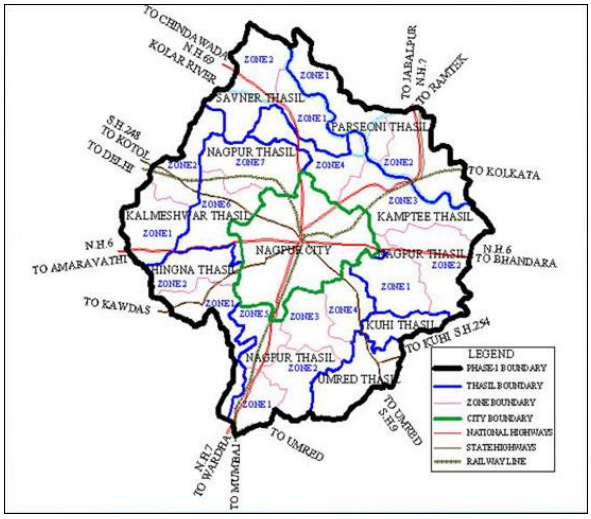


Figure 9: NMA Development plan Phase I (Source: NIT Draft Developmental Plan 2012-32)

Nagpur is the most important urban center in the district with all kinds of development concentrated, hence it is difficult to plan and organize the development magnet. National and State economic policies on the location of industrial and economic activities aid to the growth strategy of urban development. Some of the key growth drivers for NMA are MIHAN, logistics and warehousing industry availability of mineral and forest resources, tourism and skilled manpower availability (Bhonsle, 2010). Nagpur is being developed in different phases which vary in spatial scale (Figure 9, 10).

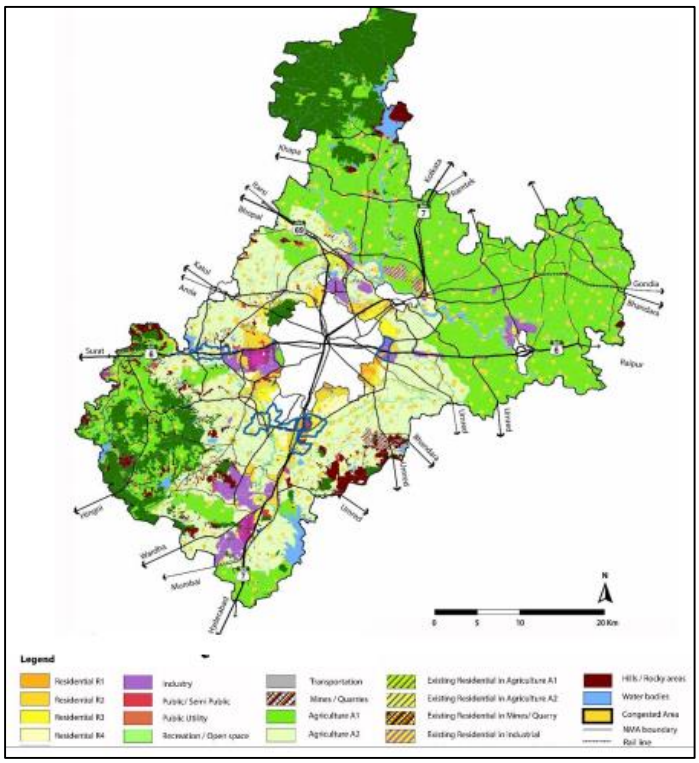


Figure 10: Development Phase I and II (Source: NIT Draft Developmental Plan 2012-32)

3.1.1 Urbanization in Nagpur Metropolitan Region

Area of Nagpur region/District is 9810 Sq km, proposed under Metro region which is 25-40 km around Nagpur Municipal limit extends to 3780 sq.km. and under NMC limits is 216 Sq. km. Phase I of development plan covers an area of 1520 sq.km. and Phase II is of 3780 sq.km.

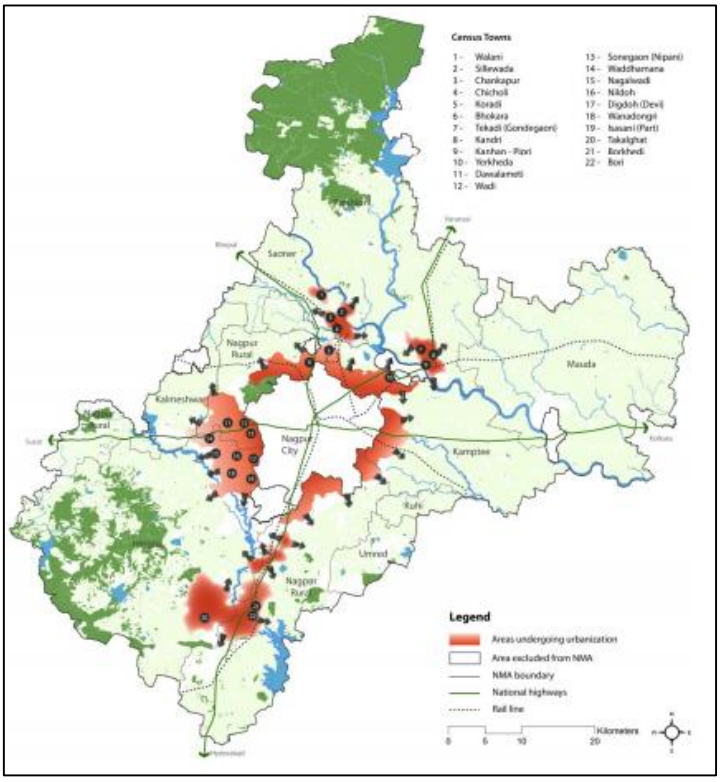


*Figure 11: Growing Urban areas in NMA (*Source: NIT Draft Developmental Plan Report 2012-32)

The growth direction in NMA (Figure 11) is greatly influenced by the employment hubs such as Hingna in the west and MIHAN and Butibori in the south. Potential areas for investment would be Steel Production, Paper and Pulp industry, Furniture, Education, Health Care, and Cotton textile (Nagpur Improvement Trust, 2015). Figure 12 shows the population trend in Nagpur from 1911 to 2011.

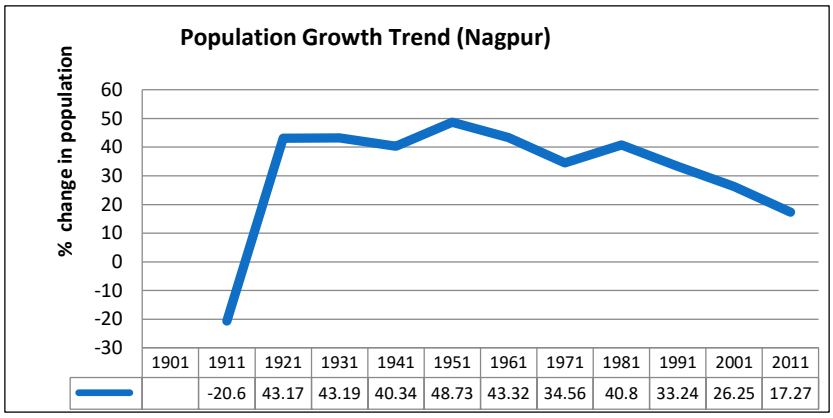


Figure 12: Population growth trend in Nagpur
(Source: Nagpur Metropolitan Area Draft Development Plan 2012-2032)

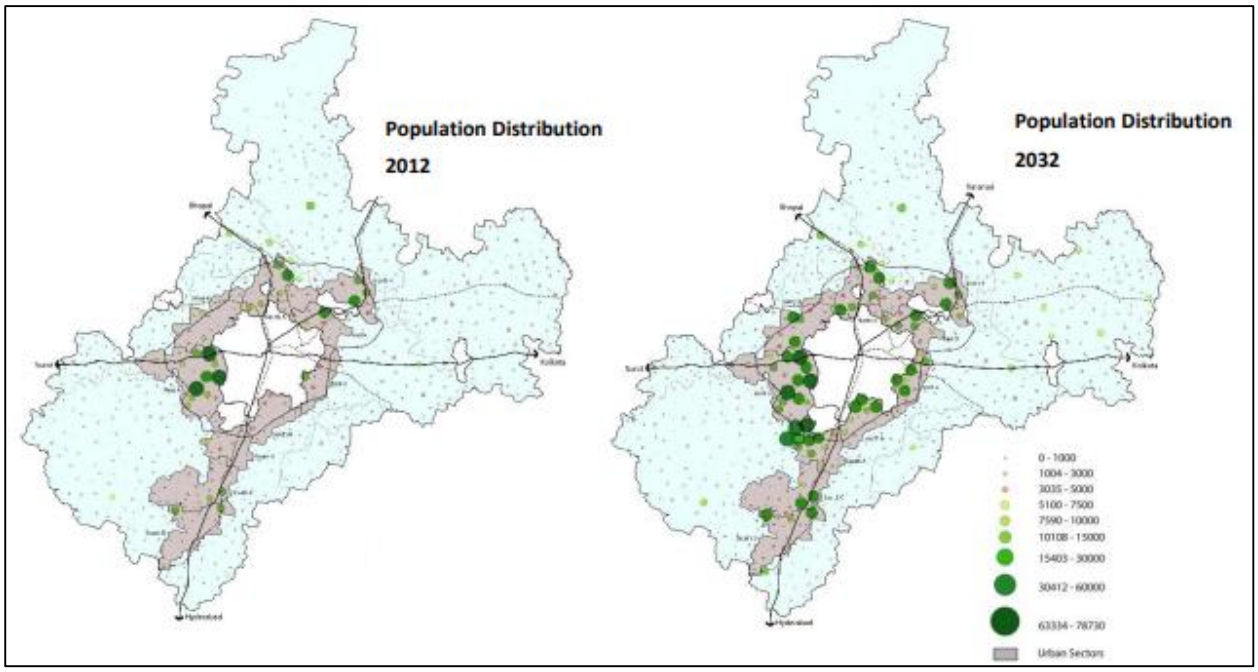


Figure 13: Estimated population growth at specific centers around Nagpur city
(Source: NIT Draft Development Plan Report 2012-32)

Due to the provision of employment, health care facilities, industries that are proposed, which would cater to all the basic requirements in specific growth centers around Nagpur, the population range is estimated as shown in figure 13. Such a development would also help reduce migration towards the urban area thereby reducing pressure on the urban infrastructure.

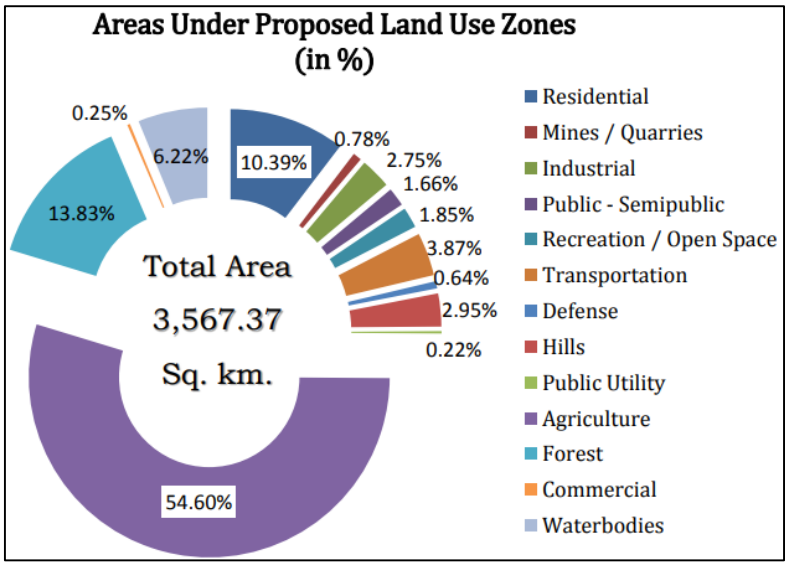


Figure 14: Proposed Land use pattern in the NMA
(Source: Presentation by Dr. P. Sekhar, Chairman Global Smart Cities Panel)

The proposed land use pattern is shown in figure 14. A major portion of land is retained for agricultural use, i.e., 54.6% of the total land, second highest being recreational and open spaces with 13.83%.

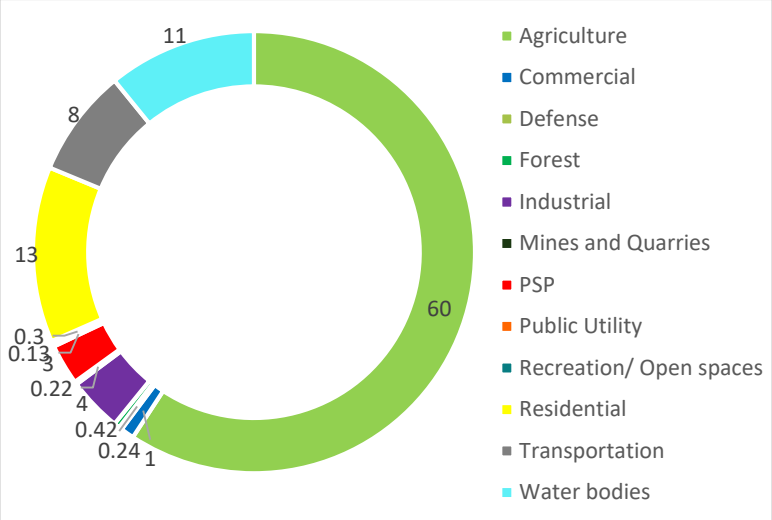


Figure 15: Land use pattern 1km buffer to NH69 North side
Source: NIT Draft Developmental Plan 2012-32

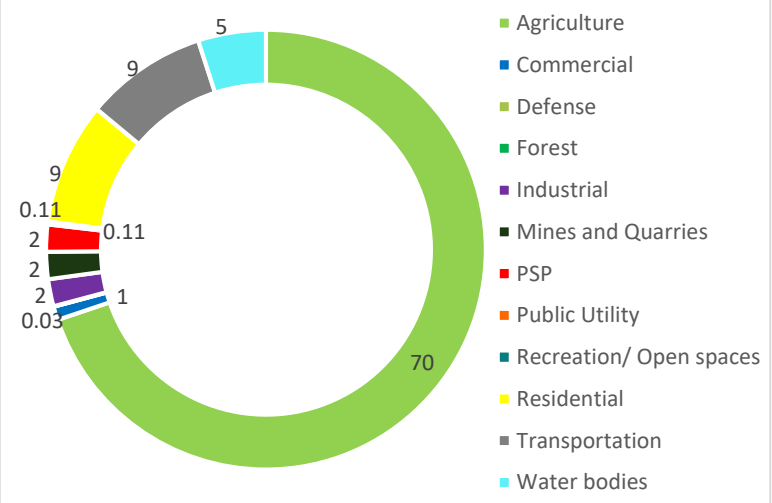


Figure 16: Land use pattern 1km buffer to NH7 North side
Source: NIT Draft Developmental Plan 2012-32

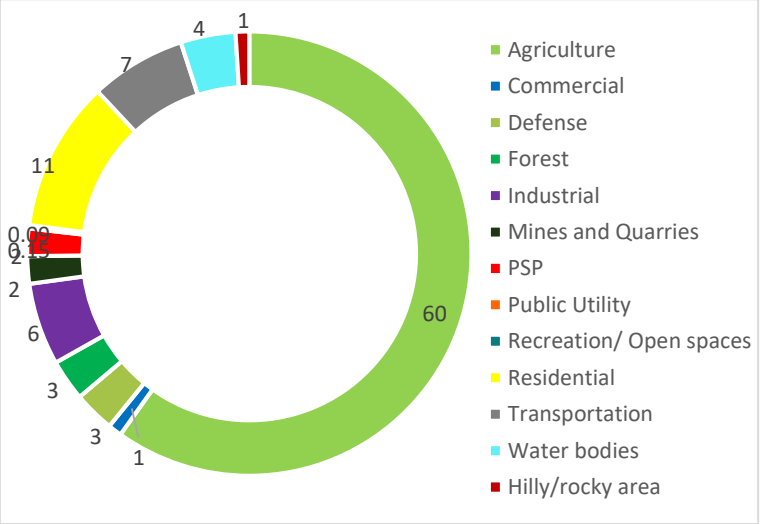


Figure 17: Land use pattern 5km buffer around Nagpur City
Source: NIT Draft Developmental Plan 2012-32

The study areas in peri-urban region ranges from 1-5 km from Nagpur city. The peri-urban areas are the ones which are the most neglected and the most vulnerable to disaster and least resilient areas. From the above figures 15, 16 and 17, it can be inferred that agricultural land ranges from 60-70% which can generate a great stakeholder partnership opportunity to improve the resource management and livelihood options but inadequate institutional support is leading to inefficient management and making the situation worse. There is a decline in agriculture observed due to climate change and farmers shifting to non-agriculture-based livelihoods offered by the city, and the agriculture lands are being converted into layout to make profits and thereby the land values are increased. The remaining farmers practicing agriculture are earning very little income, some are even in debts, due to their dependency on rain water for cultivation.

The growth rate in the primary sector has seen a decline of -21% while the secondary and tertiary sector has 53% & 23% respectively. The total growth rate was 23% in 2009. By 2032, due to the formation of Rural Centers, major growth in the population would be in surrounding areas of Nagpur (Nagpur Improvement Trust, 2015). Figure 18 shows the percentage of sectorial employment practiced in Nagpur Metropolitan Area.

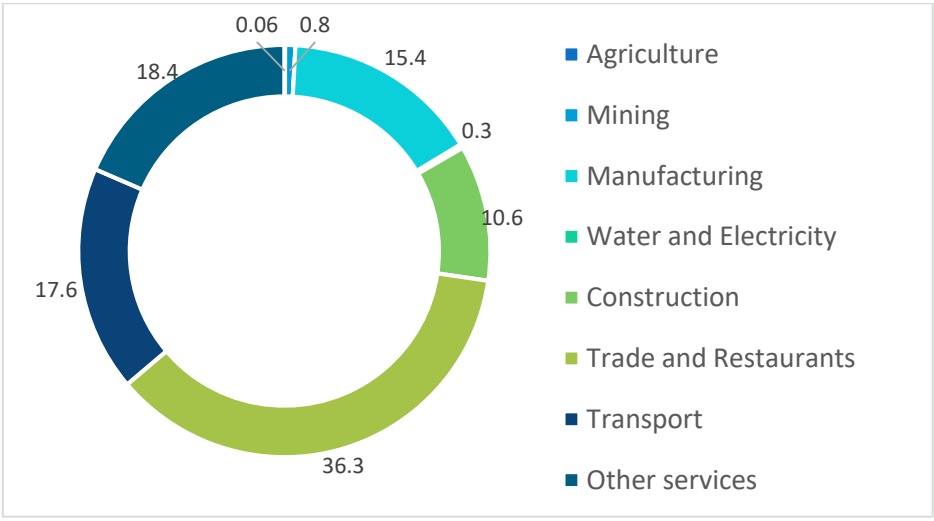


Figure 18: Sectorial Employment in the NMA (Source: NMC, City Developmental Plan

3.1.2 Objectives of Metropolitan Region Planning

The objectives of NMA is to lay wide roads and bring in sustainable development with balance in urban redevelopment along urban expansion; Identify the hierarchy of Highways & Roadways along with existing roads and enhance transport system, land use and infrastructure; Bringing global standards for common facilities like education, health & social facilities; Sustenance of vitality and viability of city and town centers by assessment of environmental impact of development and achieving a low-carbon footprint; Inclusion and planning of rural and other marginalized areas, also safeguarding natural and heritage resources (Figure 19) (Nagpur Improvement Trust, 2015).

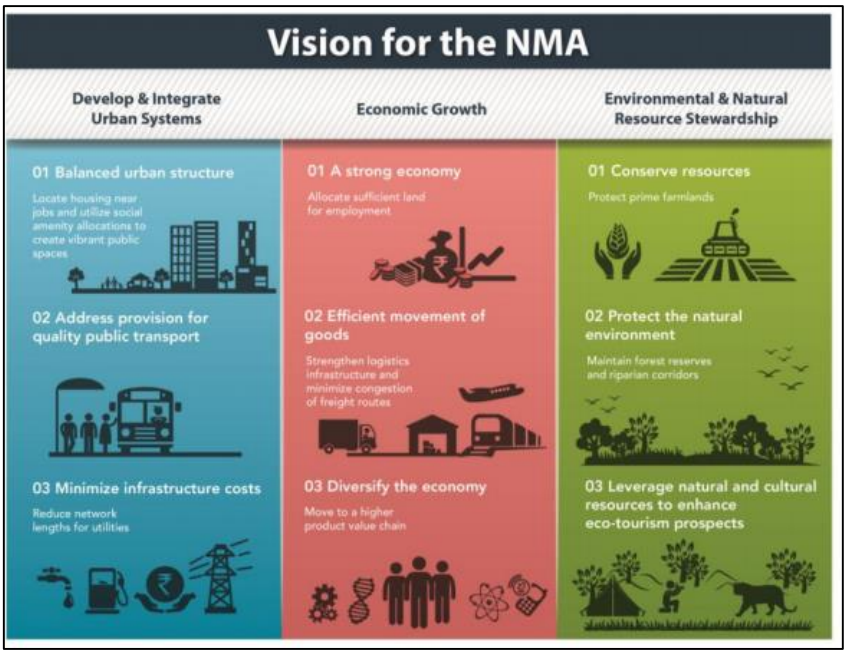


Figure 19: Goals of NMA Planning (Source: NIT Draft Development Plan 2012-32)

3.1.3 Geomorphology

The NMA region has an average elevation between 350 m and 260 m above sea level. The NMA has two parts - the west of Nagpur city occupied by the Deccan trap formation and the east of Nagpur city occupied by the metamorphic and crystalline series. Black cotton soils dominate in the NMA it is generally due to the presence of organic matter and iron, alumina, lime, magnesium, potash, phosphorus and nitrogen. This black cotton soil determines to a large extent the nature of the agriculture or cropping pattern in the area (Nagpur Improvement Trust, 2015).

Land within the NMA is very fertile and vital resource for farming and agriculture. Pench and Kanhan River usually serve for almost 2-3 type of crops per year. Over 65 percent of land in the NMA undergoes farming activities and a large proportion of farmland in the northeastern part fall under irrigation command areas. The non-urbanized areas under NMA are to be protected or else reversing from the sprawled areas to fertile land would not be possible. Rainwater harvesting and recycled water supply for industrial areas and thermal power plants are also planned to be implemented (Nagpur Improvement Trust, 2015).

Due to the rapid conversion of wilderness areas, farming land, greenway buffers into urban spaces or residential layouts is leading to depletion of natural resources. Gunthewari Act is one of the mediums through which this is done. It is leading to reduction in open spaces and natural resources. Due to increase in urban sprawl and hardscapes, water percolation and green cover has reduced greatly. The spaces for agriculture, forests have decreased which is directly impacting the ground water levels and agricultural productivity. Stakeholder partnership can be introduced on such level to check upon the conversion of land its impact on environment.

3.1.4 Climatology

The climate of the NMA is dry and tropical and experience summer, south-west monsoon, post-monsoon and winter are observed in the region. May is the hottest month of the year with maximum being 43 Celsius in Nagpur. On an average, 1200mm of rainfall is received in the NMA. Due to its placement on the equatorial belt, NMA has a lot of potential to tap solar energy and use it as an alternative source of energy. From the air quality analysis by Maharashtra Pollution Control Board (MPCB) the levels of SO2 and NOX are well below the National Ambient Air Quality Standards (NAAQS) at all the monitoring locations, 2013 (Nagpur Improvement Trust, 2015).

3.1.5 Water Resource

Main source of water in the NMA region is surface water. All the areas receive water through canals, lakes, dams, rivers (Figure 20). The groundwater recharge in the NMA region is low and in spite of excellent natural drainage pattern, some areas are susceptible to waterlogging during heavy rains (Nagpur Improvement Trust, 2015).

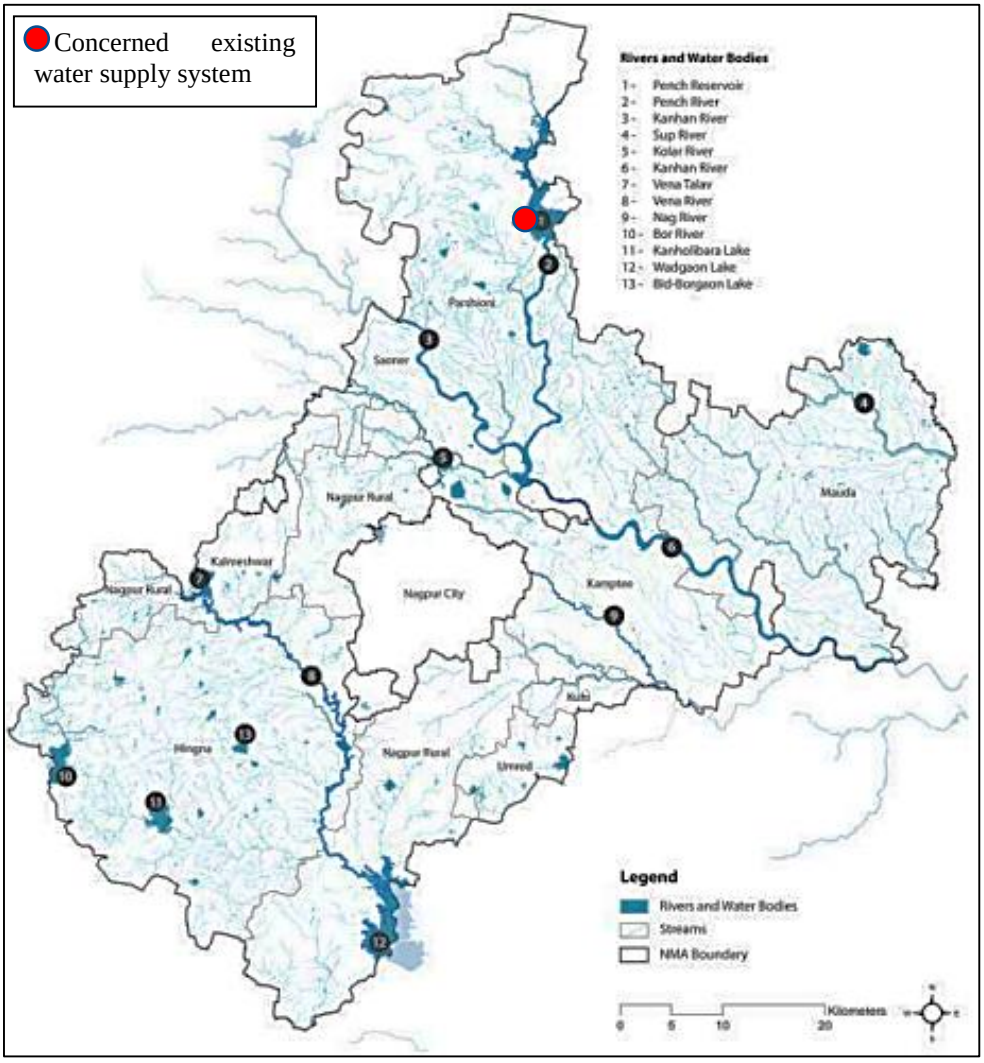


Figure 20: Surface water sources of NMA
(Source: NIT Draft Development Plan 2012-32)

The water levels in the area range from 400m below ground level (BGL) in the north to 250m BGL in the east (Figure 21). The groundwater flow direction in the entire area is towards the east with 1041.89 MCM as the net annual groundwater availability which is used for domestic as well as irrigation purpose. Area to the north of Nagpur city has augmented water from the River Pench and River Kanhan. Yield capacity in the NMA is about 1 to 5 liters/sec (Nagpur Improvement Trust, 2015)..

Six tehsils of the NMA i.e. Hingna, Mauda, Umred, Kalmeshwar, Kuhi, and Kamptee, have medium to high yield potential and, Parshioni and Saoner tehsils have low to high yield potential (Figure 19). The BOD concentration in all the rivers is greater than 4mg/l depicting organic matter water contamination, making it unfit for drinking purpose. Due to direct mixing of untreated wastewater of cities/towns located along these rivers through local drains, the coliform level is very high. The overall water quality in Parshivani tehsil is good but nitrate content is high. Water quality at Kamptee tehsil was poor due to high levels of fluoride and nitrate. In Saoner tehsil, water quality ranged from good to poor due to the presence of TH, mg, nitrate. Excessive nitrate, fluoride, Mg in the water could be due to intensive agriculture, un-sewer or irrigation of land by sewage effluents, excessive application of lime and other chemicals in agricultural areas (Nagpur Improvement Trust, 2015).

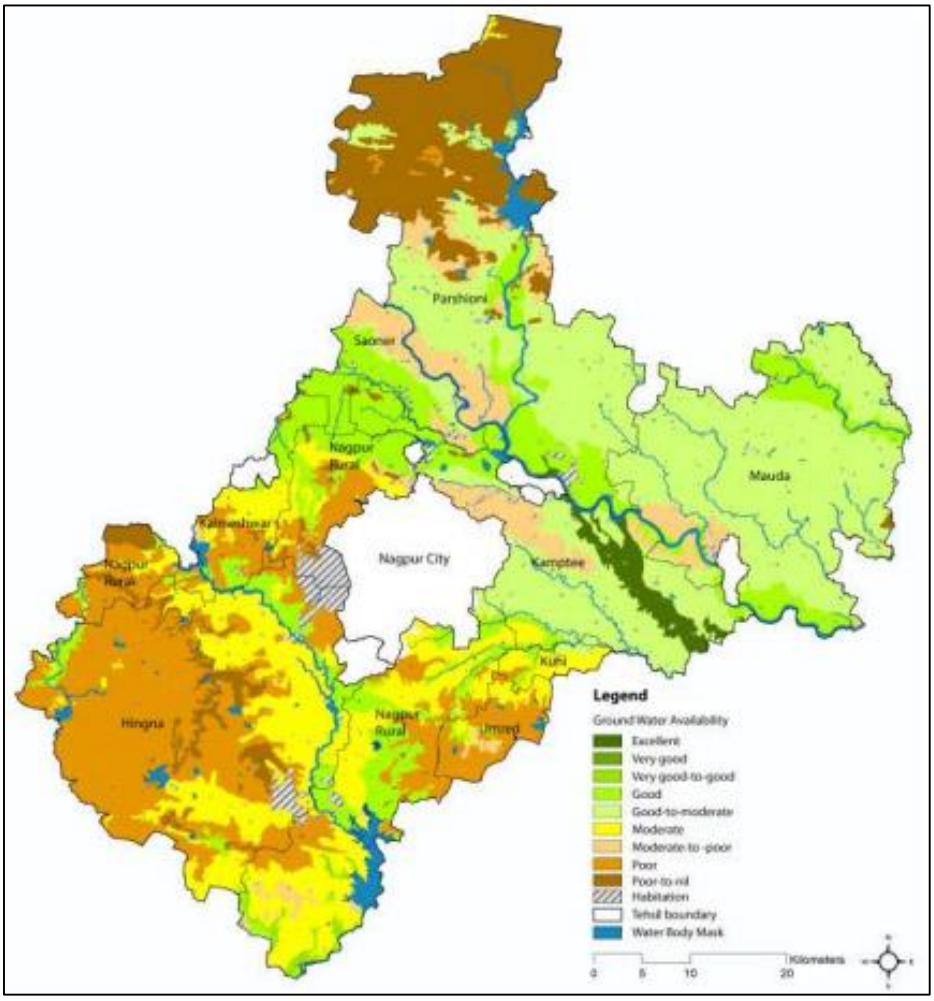


Figure 21: Ground water availability in the NMA (Source: NIT draft Development Plan 2012-32)

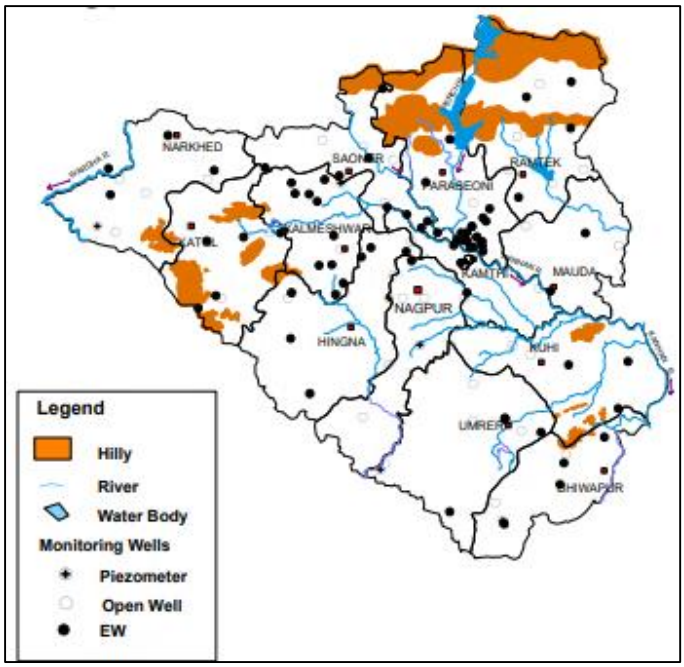


Figure 22: Topography Details of the NMA (Source: CGWB Ground Water Information 2013)

The topographical features of the NMA is shown in Fig. 22. Settlements located at higher levels had less access to water because of difficulty in tapping water at higher terrains as the water supply systems provided in the region is gravity driven which does not pump water to higher levels.

Based on the type and source of supply, the NMA region is categorized into three main categories: urban areas including municipal corporations and municipal councils/ Nagar parishad outside NMA (here lakes, reservoirs, rivers (surface water) serve water), rural village settlements (here tube wells, hand pumps, and bore wells supply water through agencies like ZP, MJP, GSDA) and agricultural lands (Table 2). Area irrigated by groundwater is 914.68 km2 (73% of the irrigated area) whereas surface water accounts for 241.74 km2 of area (Manzar, A. et al. 2013).

Table 2: Ground water availability

Tehsil	Wells			Depth (mbgl)	SWL*(mbgl)	Discharge (lps)	Draw-Down (m)	Zones (mbgl)
	EW	OW	PZ					
Parshivini	17	4	2	27.5-199.64	4.05-19.6	0.08-7.76	-	6.0-163.05
Hingana	2	3	-	85.4-234.8	14.68-27.65	0.5-21.33	-	-
Nagpur (Rural)	2	-	1	76.59-159.45	24.15	1.37-2.64	-	7.0-75.0
Mauda	2	1	-	174.5-187.25	1.0	1.37-4.43	25.06-42.58	34.75-147.65
Kamptee	6	3	-	29.93-202.45	4.53-16.45	1.37-8.85	-	11.0-140.4
Saoner	8	17	1	43.0-307	2.30-29.05	0.38-14.40	8.05-31.06	5.25-14.2
Kamleshwar	9	4	-	79.3-278	4.55-16.45	1.37-8.85	-	5.25-140.2
Umred	2	-	2	67.5-200	3.64-5.07	0.01-2.16	-	24.0-122
Kuhi	4	3	-	36.5-200	-	-	-	5.0-99.75
Total	52	35	6	27.5-307	1.0-29.05	0.01-21.33	5.6-42.58	5.0-163.05

Source: NIT Draft Developmental Plan 2012-32

Wells are dug 6.5 to 307 m below ground level (mbgl) across Nagpur district and ranges from 27.5-307 mbgl within the tehsils of the NMA. 0.01 and 38.5 liters per second (lps) is the quantity of discharge across Nagpur district and 0.01 and 21.33 lps within the NMA. 1041.89 million cubic meters (mcm) is net annual ground water availability in Nagpur District, the annual draft is 452.95 mcm. (Manzar, A. et al. 2013). North / West / South / Central part of Nagpur city is served by Pench project and WTP at Gorewada. North / Central part of Nagpur city with water supply Pench & Kanhan.

Figure: Community taps and R.O. water plants for drinking water at Bhilgaon and Khairy

Table 3: Water Project details in the study areas

Name of the Scheme	Availabl e water (total live storage)	Allocation of water for			Remarks
		Drinking / Non-irrigation uses	Industria l uses	Irrigation uses	
	mcm	Mcm	mcm	mcm	
Pench Project (Navegaon Kheri dam and Totla dam, constructed on Pench River) Full Water Levels (FWL): Totla dam- 490m Navegaon kheri dam- 325m Minimun Water Levels (MWL): Totla dam- 464m Navegaon kheri dam- 314m	1,328.00	168.00	76.00	961.00	Water allocated for NMC from RBC at Mahadula: 1. 122mcm permanent allocation 2. 78 mcm after paying to irrigation department about Rs. 100 crore Total allocation from Pench project is 190 mcm against 160 mcm planned non-irrigation water. Further there would be no surplus water in pench project for future allocation to NMC/NIT.
Kanhan intake works (at Kamptee)	Pumping				65.71 mcm (180mld) allocated for NMC area and 4.38 mcm (12mld) allocated for Kamptee municipal council.
Savangi Project: FWL - 319.25m MWL - 311.50m		4.976	1.171	-	Water is yet to be allocated

Source: NIT Draft Development Plan 2012-32

Water level rise varies from 4m to 7.5m. 1,041.89 mcm water is available for the annual extraction and other purposes. Total surface water runoff from Nagpur district is 4039 mcm, out of which about 984 mcm can be utilized for irrigation by construction of dams, canal systems and lift irrigation systems. The 7 existing projects are providing water for the NMA which are Pench project, Lower Vena River Project, Kanholi Project, Upper Vena River project, Wakeshwar Dam, Kanhan intake works, Vishvasariya Barrage from which our study areas fall under Pench project and Kanhan intake works. (Nagpur Improvement Trust, 2015).

Pench Water Projects were introduced for the supply of water to NMA (Table 3). Phase I of the project drew 113.5 MLD quantity of water from Pench right bank canal (PRBC) by gravity, which was then pumped to Mahadula and finally to Seminary hills, Gittikhadan, Sitabuldi. Phase II of the project constructed a small canal from PRBC to supply 136 MLD water and then pumped it to Seminary hills G.S.R. along with the construction of 2 Elevated Storage Reservoir at Jaripatka and Sharda rolling mill. Pench III-Phase I drew 100 MLD of water from the PRBC along with the construction of sewage treatment plant. Total of 630 MLD water was supplied which was divided into two parts of 315 MLD each. Pench IV consisted of area 217.56 sq.m. water was supplied from pench and kanhan of 521 MLD and 151 MLD. Pure water demand in the NMC in 2011 was 777.81 MLD, outside NMC limits was 102.49 MLD, at MIHAN it was 107.5 MLD whereas pure water demand at the Water Treatment Plant by 2031 would be 1185.83 MLD. (Nagpur Improvement Trust, 2015).

Jamghat Project has been proposed on Kanhan River in Madhya Pradesh. It would provide about 10.00 TMC (353 mcm/970 mld) fresh water to Maharashtra if commissioned which would be the ultimate freshwater serving more than half of NMA. (Manzar, A. et al. 2013).Other Few proposed surface water projects are - Kochi Barrage, Rehari Barrage, Lakhma pur Irrigation project on local nallah, Salai (Mokasa), Makardhokara project, Akoli Barrage, Savangi Project, Nirgandi project, Vena Feeder, Jamghat Project from which savangi project, akoli barrage falls under our area of study. Akoli Barrage has been planned to tap water from Nag River (untreated sewage) from Nagpur city. (Manzar, A. et al. 2013). About 50 mcm (140 mld) of water can be made available for the region for irrigation as well as domestic purposes by treating the water up to the desired standards. (Table 4 and Table 5) After the completion of proposed schemes, the area that can be brought under irrigation is 2.68 lakh hectare from surface water resources which is covered by Wardha and Wainganga basins. (Manzar, A. et al. 2013).

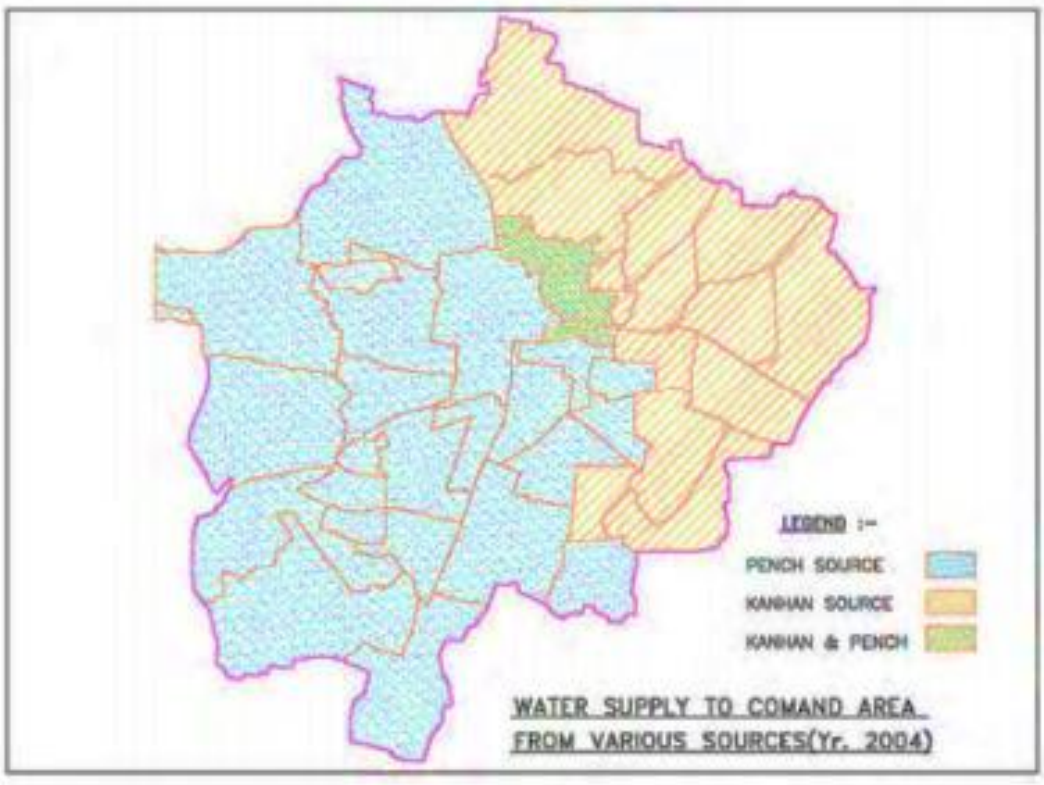


Figure 23: Water Supply source in different wards of Nagpur city (Source: NIT Draft Development Plan 2012-32)

Table 4: Water sources for NMC

Sl. No	Sources	Quantity allocated		Actual withdrawal	
		mcm	mcm	mcm	mcm
1	Kanhan intake work at Kamptee	65.71*	180.00	65.71*	180.00
2	Pench project (PRBC) from Mahadula	112.00 (permanent allocations)	306.88	174.29*	477.50
		78.00 To be produced by NMC	213.72		
3	Gorewada lake	5.80	16.00	6.80	19.00
	Total	261.51	716.6	246.80	676.50

Source: NIT Draft Development Plan 2012-32

Table 5: Proposed Water Supply scheme for NMC

Sl. No.	Source	Year wise cumulative capacities (mld)		
		2011	2021	2031
1	Pench stage III Phase II (mld)	113	113	113
2	Rahari Barrage 30 kms from Nagpur city	-	175	350 (128mcm)
3	Kochi Barrage, 33 kms from Nagpur city	-	108	108
	Total	113	396	571

Source: NIT Draft Development Plan 2012-32

Rain Water Harvesting provisions are made on the level of NMC for area greater than 150 sq.m of a plot. (Nagpur Improvement Trust, 2015).

Location: Parshivini, Ghoti

Total wastewater generation in the Nagpur area under NMC ranges from 345 MLD to 600 MLD. Only one waste management plant of 100 MLD has been installed by NMC from which only 40% of the waste generated is treated and the rest flows into nallahs and rivers which pollutes the water severely and make it unfit for irrigation purposes. Septic tanks have been installed at certain locations and but the sewage water from the remaining parts directly flows into open drains and nallahs (Nagpur Improvement Trust, 2015). Table 6 shows the capacity of present water treatment facility in NMC.

Sl. No.	Name of water Works	Supply (mld)	Capacities of water treatment plants
Surface Source			
1	Old Gorewada WW	16	16
2	Kanhan WW	170*	240*
3	Pench Phase - I	136	136
4	Pench Phase - II	140	133
5	Pench Phase – III, Stage-I	120	118
	Total	582	643
* After modification of kanhan water works 170 mld (120+50), capacity of WTP has been increased to 240 mld			

Table 6: Present treated wastewater supply from NMC
(Source: NIT Draft Development Plan 2012-32)

To sustain water resource, water recycling and recharging is an essential process. Lack of public awareness and mixing of grey water with black water leads to waster wastage. Coal mines and other mining activities also lead to depletion of fresh water available by discharging untreated polluted wastewater directly into the rivers. Water can also be saved by facilitating storm water drainage systems. Through primary survey, it is found that due to excessive mining activities from WCL not only the water but also other natural resources were getting depleted near Gondegaon and Warada areas. The wastewater generated through mining activities is disposed off into Kanhan River making the water highly polluted.

Figure: Water stored for domestic purpose in rural households. (Palora, Pipriya.)

A JNNURM grant has also been granted to NMC for water audit, leak detection study, water loss study, maintenance through 24 x 7 water supply program. It was piloted in DharamPeth and believed to provide uninterrupted water connection at desired pressure with improved billing systems. (Nagpur Improvement Trust, 2015). But according to our survey, 24 x 7 water supply resulted in more wastage of water and in the summer season they failed to provide 24 x 7 water supply.

Table 7: Minor Medium Major Water projects comparison of Nagpur from last year

Projects	Percentage of live storage w.r.t. Designed live storage(last year)	Today's (Mcum)
Major	10.67%	5.64%
Medium	14.87%	8.23%
Minor	11.41%	6.74%
Totladoh	7.21%	0.01%
Kamthi Khairy	35.36%	24.37%

Source: https://d3suziiw6thyiv.cloudfront.net/reports/storage-comparison/standard/pdf/view?MenuID=1317

The current supply of water has reduced by more than half compared to last year (Table 7). This is due to the increase in impervious construction which prevents groundwater recharge and excessive water wastage through surface runoff.

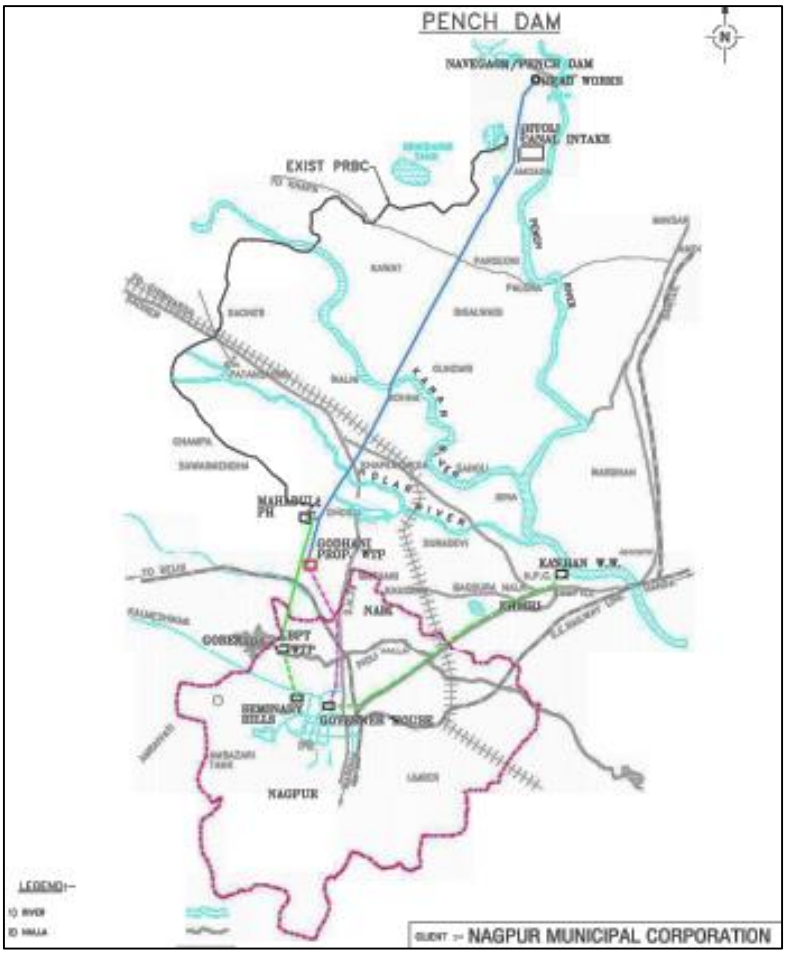


Figure 24: Map of water supply from Pench to Nagpur city (Source: Water DPR report NMC)

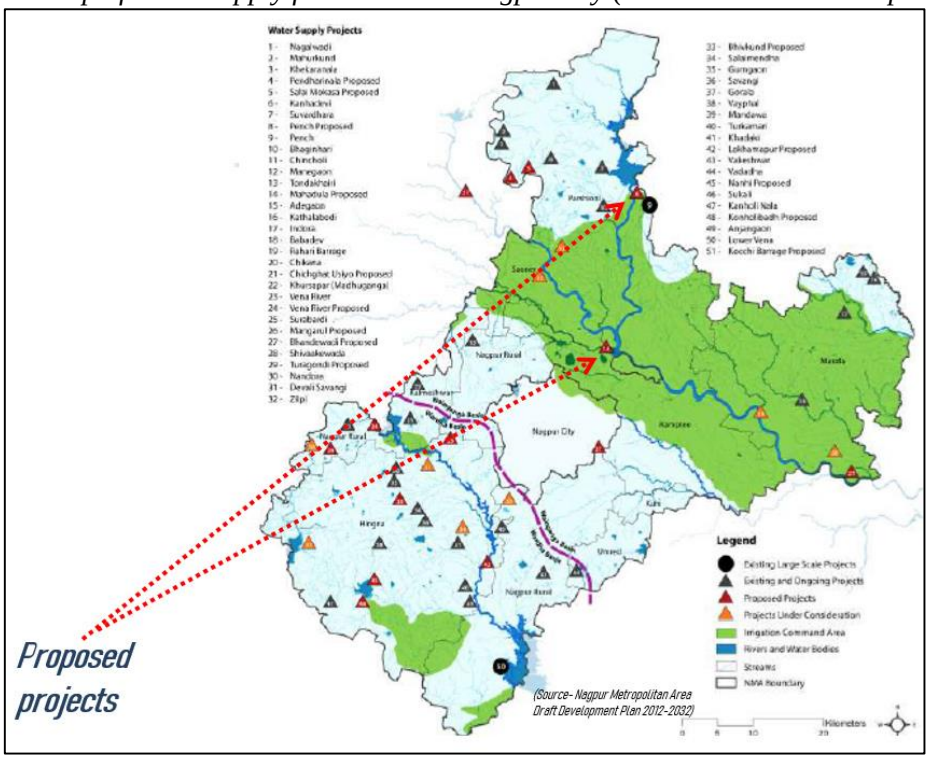


Figure 25: Location of existing and potential water supply projects (Source: Water DPR report NMC)

3.1.6 Agriculture

Most of the cultivated land in NMA is un-irrigated area dependent on monsoon rainfall (Nayakund). The major crops grown in the NMA area are paddy, jowar, cotton, and wheat. Pulses and oilseeds are also grown in NMA. Mostly orange cultivation dominates among the plantations giving Nagpur an identity as Orange city. Figure 26 shows the cropping pattern (Nagpur Improvement Trust, 2015).

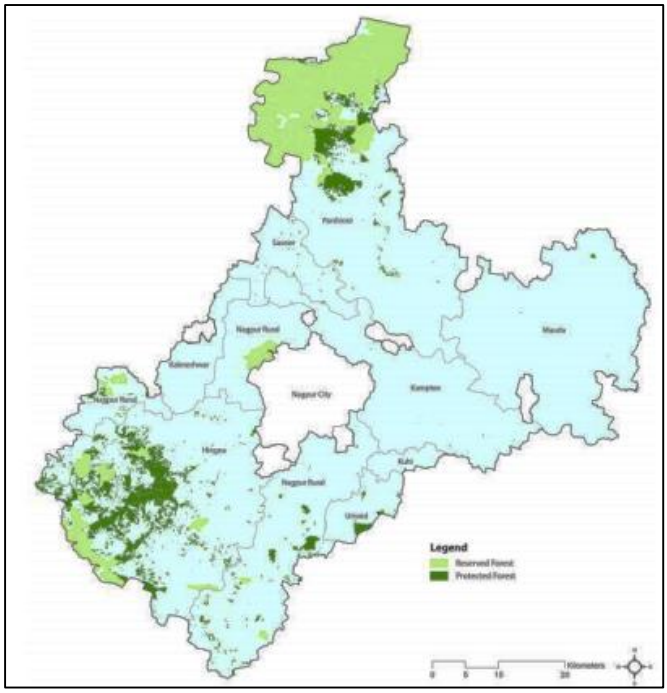


Figure 26: Cropping Pattern in NMA (Source: NIT Draft Development Plan 2012-32)

The NMA has large reserves of fertile land that has the potential to provide increased agricultural development. If this potential is unrecognized, the conversion of agricultural land into non agriculture development land will be continued and a valuable, non-renewable resource will be irrevocably lost (Nagpur Improvement Trust, 2015).

Some of the crops grown in the NMA are highly beneficial for the farmers and soil as well, as they use less water, makes the soil fertile and being seasonal there is a scope for crop rotation and grow more no. of crops per annum. Crops like cotton, toor, and soybean have proved to be beneficial. Some of the farmers harvest cotton, wheat and food crops in crop rotation up to 2-3 times a year. Figure 25 shows the cropping pattern followed in NMA. Since the major portion of the agricultural land in the area is rainfed, it is important to develop a model for crops for maximum output with minimum input yearning profits. If a partnership is laid to provide proper water supply along with canals and water management systems then this model can be successful.

3.1.7 Forest Areas

About 14.5 percent of the NMA is covered by Forest land, type of forests in NMA belongs to southern tropical dry deciduous classification. NMA has tourism potential as it shares boundaries with major national parks, tiger reserves, and sanctuaries as important tourism products however it has yet to capitalize on these strengths. (Nagpur Improvement Trust, 2015).

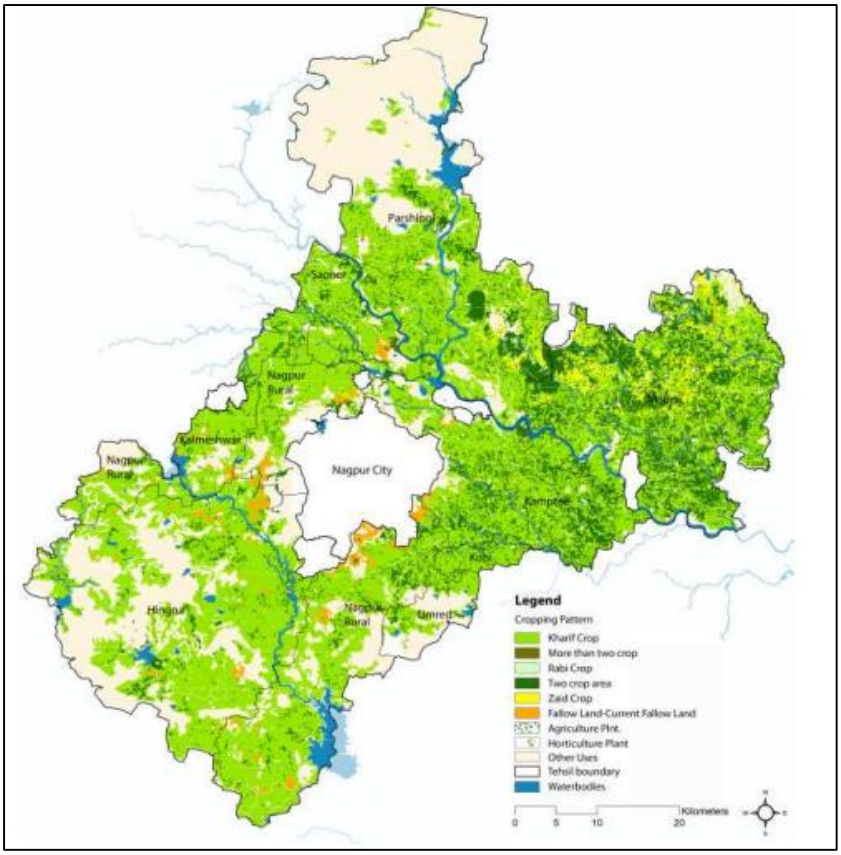


Figure 27: Type of Forest- Reserved and Protected
Source: NIT Draft Development Plan 2012-32

NMA has a varied type of forest patches within its limits which can prove to be very beneficial if used effectively. Figure 27 shows the extent of Reserved and Protected type of forest patch in the region. The communities around these forests used to entirely depend on the forest areas for their livelihood but under the guidelines of Pench National Park Act, 1977, they have been cut off entirely and denied the permission from using forest resource by any means. The act was introduced to save the depleting forest and restore them back to their original state. Collection of firewood and tendu leaves, cattle grazing and food resources from the forest was the basis for the local community livelihood but due to the sudden cut off from their prime source of sustenance, they had to shift from forest activities to agriculture, those who had land, others to daily wage laborer or migrated to rural villages. This has proved to be a population decline and, in some cases, have worsened the situation. Though they have been provided with some schemes such as Pradhan Mantri Awas Yojana, Pradhan Mantri Ujjwala Yojana, Van Hakka Kayda 2006 (sarkariyojana.com. 2018). which have helped them but have made

them more dependent and vulnerable. In case, if any natural disaster hits, they would be greatly affected and would not be able to recover unless an external aid is provided. On introduction of a partnership to make them less dependent on the external forces and making them sustain their livelihoods on their own, they can be turned towards resilient communities.

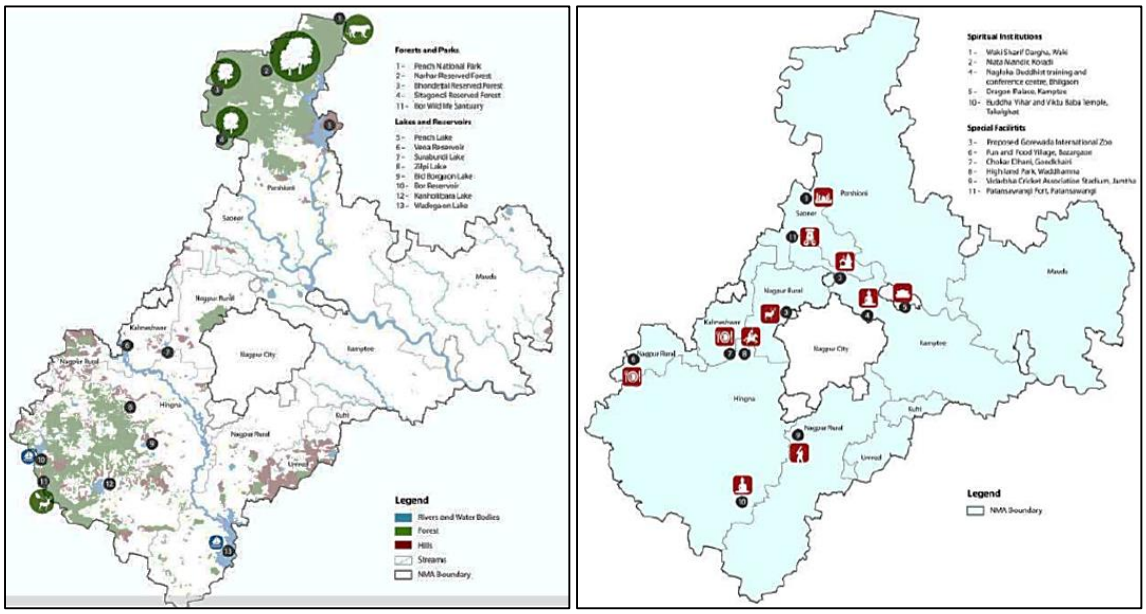


Figure 28: Major Natural Features attractions within the NMA
Source: NIT Draft Development Plan 2012-32

There are a number of Natural features that attract tourist towards this region (Figure 28) which the Forest Department has identified and developed further. In this line, there are initiatives taken to provide employment to the local community in tourism sector. They have arrangements of pickup and drop facility to their home on a daily basis and provide them with a reasonable amount of salary to sustain. This has made the community dependent on the forest department and gradually losing the knowledge of indigenous and traditional techniques of forest conservation which is no longer practiced by the community due to the restriction posed by the law. To sustain these systems, a model can be introduced to provide the community with some provisions where they are allowed to carry out their traditional livelihood and conserve the forest resources.

Figure: Tendu leaves trading taken up seasonally by the rural and forest community (Bakhari, Gorewada)

3.1.8 Key Disaster Concerns

Building materials and technology promotion council (BMTPC) has placed Nagpur under Zone II, categorized as low damage risk zone/low hazard zone. As per earthquake disaster management and control action plan of Nagpur (1993), Wainganga and Wardha river basins have been identified as prone to geo-seismic activities like river channel migration, floods, fissuring falling under two regions IA and 1B respectively. No major seismic activities have been recorded in Nagpur region baring few minor tremors ranging from 4 - 6.5 on Richter scale. Land use regulations and zoning bye laws are put into practice pertaining to urban areas. Nagpur metropolitan region is extremely prone to floods during monsoon, especially in the northern region around Kanhan and Pench river basins. Seven major instances of flooding have been recorded so far over the past 50 years tolling heavy infrastructure loss and casualties. Catchment area of rivers Wardha, Kanhan, Pench Rivers are prone to floods during monsoon caused by heavy rainfall in the Satpura ranges. Non perennial streams termed as "Nalas" are usually vulnerable to flash floods. Kanhan and Pench rivers in NMA region are vulnerable to heavy floods once in 10 years. Saoner, Parshivanii, Kamptee and Mauda tehsils fall under sensitive regions affected by floods in Kanhan and Pench rivers. (Nagpur Improvement Trust, 2015).

Nagpur is also prone to severe droughts resulting from scanty rainfall and shrinking groundwater levels over the past few years. Government has declared 151 tehsils as drought affected scaling from moderate to extreme intensity. Amongst noted tehsils in Nagpur district, Katol and Kalmeshwar tehsils are considered extremely hit by drought. The agricultural productivity in these droughts hit areas has fallen below 50%, which marks the severity of the situation. Most of the minor and major dams reeling at 5-10% lower water levels than usual levels worsen the situation adding to the drinking and irrigation water woes. Nagpur district's vulnerability to drought conditions, calls for watershed management measures and other relief measures to aid the affected areas. Subsidized agricultural facilities like electricity, micro irrigation facilities etc. and processes like pruning, canopy management etc. should be looked upon to control the severity of impact from droughts. Scaling down to the selected places of study, the inter-relation between socio-ecological factors majorly are seismicity, droughts, floods as natural factors, others being governmental acts in case of forest areas, reservation of forests, privatization, bureaucracies, lack of administrative/governmental help, nature-based livelihoods.

Location: Pipriya, M.H.

4. METHODOLOGY

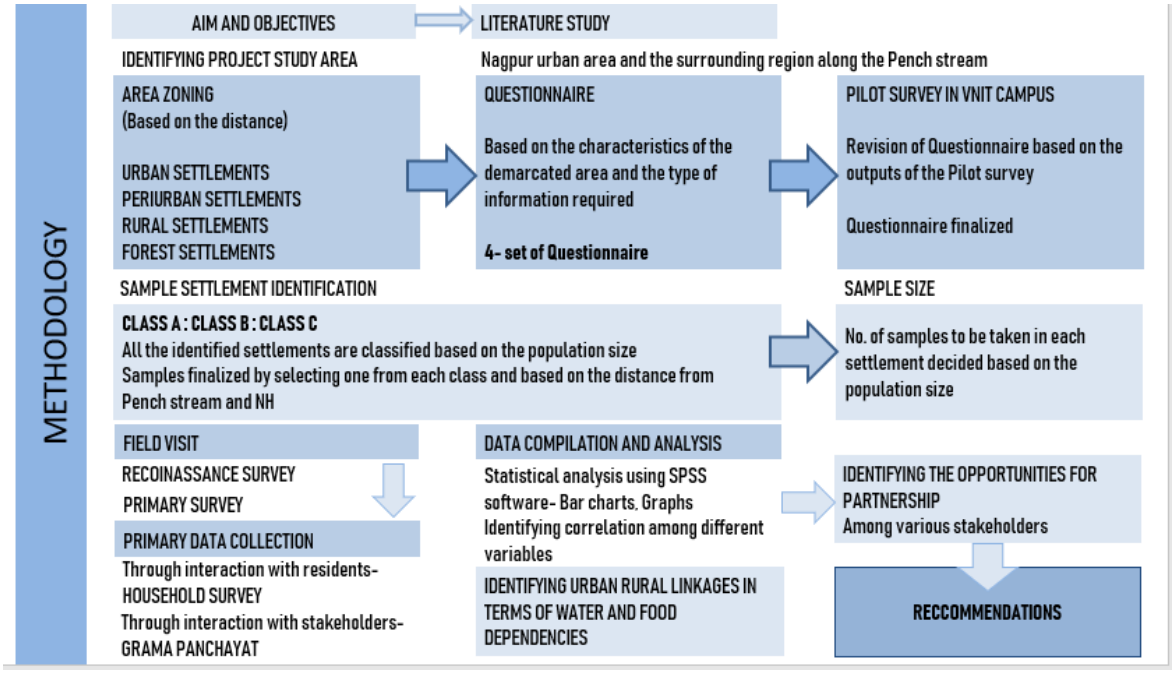


Figure 29: Research Methodology

The project was initiated with an aim to achieve sustainable resource management in Nagpur city and Metropolitan Region under the concept of Regional Circular and Ecological Sphere. The objectives for the project were defined and literature study was carried out to understand RCES concept and the urban rural linkage pattern and secondary data were collected. The study area for the project was identified in Nagpur city and its surrounding region along the Pench stream. The identified area was delineated into four zones, i.e., urban, peri-urban, rural, and forest areas and settlements within these zones were identified considering various factors. Based on the characteristics of the demarcated area and the type of information to be collected, the questionnaire for urban rural and forest areas were formulated. Peri urban areas have a combination of both urban and rural characteristics and hence a combination of urban and rural questionnaire formats were used. To check the effectiveness of the questionnaire a pilot survey was conducted in VNIT campus and the results were analyzed, according to the outputs obtained the questionnaire were revised and finalized (Figure 29).

The settlements in each zone were classified into three based on their population size and shortlisted based on their distance from Pench water stream and distance from National Highways. The final list of settlements to be surveyed was prepared by selecting a number of settlements to achieve the total number of samples in every zone and selecting at least one from each class. Sample size for each settlement was decided based on their population size. The primary data collection involved field visit to every settlement selected and interaction with local communities there through household surveys and interaction with the village administration, i.e., Gram Panchayat. Data regarding water source, supply and usage, community livelihood, agriculture pattern and the interdependency between urban

and rural areas for market and recreation purpose were collected. Statistical analysis of the collected data was done using SPSS software, charts and graphs were prepared to identify the correlation among different variables. Based on the analysis the existing linkages were identifies and opportunity for future partnerships were identified. A stakeholder consultation workshop was organized involving various stakeholders where opportunities for urban rural partnership for sustainable resource management was discussed. The inputs given by the stakeholders were analyzed and possible partnership avenues were identified and recommendations are drawn.

4.1 Selection of Settlements

4.1.1 Primary Data collection

The survey area covers the settlements around the Pench stream connecting Totladoh reservoir to Nagpur city. The study area was divided into 4 zones as per the distance from the city center and zoning of settlements was done (Figure 30). Nagpur city limits comes under the first zone classified as urban settlement, the second zone lies in the range of 10km from the city limits where peri-urban settlements are identified, the next 20km range from the second zone contains rural settlements and the next 30km range from the third zone which is nearby the Totladoh reservoir is zoned as forest settlements. Within the zones defined a total number of fifty-four settlements were identified along the Pench water stream within a maximum distance of 12km from the stream. The identified settlements have varying demographic characteristics and they are further classified based on their population size.

4.1.2 Sample Selection

Based on the population and number of households, settlements in these zones were classified into 3 classes and the range of population in each class were defined (Table. 8). In forest settlements the range of population for class A was more than 1000 (A >1,000); for class B was in between 500 to 1000 (500<B<1,000); and for C was less than 500 (C<500). In Rural settlements the range of population for class A was more than 2,000 (A>2,000); for class B was in between 500 to 2,000 (500<B<2000); and for C was less than 500 (C<500). In Peri-urban settlements which had dominating rural characteristics, the range of population for class A was more than 5,000 (A>5,000); for class B was in between 1,000 to 5,000 (1,000<B<5,000); and for class C was less than 1000 (C<1,000). For Nagpur city areas, the range of population for class A was more than 20,000 (A>20,000); for class B was in between 10,000 to 20,000 (10,000<B<20,000); and for class C was less than 10,000 (C<10,000).

Table 8: Population range for Classification of Settlements

Settlements	Class A	Class B	Class C
Forest settlements	A>1000	500< B <1000	C<500
Rural settlements	A>2000	500< B <2000	C<500
Peri-urban settlements	A>5000	1000< B <5000	C<1000
Urban settlements	A>20000	10000< B <20000	C<10000

Source: Author

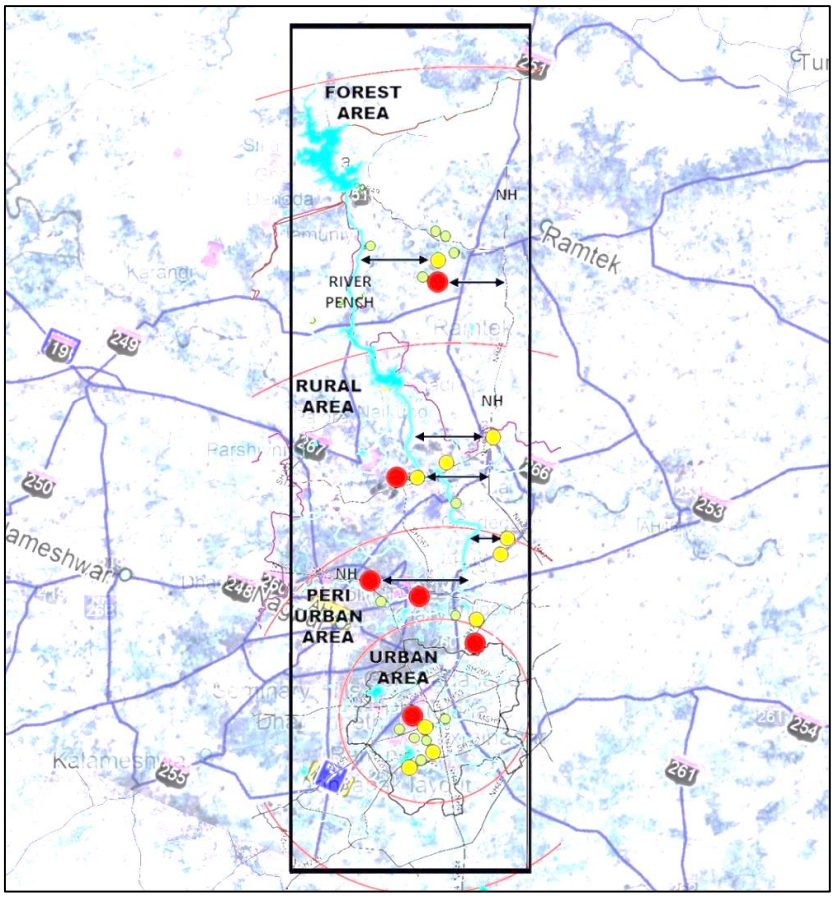


Figure 30: Selected settlements for study (Source: Author)

4.1.3 Survey Area Finalization

The settlements were further segregated based on their proximity to the water source and from the National Highways. The settlements in each zone were finalized considering their proximity to the water source (Pench River) selecting at least one from each population class

Figure: Interaction with local community and collection of water samples. (Gondegaon, Dahoda)

Dahoda, Ghoti, Sillari, Salai, Kirangi Sarra, Jamuniya, and Pipriya settlements in forest area, Parshivini, Palora, Amadi, Nayakund and Bakhari in Rural area, Dahegaon, Nanda, Chicholi, Kawtha, Khairy, Bhilgaon, Warada and Gondegaon in Peri-urban area were finalized as the sample set for each zone.In

Nagpur city, areas were selected based on three different criteria, first is the water supply source being either Pench reservoir or Gorewada reservoir, second is the scheme of 24X7 water supply and third being the areas near two major lakes of Nagpur city, Ambazari and Futala lakes. Accordingly, Dharampeth, Laxmi Nagar, Manish nagar, Gayatri nagar, Sitabuldi, Futala, Gorewada, Pardi, Adhyapak Layout, Ambazari, Ram Nagar, Shankar Nagar wards were finalized as the sample set for Urban areas.

4.1.4 Sample size

The total sample size for the project was 530 including all the four zones. As per the classification, the selected settlements fall under the classes given in Table 9, Class A settlements having larger population were assigned to higher sample size and Class C settlements having smaller population were assigned the least sample size. According to the class of settlement the number of samples to be taken in each settlement were finalized. In Forest area, a total of 85 samples collected from 6 settlements; in rural areas, a total of 100 samples were collected from 6 settlements; in Peri urban areas, a total of 145 samples were collected from 5 settlements and in urban areas a total of 200 samples were collected from 11 wards through random sampling method.

Table 9: Sample size for each settlement (Source: Author)

S.No.	Settlement	Population	Class	Sample size
Forest settlements				
1	Dahoda	1317	A	25
2	Ghoti	824	B	20
3	Sillari	454	C	10
4	Kirangi	201	C	10
5	Jamuniya	243	C	10
6	Pipriya	818	C	10
	Total			85
Rural settlements				
1	Parshvini	11156	A	25
2	Palora	1837	B	20
3	Amadi	1594	B	20
4	Naikund	1994	B	20
5	Bakhari	792	C	15
	Total			100
Peri-urban settlements				
1	Dahegaon	5193	A	25
2	Nanda	856	C	12
3	Chicholi	18469	A	25
4	Kawtha	622	C	12
5	Khairy	1679	B	16
6	Bhilgaon	5030	A	25
7	Warada	1350	B	15
8	Gondegaon	3737	B	15
	Total			145
Urban settlements				
1	Dharampeth	12211	C	15
2	Shankar nagar	12708	C	15
3	Seminary hills	19835	B	20
4	Sitabuldi	12957	C	15
5	Ramnagar	15979	B	20
6	Adhyapak layout	21257	B	20
7	Gayatri nagar	15255	B	20
8	Laxminagar	1894	C	15
9	Gorewada	36763	A	30
10	Phutala	14654	C	15
11	Ambazari	12282	C	15
	Total			200
	Grand Total			530

5. ANALYSIS AND RESULTS

From the primary survey of 30 urban, peri-urban, rural, forest settlements, primary data was collected regarding urban-rural linkage parameters such as water, migration patterns etc. which would ultimately help in finding out avenues of potential stakeholder partnership and help develop a model for a sustainable and resilient future.

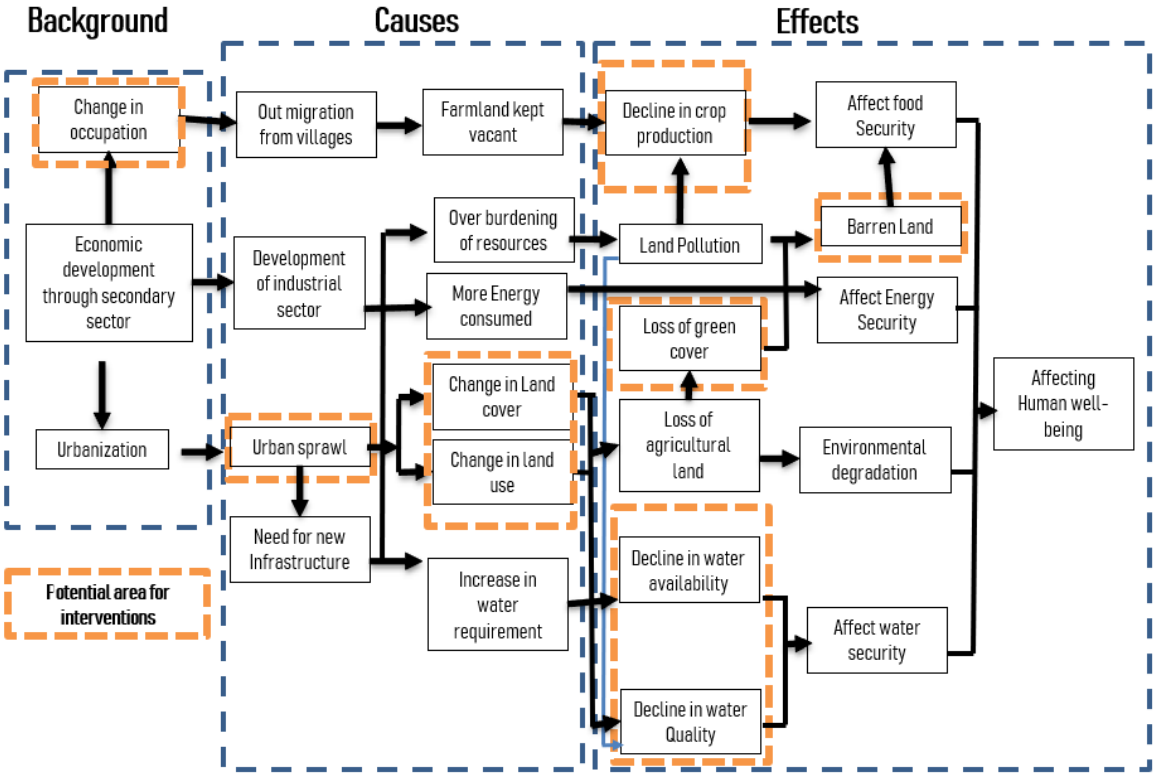


Figure 31: Trends of Urbanization in our study areas (Source: Author)

It is found through the primary survey that due to out-migration from villages and shift in livelihood the farm lands are left unused and gradually fertile lands are becoming barren producing less yield which eventually pose a threat to food security of the region. If an intervention is introduced to drive people to continue the agricultural practices then the communities can be made resilient. Economic development through industrial sector (secondary sector) will increase the energy demand and ultimately degrades the environment in meeting the demands. This type of intervention in providing employment to local community is not a sustainable way. Instead, works need to be done in reversing the situation by improving the productivity of the land, support the primary sector to flourish and make the local communities self-sustainable and there by resilient. A model can be framed by understanding the background of the region, causes and effects of migration and the ultimate result on urban and rural areas (Figure 31). If a partnership is introduced to maintain the water quality and quantity to enhance the green cover and develop the urban sprawl into resilient communities then it would frame in to a sustainable development.

From the Fig. 32, it can be seen that the flow of water is from upstream, higher elevation forest areas to downstream, rural and urban areas; the geomorphology of the selected region widely varies which implies different types of settlements and geographical locations need different type of models and solutions specific to the physical features. Due to rapid construction in the peri-urban and outlying areas the built spaces have increased. It has grown from 12893.4 ha. to 23852.2 ha. almost increasing by 50%.

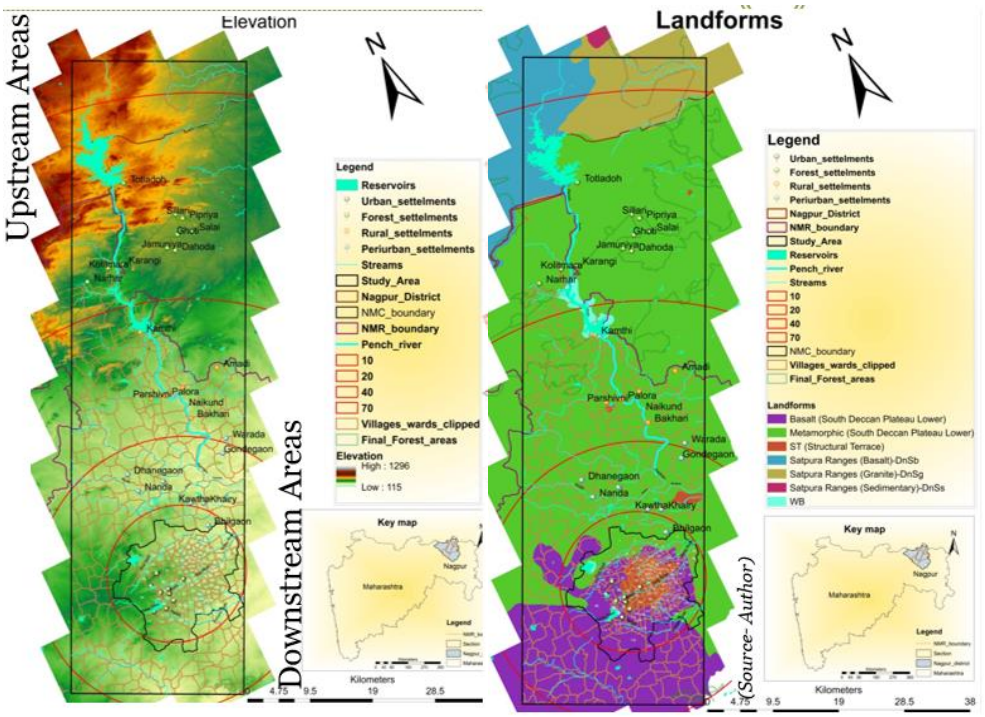


Figure 32; Elevation and Landforms in the study area (Source: Author)

Table 10: Population comparison 2008 and 2018

LULC Classification	2008 (Area in Ha.)	2018 (Area in Ha.)
Bare	89066.5	79109.3
Built	12893.4	23852.2
Water	4884.11	4361.98
Forest	66505	64836.1

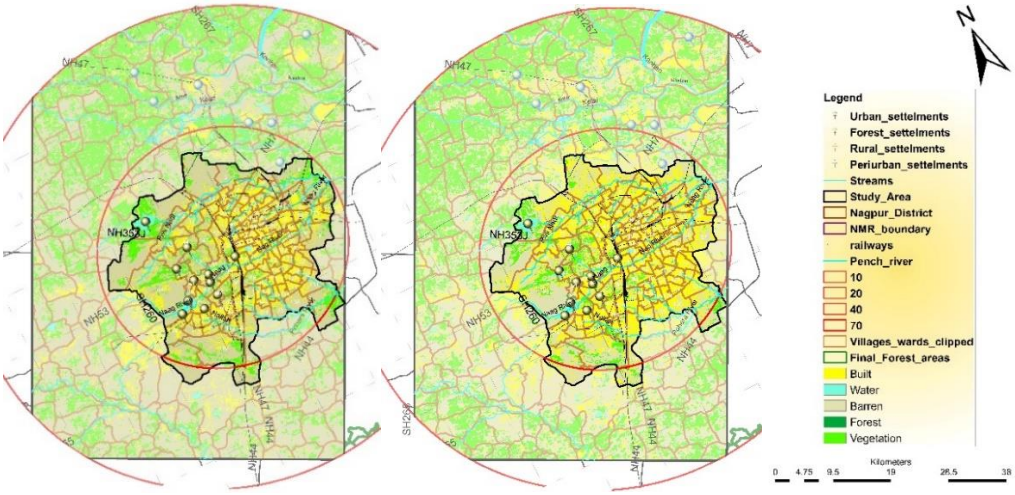


Figure 33: Land use/ cover comparison 2008 and 2018 (Source: Author)

Table 10, Fig 33 shows the increase in built up areas and decrease in bare, water and forest areas due to direct impact of occupied urban spaces. This is also one of the significant factors leading to unplanned settlements and growing vulnerability at the time of disaster.

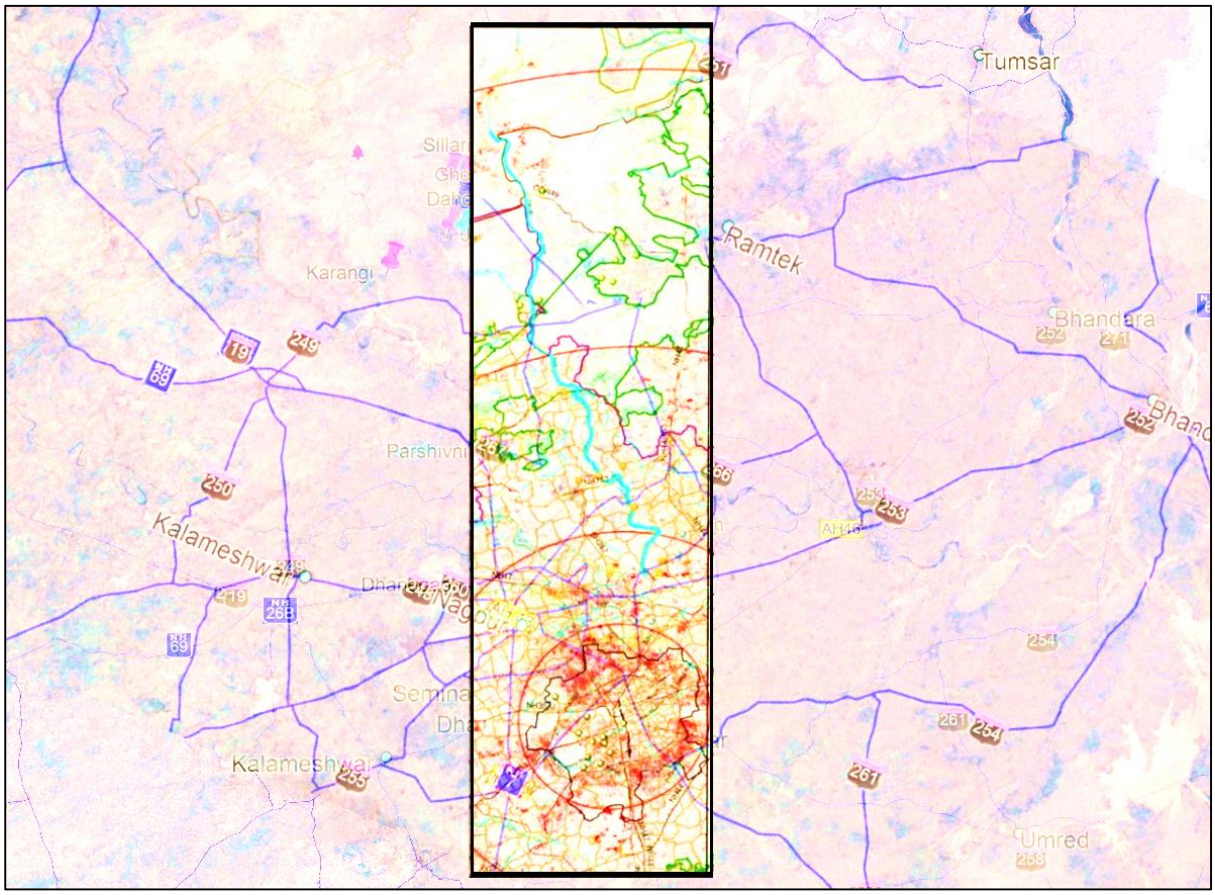


Figure 34: Change in land use and land cover from 2008 to 2018 (Source: Author)

Table 11: Irrigation Status of the study areas

Tehsils	No. of villages	Information of Canal Command			Information on the other Services Command			Total Area	
		Developed	Un-developed	Total	Developed Command	Un-developed Command	Total Area	Developed Command	Un-developed Command
Nagpur	31	8835	746	9581	44.84	46	90.84	8879.84	792
Kamptee	49	12696	0	12696	5444.8	6	5450.8	18140.8	6
Ramtek	51	16251	0	16251	50	76	126	16301	76
Parseoni	85	27070	0	27070	262.4	3	265.4	27332.4	3

Source: District Irrigation Plan, Nagpur

Irrigation status of the survey areas can be identified in Table 11, 12. Farmers having ponds at their own farmers were negligible, hence, the dependency on rain and other sources are high. Even the accessibility to groundwater was inadequate, few of them had wells but dried up during summer seasons. Area under irrigation became lesser and lesser as the ground water levels dropped and other resources dried up. The governmental schemes have not been implemented or the awareness about the same have not reached the farmers. Even after its implementations the situation has not improved.

Table 12: Surface Irrigation status

Tehsil	Source of Irrigation	Command Area through Surface Irrigation					Command Area through Ground Water			Water Extraction Devices		
		Canal Based		Tanks/Ponds/Reservoirs			Tube wells	Open wells	Bore wells	Electricity pumps	Diesel Pumps	Others
		Govt.	Community /Private	Community	Individual Private ponds	Govt. reservoir/ Dams		Govt.+ Private	Private			
Nagpur	No.	9	0	0	369	0	0	220+3187	596	4321	8	0
	Command Area	9120.6		0	169	0	0	125.84	0	0	0	0
Kamptee	No.	2	0	0	96	0	0	147+2945	411	1856	0	0
	Command Area	12759	0	0	96	0	0	0	0	0	0	0
Ramtek	No.	5	0	0	70	0	0	50+3120	458	1300	3	0
	Command Area	16251	0	0	70	0	0	-	0	0	0	0
Parseoni	No.	14	0	0	153	0	0	248+4773	395	5159	5	0
	Command Area	27070	0	0	153	0	0	836	0	0	0	0

Source: District Irrigation Plan, Nagpur

Table 13: Water use characteristics of settlements

	Settelments	Service provider by VP/ULB	Source- Gw	WTP	Mode of Water Supply				Metering	Rainfed irrigation	Single crops	Crop types
					Piped	Tanker	Open well	Handpump				
Peri-urban	Bhilgaon	100.0	100	Yes	47.6	19.0	33.3	28.6	0.0	-	-	-
	Chicholi	100.0	100	No	100.0	6.6	20.0	0.0	0.0	0.0	100.0	Cotton, Rice, Chana
	Dahegaon	100.0	100	Yes	88.5	3.8	19.2	3.8	0.0	23.1	15.4	Cotton, Rice, Chana, Vegetables
	Gondegaon	100.0	100	No	100.0	0.0	0.0	0.0	0.0	-	-	-
	Kawtha	100.0	100	Yes	100.0	0.0	14.3	7.1	0.0	35.0	64.0	Cotton, Rice, Chana
	Khairy	100.0	100	Yes	100.0	0.0	12.5	6.3	0.0	38.0	72.0	Cotton, Rice, Chana
	Nanda	100.0	100	No	100.0	0.0	0.0	0.0	0.0	27.3	9.0	Cotton, Rice, Chana, Vegetables
	Warada	0.0	100	No	0.0	0.0	72.2	27.8	0.0	66.6	72.2	Cotton, Rice, Chana
Rural	Bakhari	100.0	100	No	100.0	0.0	0.0	0.0	0.0	100.0	60.0	Cotton, Rice, Tur
	Amadi	100.0	100	Yes	100.0	0.0	0.0	0.0	0.0	55.5	44.0	Cotton, Rice, Tur, Wheat
	Nayakund	100.0	100	No	90.0	0.0	15.0	5.0	0.0	55.0	10.0	Cotton,Chana,Tur,Soy, Rice
	Palora	100.0	100	No	85.0	25.0	0.0	0.0	0.0	85.0	80.0	Cotton,Toor
	Parshivni	92.9	100	Yes	93.4	0.0	6.6	0.0	0.0	20.0	16.6	Cotton, Rice, Tur, Wheat
Forest	Dahoda	100.0	100	No	100.0	0.0	0.0	0.0	0.0	90.0	100.0	Cotton, Tur
	Ghoti	100.0	100	No	60.0	0.0	0.0	40.0	0.0	67.6	100.0	Cotton, Tur
	Jamuniya	100.0	100	No	80.0	0.0	0.0	20.0	0.0	84.6	100.0	Cotton, Tur
	Kirangi Sarra	100.0	100	No	90.0	0.0	0.0	10.0	0.0	100.0	85.0	Cotton, Tur
	Pipriya	100.0	100	No	86.6	0.0	0.0	13.4	0.0	93.3	100.0	Cotton, Tur
	Sallai	100.0	100	No	91.7	0.0	0.0	8.3	0.0	83.0	100.0	Cotton, Tur

Source: Author

Piped water supply is not available at Warada. All other settlements have only ground water supply and all the settlements were dependent on it. The rural villages had to pay an annual tax for the water supplied but there no accountability for the quantity of water supply and no metering systems installed. Mainly due to less infrastructure coverage agriculture was rain fed in Parshivani, Nanda and Khairy areas due to inadequate resources (Table 13).

The urban areas have irregular and interrupted water supply yet high water consumption pattern is observed due to lack of awareness among the lower and middle income groups regarding efficient water utilization.

In forest areas, due to the presence of high levels of nitrate and other minerals, the water quality average and poor at some places. Inadequate water supply system is a major problem in which the area at higher

altitudes do not get sufficient water supply whereas that is not the case in areas at lower altitudes since the supply system is gravity driven. For irrigation purposes, the resources to utilize groundwater is inadequate and the local communities are unaware of the techniques that could be implemented for better irrigation. At peak summer due to water shortage, they sell out their livestock as they don't have enough water to feed them resulting in decrease in milk production affecting their livelihood.

In peri urban and rural areas, drinking water quality was found to be average due to high mineral content. There was inadequate water distribution network and had no water treatment plants for recycling of water. The groundwater levels dropped day by day due to excessive mining activities. There were no adequate resources to utilize groundwater for irrigation purposes. The policies were implemented at lower rate and the awareness about the policies were very low. Water efficient fixtures or technologies are not implemented in full fledge by irrigation department. Due to these causes there is decreased water allocation for irrigation purposes leading to reduced agriculture production.

Before WCL

After WCL

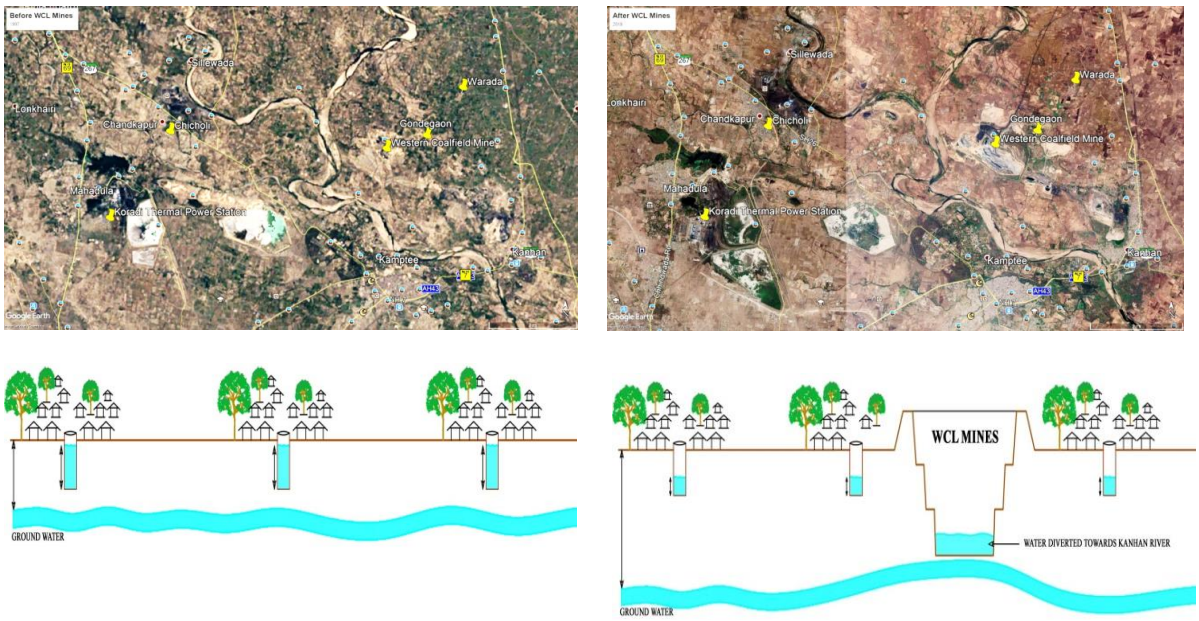


Figure 35: Comparison of water levels before and after WCL (Source: Secondary Data Survey)

WCL is seen as the major cause of water depletion in Warada and Gondegaon (Figure 35). All the settlements nearby are being exploited and water, air, noise pollution have risen beyond controllable measures. These activities lead to unsustainable practices and direct exploitation of natural resources and disturb the biodiversity, it has also caused severe deforestation and loss of groundwater. It falls under the secondary type of development which as seen in Fig 36 is not suitable type of development for the areas.

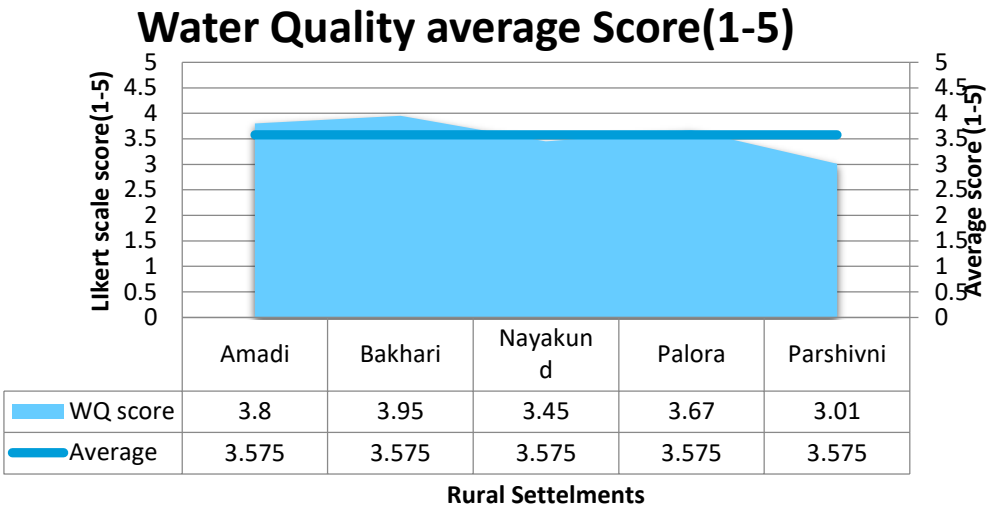


Figure 36: Water quality measure in rural settlements (Source: Primary survey)

Amadi, Bakhari, Nayakund, Palora, Parshivani settlements were surveyed in the rural areas. The people were asked to rate the quality of water, accordingly the water is found to be of average quality. Water sample was collected from some of the settlements. In Parshivani and Nayakund water quality is below average due to the presence of physicochemical contents and due to old water supply network, an intense treatment of water is a necessity before consumption (Figure 36).

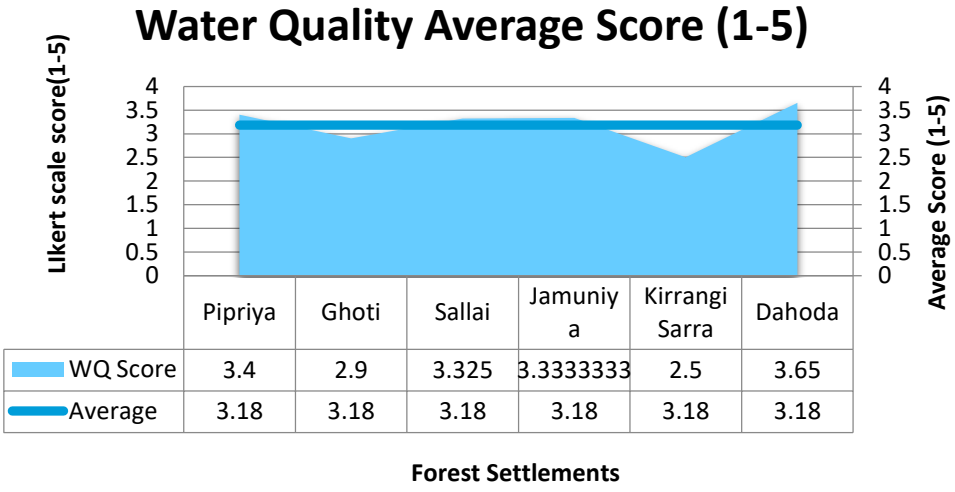


Figure 37: Water quality in Forest settlements (Source: Primary survey)

Pipriya, Ghoti, Sallai, Jamuniya, Kirrangi Sarra, Dahoda settlements were surveyed. When asked to rate the water quality, the people have rated it to be average and not satisfactory. In Ghoti and Kirrangi Sarra the water quality was below average and due to the presence of minerals the water had to be treated for making it potable and use for drinking purpose (Figure 37).

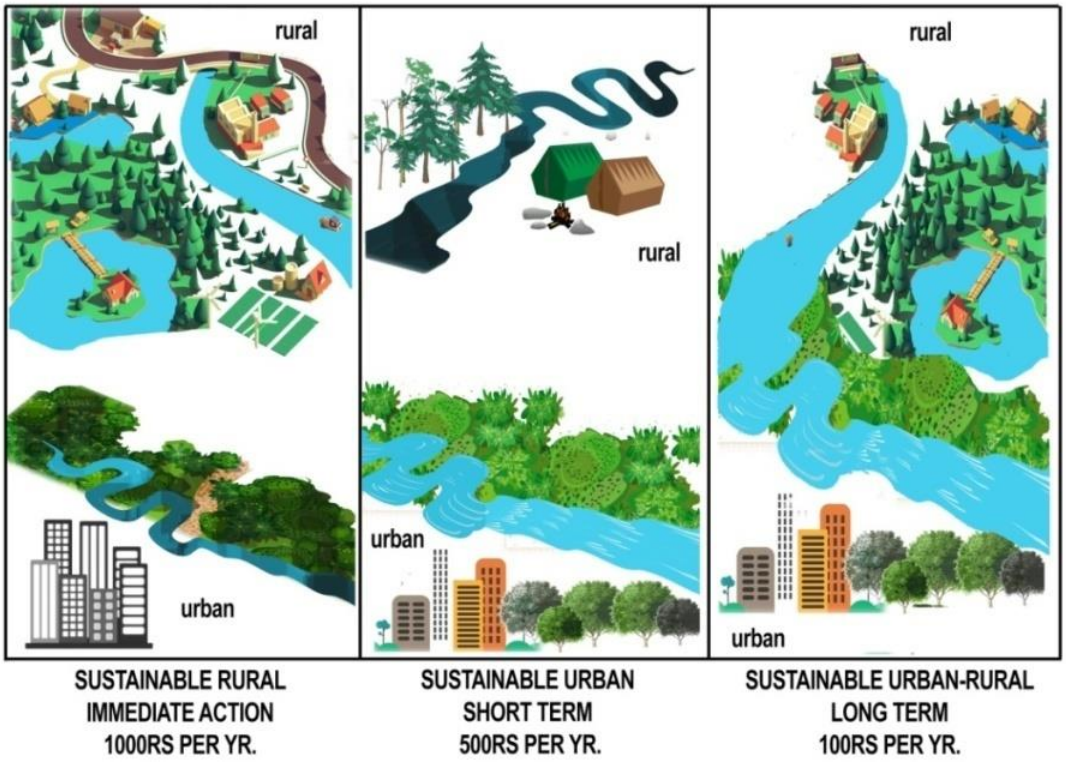


Figure 38: Sustainable Urban-Rural development (Source: Author)

In order to understand the public perception regarding the resource management and distribution over different regions, the respondents were given three options for development orientation, they are Sustainable Rural development, Sustainable Urban Development and Sustainable urban-rural development (Figure 38). 95% of the respondents wanted Sustainable Rural-Urban Development which would ensure sustainability of resources and there by the perception of public towards balanced development has been identified (Figure 39).

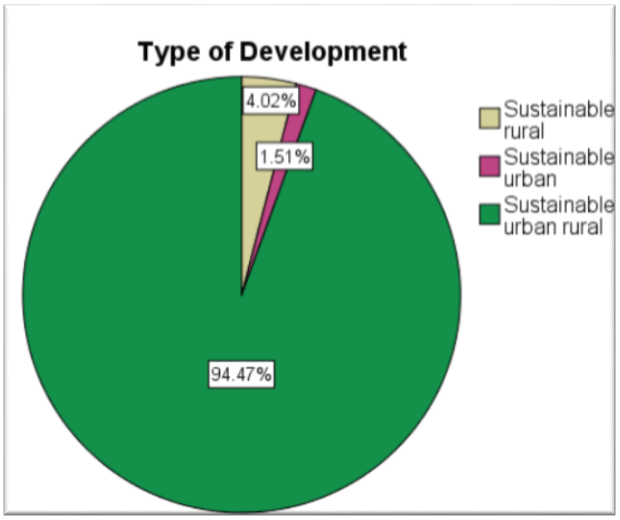


Figure 39: Type of development (Source: Primary survey)

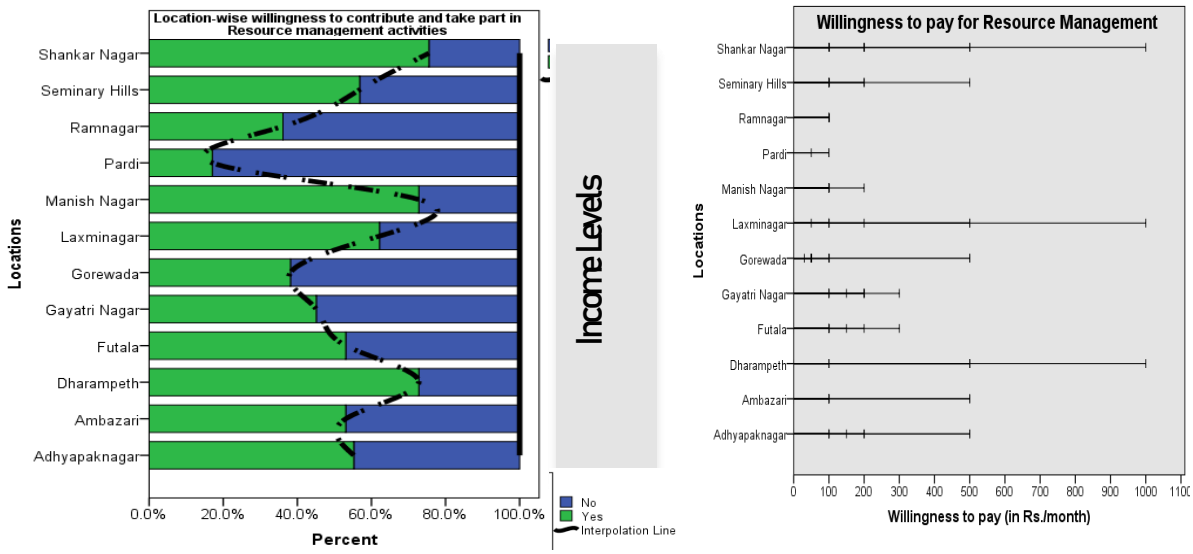


Figure 40: Income levels of Urban households, Willingness to pay for resource management (Source: Primary survey)

The urban areas were also questioned about their income levels, their opinion about the resource management and their willingness to participate in it. Majority of them responded positively when asked about their willingness to participate in resource management. Those who are getting assured and uninterrupted supply of water were willing to contribute to resource management. Low willingness came from low income households as it can be seen in areas like Pardi and Gorewada. The areas where people majorly wanted to contribute was conservation of natural resource management followed by knowledge sharing, watershed development and the least being operation and maintenance (Fig. 40). In upstream areas watershed development was found to be of major concern.

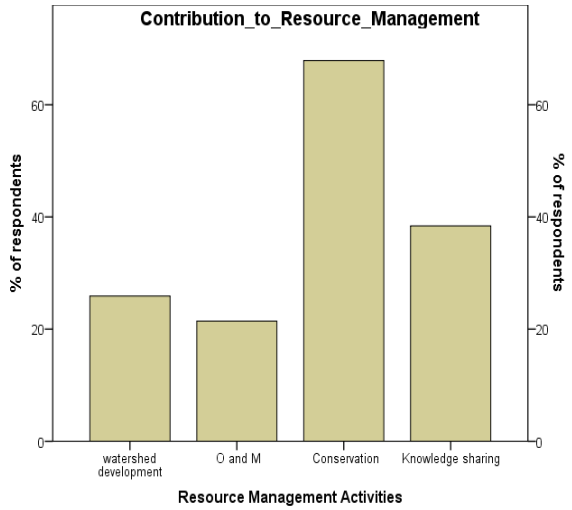


Figure 41: Contribution for Natural Resource Management (Source: Primary survey)

Table 14: Income levels and consumption characteristics

Rates/Month For Water Consumption			Monthly Water Charges As Per Size & Category Per Tenement In Rs.										
			15	20	25	40	50	80	100	150	200	250	300
Category	Billing Slab	Rs. Per Unit	Units	Units	Units	Units	Units	Units	Units	Units	Units	Units	Units
			10	20	30	60	85	150	215	425	725	1110	1580
Residential (R1)	1-20	7.75	77.57	155.13	279.24	791.19	1248.81	2761.37	4273.92	9160.58	16141.58	25100.49	36037.35
	21-30	12.41											
	31-80	17.08											
	Above 80	23.27											

Income levels and Consumption characteristics						
Income Levels	<10,000	10k-15k	15k-20k	20k-25k	25k-30k	>30,000
Min. Monthly Bill	90	200	100	100	75	150
Max. Monthly bill	120	350	1200	500	800	1850

(Source: Primary survey)

From table 14, it is evident that the monthly bill does not vary w.r.t the income levels and their affordability in urban areas, in rural areas the bill was common, i.e., same amount was collected in the form of annual taxes by municipal corporations.

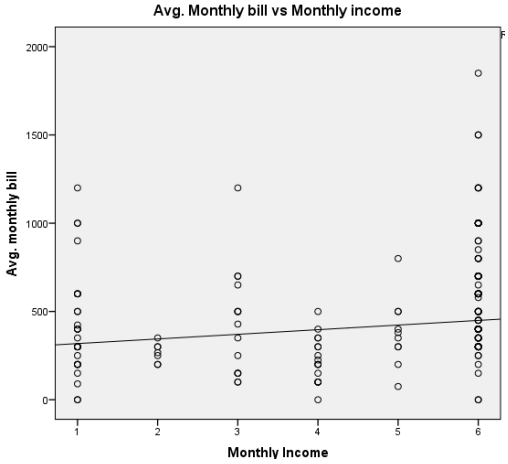


Figure 42: Average monthly income and bill dependency

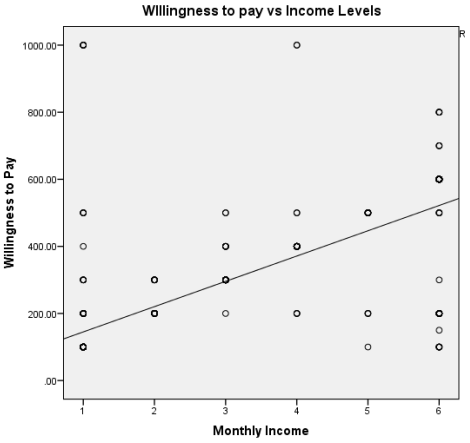


Figure 43: Willingness to pay vs. Income levels

Source: Primary survey

The water consumption pattern is inelastic in nature. The figure 42 shows that water consumption pattern is irrespective of the income levels. Awareness must be created among the lower income group and middle-income group people. People with good income are willing to pay for resource management activities.

It can be seen that the willingness to pay for resource management increases as the monthly income of the households increases (Figure 42). People are willing to contribute for resource management but currently ULB or any other institute has not paid much attention to this concern. People with high income are willing to pay only if other institutional setups like NGO will take lead in resource management who will ensure the accountability but not to NMC.

Table 15: Waste water discharge

Waste water discharge into river	MLD/day
Water supply to city	540
Waste water generation from city	450
Other than NMC supply	162
Total waste water generation	612
Existing treatment capacity	380
Waste water discharged in Nag river without treatment	232

The table 15 shows wastewater linkages, i.e. the amount of waste water discharged into the river per day. Water supplied to the city from NMC is 540 MLD and from other sources is 162 MLD. The wastewater generated from the city is 450 MLD. The amount of wastewater discharged into Nag river without treating is 232 MLD.

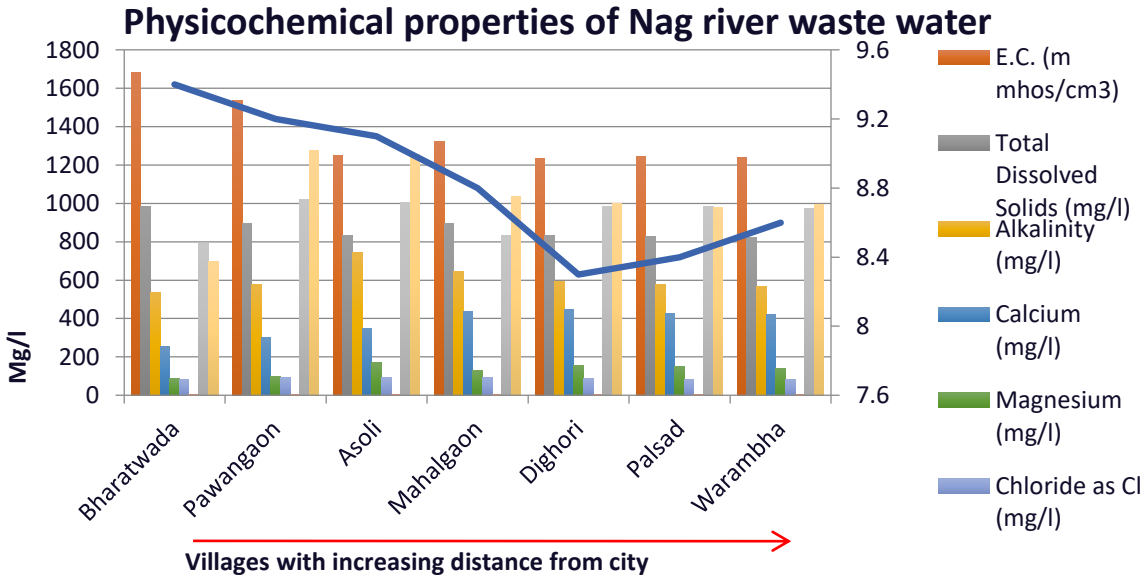


Figure 44: Physiochemical properties of Nag river waste water

As the distance of the village from the River Nag increases their waste water discharge into the river goes on decreasing. The discharge of waste water increases the pH value and mineral content of water. The pH value of water from the Nag River is higher than the normal range. The water required for irrigation purpose required pH value in between 5 and 7. If this wastewater is treated properly it can be utilized for irrigation and other purposes. Also, the water of Nag River has high concentration of dissolved minerals (TDS- 200-400 mg/l). If such water with high mineral content is used for irrigation then it affects the soil infiltration.

Fig 45 represents the concentration of minerals in the Nag river waste water from different villages namely; Bharatwada, Pawangaon, Asoli, Mahalgaon, Dighori, Palsad and Warambha. It can be seen that the water in Nag river is getting polluted majorly because of the waste water from Bharatwada; Zn

being the major metal deteriorating the water. Next major water polluter is Pawangaon, followed by Asoli, Palsad, Warambha, Mahalgaon. The concentration of zinc is maximum, followed by iron, copper, manganese, nickle and lead.

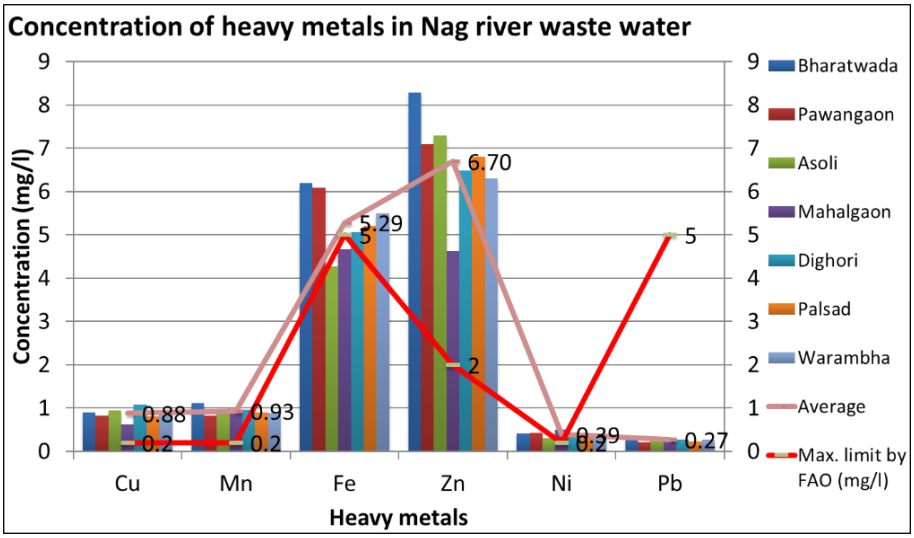
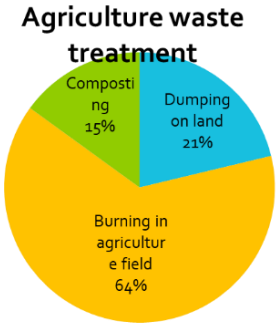


Figure 45: Concentration of heavy metal dump in Nag River

The waste generated through agricultural activities can be treated and it can be used as a main resource for agricultural production. From the above graph, we can see that about 15% of people prefer composting. 21% people prefer waste to be dumped on land, while remaining 64% people burn it in the agricultural field. (Fig 46)



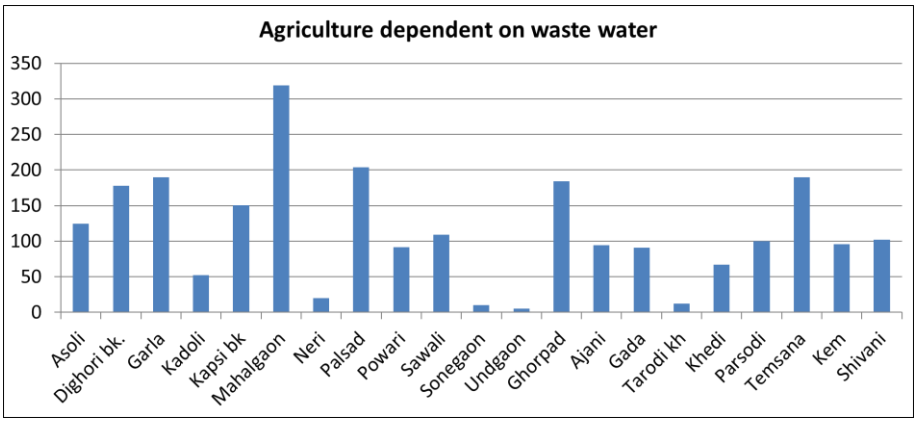


Figure 46: Agricultural waste treatment *Figure 47: Agricultural dependency on waste water*

Around 16% of total agriculture area uses waste water from river which can be fatal. If the use of waste water continues, then it can lead to environment, health and economic related risk. The above graph shows the amount of waste water used by different villages for agricultural purpose.

5.1 Linkages

The rural urban continuum is a conceptual tool to study different types of interactions happening between them and transition between rural and urban area (NPTEL, 2013). Spatial and sectorial linkages have been identified in rural-urban linkage studies. Spatial flows include flows of people, goods, produce, information, waste, social interactions and remittance (Douglass, M. 1998). While sectorial linkage includes functional interactions between primary, secondary and tertiary sector (IIED, 2012). The Urban-Rural linkages are identified through the primary survey in the study areas. A questionnaire was prepared consisting of various types of questions from different sectors, some of them pertaining to employment, demographics, water supply, electricity, migration patterns etc. The answers were then analyzed and linkage diagram was created. It consists of all the factors and flow of resources and commodities between different areas.

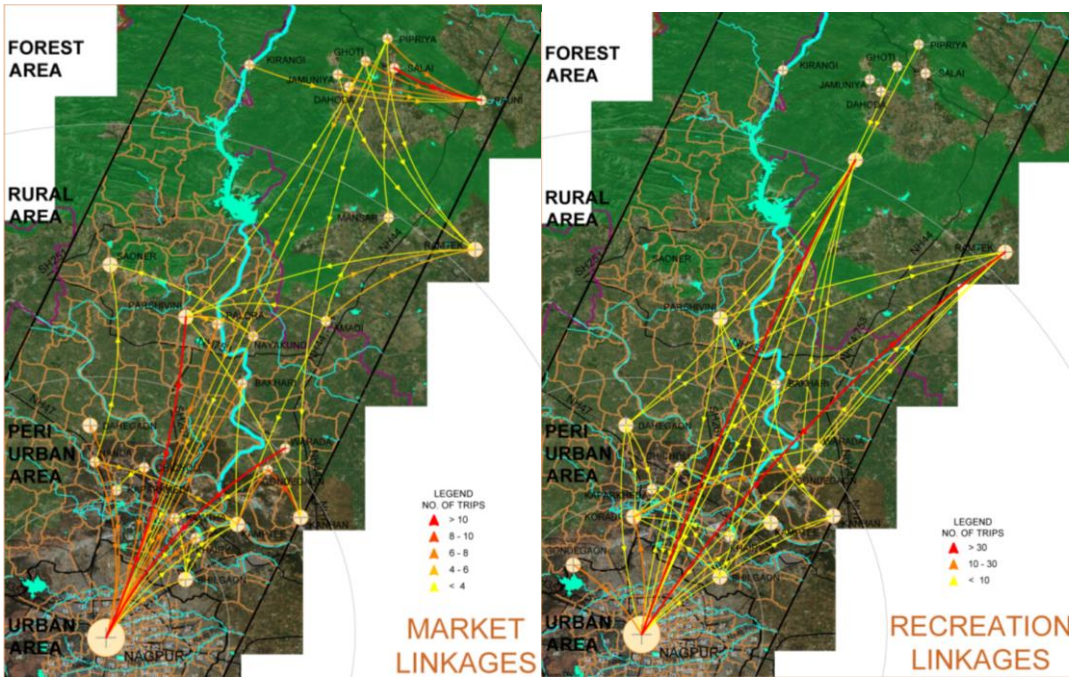


Figure 48: Market and Recreation Linkages between Urban and Rural areas
Source: Primary survey

During the primary survey, questions about marketing pattern and recreational visits were asked. They were then analyzed and Fig 48 were made. It was found that people from towns went to city markets for shopping; from city, towns they went to forest areas; villagers went to towns to shop. Dependency of rural areas were on areas with higher order e.g. urban centers for markets.

Recreational visits included their visit to temples, relatives, picnics and other purposes. Similar linkage as market was found. People from towns travelled to city centers, people from the city visited forest areas and people from village visited towns for both market and recreational purpose. Major portion of urban residents visit forest areas for recreational purpose. These types of linkages will help us decide avenues for partnership.

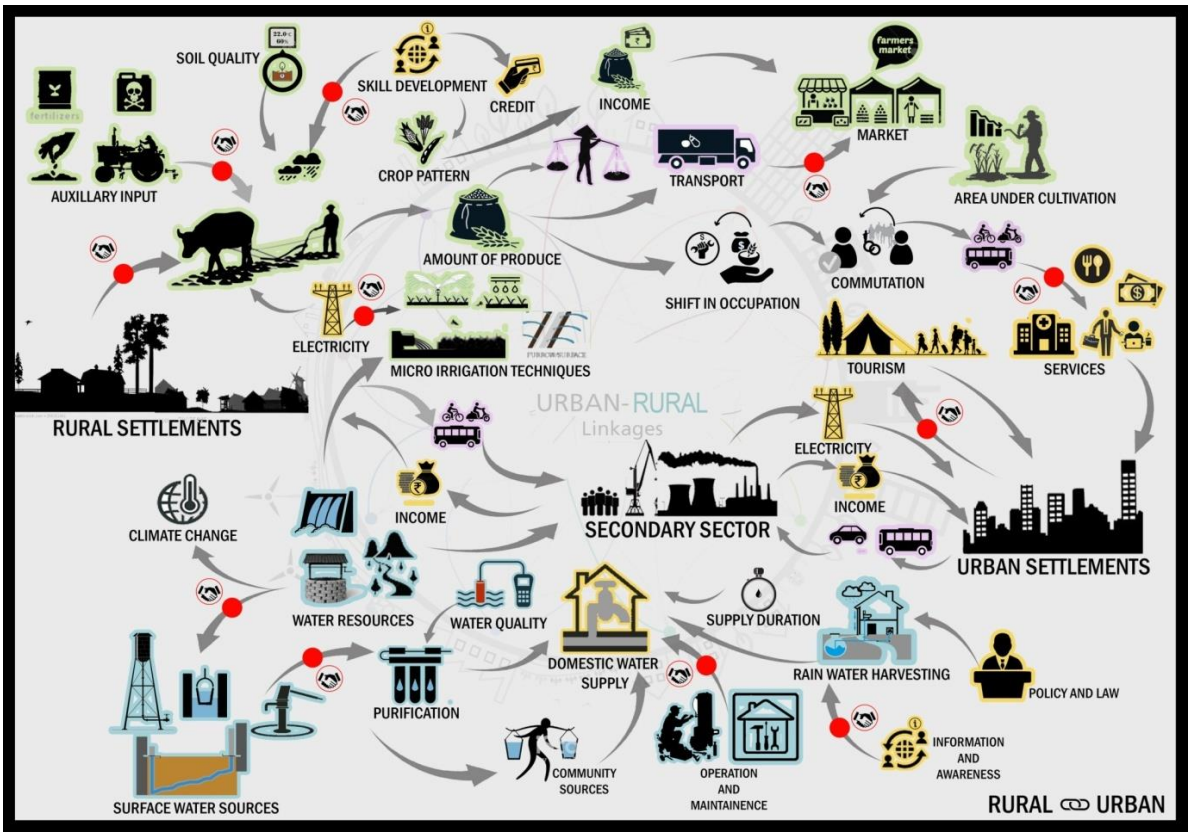


Figure 49: Urban-Rural Linkages (Source: Author)

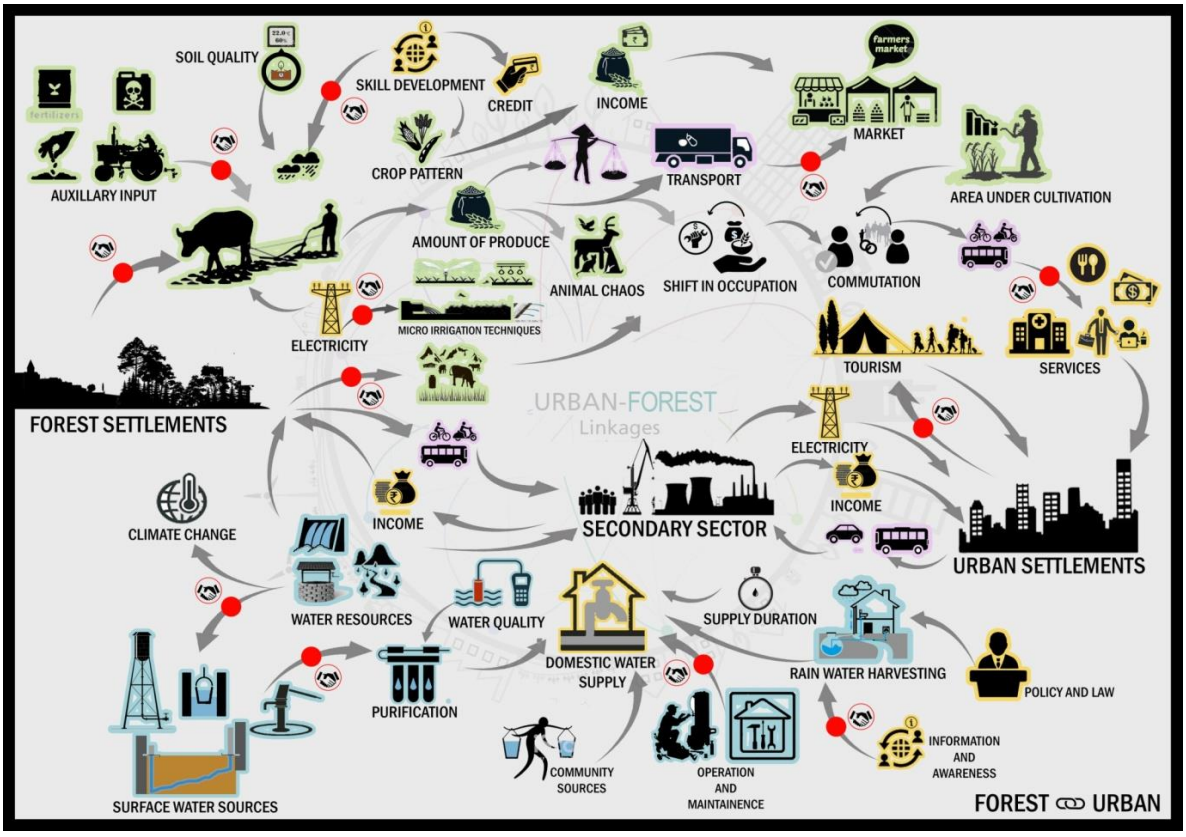


Figure 50: Urban- Forest linkages (Source: Author)

From the analysis of linkages as shown in Fig 49, Fig 50, the necessity of building sustainable and resilient communities is identified. The nature and extent of linkage were analyzed thereby identifying parts where stakeholder partnership can be introduced. The parameters and approaches can also be assessed by these linkages for resilience and sustainability. The weaker linkages and their impacts on resilience, indicators can also be identified through these linkages. Interventions and strategies can be formulated for strengthening of linkages and enhancing resilience. Transfer of information technology applied for enhancing yield, resource management, and economic gain results in positive linkage and is beneficial for both the settlements (Satterthwaite, D. 2010). Expenditure of rural HHs on goods and services supports the economic activities in urban areas.

5.2 Workshop

Figure 51: Stakeholder consultation areas (Source: Author)

Picture: Organizers and Participants of stakeholder workshop

The stakeholder Consultation workshop was organized to interact with the various stakeholders who could be involves in the sustainable resource management in the study area. The participating stakeholders included government officials, NGO, academicians, Media, experts from the field of research and water management, public representatives including village Sarpanch, and community-based organizations (Figure 51). The participants were initially oriented towards the project details and current scenario in the study area.

A series of lectures by experts was organized followed by a group discussion among the participants from various fields where answers to questions on various opportunities for Urban-Rural partnerships were sought. The Central theme of this discussion included the convergence among various types of stakeholders, including NGOs, Government officials, Academicians and Local Communities for improving the urban-rural partnership. The discussion was successful by providing certain suggestion on what measures to be taken in bridging the link between Urban and Rural areas, who must take actions at what level and how to proceed with such measures.

Key observations from stakeholder workshop:

Stakeholder participation must also aim at livelihood security and increased agricultural productivity. Actions for environmental conservation including plantation and water conservation measures are necessary to be initiated at both urban and rural areas with better coordination between authorities and participating NGOs, CSOs and local communities.

Picture: Active participation of stakeholders during the workshop

Multiple agencies working on agriculture, livelihood programs, water and forestry etc. need to be converted into a single forum in order to ensure effective implementation of resource conservation efforts. Institutions involved need to sensitize and build capacity for better addressing of local environmental concerns and improved participation of local communities. Research and Development in terms of Agrarian finance is required.

Putting up the role models: documenting and showcasing the best practices from different places, introducing innovative methods to local people to improve their agriculture produce and irrigation methods. Measures such as water audit and other innovative mechanisms need to be encouraged at appropriate levels.

A board with a common vision must be formed and the vision must not be altered with changing governing body. All the members of the boards must work towards the set goal. Concrete policy must be framed to achieve the common goal. The board must consist of enough representation from the local communities as the form the most basic of all stakeholders. Demarcation of responsibilities within the board: responsibilities allotted as per their qualification.

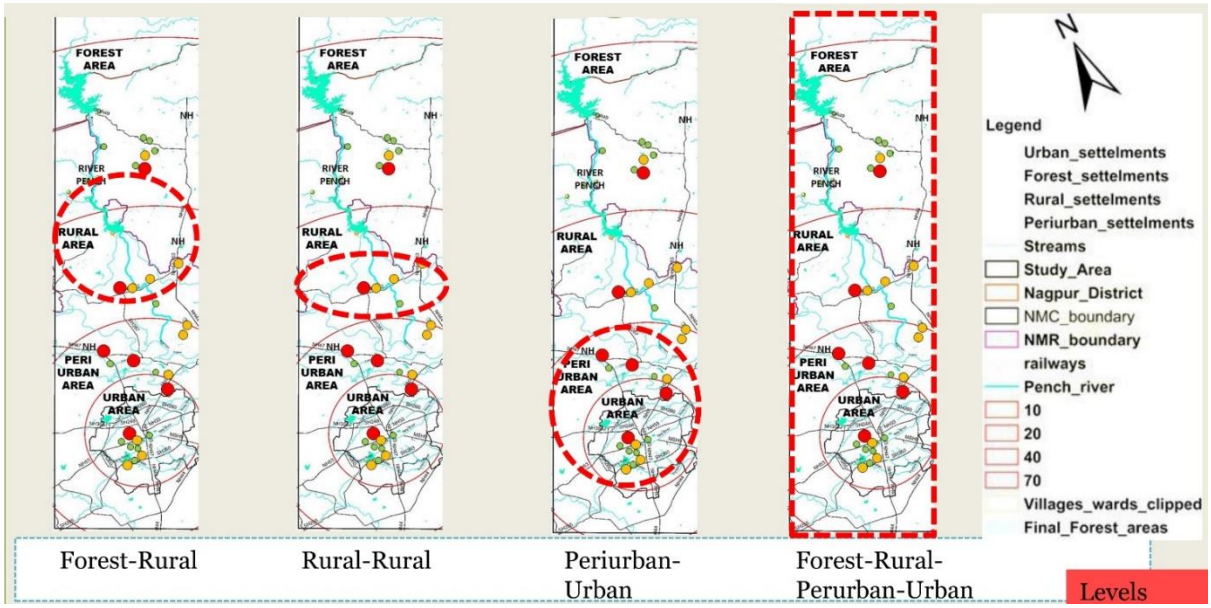


Figure 52: Scale of Partnership (Source: Author)

As the outcome of the stakeholder consultation, possible partnerships are identified to be of two characteristics such as Partnership which may be mobilized and utilized only under the right conditions; and the partnership with dual or multiple parties. Further the partnership varies in spatial scale involving various stakeholders. Sometimes the stakeholders are from the local community in other cases they are from different regions giving external aid and getting benefits in return.

Table 16: Avenues for Partnership (Source: Author)

Sectors			Government (Hierarchists)	District level	Private sector (Individualist)	Civil society (Egalitarians)	Communities (fatalists)
Agriculture-Food	Local	Urban	APMC_Marketing Research and Information Network	Collector	Private financial institutions	Co-operative societies	Farmers organizations
			NMC tax collector	PD, DRDA	Supermarkets_Implementation of PDS	Agriculture university	Self help groups
			Technical officer	Agriculture development officer	Farmer producer company	Co-operative banks	Associations of Pasture Users
			Extension service officer	Campaign officials (Mohim adhikari)	Private sector input supply firms	Co-operative Marketing Societies	Producer Associations
			Marketing board	Junior assistant	Agricultural suppliers and services	Block Farmers' Advisory Committee	Youth organizations
			District manager, NABARD bank Meteorological department	District animal husbandry Dy. Director General of Meteorology	Non-stakeholder NGOs Food distributors and processors	Primary Agriculture Cooperative Societies Community seed banks	Women organizations Labour unions
			PDS, officer	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola			Joint Liability Groups
		Rural	Regional Agricultural Marketing Adviser Gram panchayat	short message service Project director ATMA	Fertilizer industry Risk Insurance companies		Commodity Interest Groups
			Gram sabha	Krishi Sanshodhan Center	donors		
			Sarpanch	Soil Testing Officers	Money lenders		
			Department of Livestock and Veterinary Services	Zilla parishad, SAO- agriculture officer	krishi kranti kendra		
			Patwari	GSDA, Nagpur	Principal Nodal Officer of GKMS, Agriculture Research Station, Chandrapur		
			Talathi Tehsildar	Command Area Development Authority			
			Tehsil agriculture officer				
Water	Local	Urban	Micro Irrigation department- executive engineer		OCW	Industrial co-operative society	Ward committee
			Water works department Lake development authority	Zilla Parishad- water and sanitation department sub-executive engineer Watershed development authority	Industrial water user associations Builders		
			Health and sanitation officer	Forest officer	Waste water treatment agency		
			Chief Town planner	Rural water supply department- Executive engineer	Developers		
			Garden department Maharashtra pollution control board regional office nagpur	District agriculture officer PD, DRDA	Western Coalfields Limited, Nagpur Private financial institutions		
			NIT	Executive engineer, civil	NGO		
		Rural	Commissioner Gram panchayat secretary	GSDA, Nagpur Command Area Development Authority			Associations of Water Users
			Sarpanch				Domestic water users
			Gram sabha Talathi				Water lifting association Watershed Committees
			BDO				
			Animal husbandry officer panchayat samiti member				
			Z P member				
Waste	Local	Urban	Health officer Pollution control board				Waste water users
			District health officer				
		Rural	Village panchayat, health officer Executive engineer, civil		Transport Operators/providers		Transport Users
Transportation	Local	Urban	Public works department		Private Financiers		Citizens
			Transport Manager		Business Associations Retailers		Media Transport user association
							Environmental association
Recreation		Rural	Village development officer Forest Department	MTDC	Van Hakka Samiti		Forest communities
					Local companies, Media, Business owners, Financial Institutions		

The four major kinds of partnership scales identified in the study are Forest-Rural partnership: involves forest department and the local community; Rural-Rural partnership: involves corporate sector and local community; Peri urban and Urban partnership: involves corporate sector, MJP, NGOs, CBOs, NMC, ULBs and Village Panchayats; and Forest-Rural-Peri urban-Urban partnership: involves MJP, NGOs, CBOs, NMCULB, Village Panchayat, urban residents and institutions.

6. CONCLUSION

On the basis of the survey which was conducted in the study region, it is concluded that both the upstream region (i.e. the settlements in the forest area) and the downstream region (i.e. the settlements in the peri-urban area and rural area), are dependent on the Pench which is the major source of water. The upstream region uses Pench water mostly for fishery and agriculture purposes. For domestic water, they are dependent on groundwater which is extracted with the help of hand pumps and wells. As far as agriculture in the forest region is concerned it is rain fed. Major crops grown in this region are cotton, rice, wheat, and soybean. Apart from this, vegetables like tomato, brinjal etc. are also cultivated here. For selling the agricultural produce, farmers from forest areas go to Ramtek and Pauni.

The downstream areas use Pench water majorly for agriculture and domestic purposes. For agriculture purpose, Pench water is supplied through canals, also some farms have walls and bore wells depending upon their economic status. Mixed farming has been majorly practiced in this region with cotton being the main crop along with Toor dal, paddy and vegetables are also grown. Farmers sell their agriculture goods to APMC. People also buy food-grains from the Kalamna market, Cotton market which shows the consumption linkage with the urban area. Clothing, utensils and building materials are procured from the Nagpur city and perishable goods from the weekly market from the nearby surrounding villages. Apart from this, livelihood here is also based on allied activities like poultry farming, cattle farming, and furniture making. For occupation like furniture making people travel to Nagpur city. For higher studies, people travel to Nagpur, which means rural areas are dependent on urban areas for education and employment.

Dependency of Urban areas on Rural is basically for food supply and recreation. The drinking and domestic water supply in the urban area of the selected study region is from Pench and Gorewada Lake. The water from these sources is first filtered and then supplied to the respective zones. Further, to understand the dependencies in detail survey questionnaire outputs were analyzed. For survey, four different questionnaires to understand the linkage related to water supply, migration and remittances, availability of electricity, procurement of food-grains, vegetables, daily needs goods, etc.

From the analysis, it is inferred that in forest and rural areas, majority of the households received water from pipe supply, quality of water being good enough for drinking and other domestic purposes. In case of emergency, they use water from tankers and wells. Only at Warada and Gondegaon the quality of groundwater is deteriorated due to the coal mining activities making it unfit for use. Thus, the settlement is being relocated. No rain water harvesting techniques are being significantly practiced neither in the rural nor in the forest regions. When asked about supporting farming activities, only 66% of people were willing to contribute, rather they were much interested in farming on their own agricultural land.

In Urban region, all the households have piped water supply in the individual plots. Around 55% of people have rain water harvesting structures installed. Also, many people (around 71%) are ready to

contribute to the water resource management activities by paying charges and by knowledge sharing and conservation of water. They feel that water resource management shall be done by NMC as it the main water supplying body to the Nagpur city along with the Institutional setups and NGOs. About 11% of people are practicing kitchen garden, also about 62% people are willing to participate in urban framing activities.

Finally, on the basis of survey and analyzing the questionnaires we deduced that Urban and Rural areas both are interdependent on each other not only for water resources but also for education, employment, food-grains, etc. The transportation between the rural and urban area is good enough to facilitate their needs. The major problem is with the water supply system. Pench being the common source of water for drinking or for domestic purpose the water shall be fairly supplied to both the areas, but this is not the scenario. majority of the water from the Pench source is supplied to the City where as the village settlements receive less water, which has a negative influence on irrigation status and so the food security of these settlements. If this continues, Sustainable Urban-Rural development cannot be achieved. Thus, to tackle this problem and to understand where Urban-Rural Partnership could be established Stakeholder Consultation Workshop was conducted. Various stakeholders were present at the workshop local development authorities, natural resource governing agencies, academia, NGOs, the private sector and most importantly the urban as well as rural communities for natural resource management & resilient development. At the end of the workshop, a group discussion was conducted among the stakeholders where various questions regarding the Urban-Rural Partnership were discussed. The main intention was to bring together all the stakeholders, including NGOs, Government, Academicians and Local Communities for improving the urban-rural partnership. Also, various other questions were raised such as what measures shall be taken for bridging the links between the Urban-Rural areas, identifying key stakeholders at various levels of resource management and how to proceed with implementation of such measures. From the workshop, it was concluded that the stakeholder participation shall not only extent during the initial stages but also during the review and monitoring stage. Participation of the stakeholder must also aim at livelihood security and increasing agricultural productivity. The discussion also deduced that multiple agencies working on agriculture, livelihood concerns, water and forestry shall meet together to make sure of effective implication of resource conservation. Environment related issues were also discussed, it concluded that action shall be taken for environmental conservation including plantation and water conservation measures are necessary to be initiated at both urban and rural areas with good coordination between the participating communities and authorities. Also, measures such as water audits shall be encouraged. Institutions shall be sensitized and shall built capacity for addressing the local environmental issues and improved participation of local communities.

Picture: A women in Pipriya village of Nagpur district, fetching water from distant areas

REFERENCES

1. CCMR. Council of European Municipalities and Regions (2013). CEMR survey on integrated territorial. Council of European Municipalities and Regions.
2. Thomas Forster, G. S. (2015). Strengthening Urban Rural Linkages Through City Region Food Systems. UNCRD/ UN Habitat issue of Regional Development Dialogue, 19
3. International Institute of Environment and Development. (2012). Urbanisation and rural-urban linkages. Retrieved 1 08, 2019, from iied: https://www.iied.org/rural-urban-linkages
4. Rondinelli D., (1976) Urban Functions in Rural Developmen: An analysis of Integrated Spatial Development Policy. Agency for International Development, Technical Assistance Bureau, Office of Urban Development.
5. RuralUrbanNexus, (2016), Rural Urban Nexus Global sustainable land use and urbanization, Umweltbundesamt,

   https://rural-urban-nexus.org/sites/default/files/Projektsteckbrief_RUN_EN_20170227_update.pdf
6. Nitin Srivastava, R. S. (2016). Enhancing City Resilience Through Urban-Rural Linkages. In Disasters and Resilience in Asia (p. 10).
7. Takeuchi, P. K. (2018). Regional Circular and Ecological Sphere (Regional CES). Japan. www.iges.or.jp/en/sdgs/sts.html
8. sarkariyojana.com. (2018). Retrieved from https://sarkariyojana.com/maharashtra/
9. Urban Land Institute, (2015), resilience Strategies along the Rural Urban Transect. Washington, DC: Urban Land institute.
10. Bhosle, K. D. (2010, July). A study of urbanization in Nagpur district. ITPI Journal, 88-95. Retrieved from http://www.itpi.org.in/uploads/journalfiles/jul8_10.pdf
11. Nagpur Improvement Trust. (Feb, 2015). Draft Development Plan Report. Nagpur: Nagpur Improvement Trust
12. Nagpur Improvement Trust. (2015). Development Control Regulations. Nagpur: Nagpur Improvement Trust.
13. Sekhar, P. (2017). NMA turns into Smart Metropolitan Region. Nagpur, Maharashtra, India: Global Smart Cities Panel & Micro Tech Global.
14. Manzar, A. et al. (2013). Ground water Information. Cetral Ground Water Board, Central region, Nagpur. Ministry of Water Resources.
15. NPTEL. (2013). Rural-Urban Continuum: Meaning and Context. NPTEL.
16. Water works department, NMC (2005), Water DPR report NMC, Water Works Department Nagpur Municipal Corporation.
17. Kappeler, P. M. (2016). oxfordbibliographies. Retrieved from www.oxfordbibliographies.com
18. Satterthwaite, D. (2010) The Role of cities in Sustainable Development, Sustainable Developmet Insights https://www.bu.edu/pardee/files/2010/04/UNsdkp004fsingle.pdf
19. Douglass, M. (1998). A regional network strategy for reciprocal rural-urbanlinkages: An agenda for policy research with reference to Indonesia. Third World Planning Review, 20, 33.
20. International Institute for Environment and Development. (2012) Urbanization and Rural-Urban Linkages. https://www.iied.org/rural-urban-linkages

Dr. Sameer M. Deshkar
IRDR ICoE, International center of excellence in Resilient Communities and Settlements,
Nagpur, Maharashtra-440010, India.
Email: sdeshkar@gmail.com