Planning framework for Urban Agglomeration - A Case of Indore

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By

BHARTI VERMA
(Scholar No: 24209011103)
Under the Guidance of
Dr. SONIA TANEJA



MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ARCHITECTURE AND PLANNING

BHOPAL - 462003, MADHYA PRADESH, INDIA

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MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY, BHOPAL

DECLARATION

I hereby certify that the work which is being presented in the thesis entitled "**Planning Framework for Urban Agglomeration : A Case of Indore"** in partial fulfillment of the requirements for the award of the Master of Planning (Urban Planning)and submitted in the Department of Architecture and Planning of the Maulana Azad National Institute of Technology, Bhopal is an authentic record of my own work carried out during the period from Jan 26 to June26 under the supervision of Dr Sonia Taneja Professor, Department of Architecture and Planning, Maulana Azad National Institute of Technology, Bhopal.

The matter presented in this thesis has not been submitted by me for the award of any other degree of this or any other Institution.

Bharti Verma

(24209011103)
(Name & Signature of Candidate)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge

Dr. Sonia Taneja
(Name and Sign. of Guide)

Date: 7-07-26

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Bharti Verma

(24209011103)
M. Plan (Urban Planning)

Abstract

Urban agglomerations are emerging as dominant spatial forms of growth in both developed and developing nations. While they serve as engines of economic development, they also produce spatial challenges such as congestion, imbalance, and unplanned peripheral expansion. This dissertation explores how the principle of spatial planning can be applied as a planning approach to restructure urban agglomerations into balanced, functionally integrated regions.

The study will follow a qualitative and analytical methodology, gathering its data from secondary sources of academic literature, institutional reports, and planning frameworks. The research provides a synthesis of theoretical foundations such as Central Place Theory, Growth Pole Theory, Growth Focii theory and Polycentric Development Theory in conceptualizing how distribution can be supportive of spatial balance.

The proposed planning framework for urban agglomeration through spatial distribution emphasizes three integrated components: Demography, functional linkages, and Infrastructure. It advocates a polycentric spatial hierarchy wherein several centers within the agglomeration share complementary roles supported by efficient connectivity and coordinated regional planning.

Findings show that spatial planning can reduce monocentric over-concentration, make land use more efficient, and promote regional equity. The study concludes that the future of sustainable urbanization lies in multi-nodal, integrated, and spatial planning frameworks that transcend administrative boundaries.

The policy recommendations include the establishment of regional planning authorities, integration of land use and transport planning, strengthening growth centers in peripheries, and GIS-based monitoring systems. It would align with the objectives of the National Urban Policy Framework of 2018 and SDG-3 and 4 thereby adding to the discourse on spatially balanced and sustainable urban development.

सारांश

शहरी समूह (Urban Agglomerations) विकसित और विकासशील दोनों प्रकार के देशों में वृद्धि के प्रमुख स्थानिक रूप के रूप में उभर रहे हैं। जहाँ ये आर्थिक विकास के इंजन की तरह कार्य करते हैं, वहीं ये भीड़भाड़, असंतुलन और अनियोजित परिधीय विस्तार जैसी स्थानिक चुनौतियाँ भी उत्पन्न करते हैं। यह शोधप्रबंध इस बात का विश्लेषण करता है कि स्थानिक विकेंद्रीकरण के सिद्धांत को एक नियोजन दृष्टिकोण के रूप में कैसे लागू किया जा सकता है, ताकि शहरी समूहों को संतुलित और कार्यात्मक रूप से एकीकृत क्षेत्रों के रूप में पुनर्गठित किया जा सके।

यह अध्ययन गुणात्मक और विश्लेषणात्मक पद्धति का अनुसरण करेगा, जिसके लिए डेटा द्वितीयक स्रोतों जैसे कि अकादमिक साहित्य, संस्थागत रिपोर्टों और विभिन्न नियोजन ढाँचों से एकत्रित किया जाएगा। यह शोध सैद्धांतिक आधारों–जैसे सेंट्रल प्लेस थ्योरी, ग्रोथ पोल थ्योरी और पॉलीसेंट्रिक डेवलपमेंट थ्योरी–का संकलन प्रस्तुत करता है, जो यह समझने में सहायता करती हैं कि विकेंद्रीकरण स्थानिक संतुलन को कैसे बढ़ावा देता है।

शहरी समूहों के लिए प्रस्तावित विकेंद्रीकरण-आधारित नियोजन ढाँचा तीन परस्पर जुड़े घटकों पर आधारित है: स्थानिक संरचना, कार्यात्मक संपर्क और संस्थागत तंत्र। यह एक पॉलीसेंट्रिक स्थानिक पदानुक्रम की वकालत करता है, जिसमें समूह के भीतर कई केंद्र परस्पर पूरक भूमिकाएँ निभाते हैं, जिन्हें कुशल संपर्कता और समन्वित क्षेत्रीय नियोजन का समर्थन प्राप्त होता है।

अध्ययन के निष्कर्ष दर्शाते हैं कि स्थानिक विकेंद्रीकरण मोनोसेंट्रिक अत्यधिक-सघनता को कम कर सकता है, भूमि उपयोग को अधिक कुशल बना सकता है और क्षेत्रीय समानता को बढ़ावा दे सकता है। शोध इस निष्कर्ष पर पहुँचा है कि भविष्य की सतत शहरीकरण प्रक्रियाएँ बहु-नोडीय, एकीकृत और विकेंद्रीकृत नियोजन ढाँचों में निहित होंगी, जो प्रशासनिक सीमाओं से परे जाकर कार्य करेंगी।

नीतिगत सिफारिशों में क्षेत्रीय नियोजन प्राधिकरणों की स्थापना, भूमि उपयोग और परिवहन नियोजन का एकीकरण, परिधीय क्षेत्रों में वृद्धि केंद्रों को सशक्त बनाना, तथा GIS-आधारित निगरानी प्रणालियों का विकास शामिल है। यह राष्ट्रीय शहरी नीति ढाँचा (2018) और सतत विकास लक्ष्य (SDG-3 & 4 के उद्देश्यों के अनुरूप है, और स्थानिक रूप से संतुलित एवं सतत शहरी विकास पर चल रहे विमर्श को आगे बढ़ाने में सहायक होगा।

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CHAPTER 1

1. Introduction

1.1Background of the Study

Urbanization is among the global defining phenomena of the twenty-first century. More than 55% of the world's population currently lives in urban areas, and this share is expected to increase to almost 68% by 2050. The increasing concentration of people and economic activities in limited cores has resulted in mono-centric development, excessive land use, congestion, and spatial inequality. As cities expand beyond their administrative boundaries, they transform into urban agglomerations-spatially continuous and functionally interdependent urban regions.

While agglomeration can give rise to productivity in the case of agglomeration economies, it basically fosters uneven development, environmental degradation, and social segregation due to an unbalanced and centralized spatial structure (Fujita, M., and Thisse, 2014). Consequently, planners and policymakers increasingly stress a strategy of spatial decentralization, which distributes residents, employment, and services across a number of centers in the region for balanced urban growth (Krugman, 1994).

Large agglomerations, such as Delhi NCR, Mumbai Metropolitan Region, and Indore UA, have resulted from rapid, unregulated urbanization in the Indian context. Various characteristics of these areas include a single core city with peripheral towns that are functionally dependent upon the core but weakly integrated. Agglomeration planning with spatial decentralization has to be done to ensure sustainable growth of cities by strengthening the secondary centers, mixed land use, and decongesting the pressure on urban cores (Kundu et al., 2024) .

1.2 Concept of Urban Agglomeration

According to the Census of India, 2011, an urban agglomeration is a continuous urban spread constituting a town and its adjoining outgrowths, or two or more physically contiguous

towns together with or without outgrowths." It constitutes a spatial form of urbanization during which more than one settlement physically and functionally merges into one extended urban region (Chakraborty et al., 2022). Urban agglomerations are groups of cities and towns that have merged into an integrated spatial, economic, and functional unit, often physically linked in a single continuous built-up area(M. Das et al., 2024).

Urban agglomeration (from Latin ‘aglomero’ – I collect into a mass) is a compact cluster of settlements around the main core(s) unified by intensive production, labor, cultural and recreational connections. The name “urban agglomeration” appeared for the first time in the French scientific literature, and then in the USSR . British scientists call it “conurbation” (from Latin‘con’ – together, and‘ urbs’- city), and scientists of the USA refer to it as “metropolis” (from Greek μητρόπολη – main city). In the USA where the group forms of urban population distribution began to evolve earlier than in other countries, as early as 1910 the concept of “metropolitan territory” was coined (Badalov, 2016).

The concept of an "urban agglomeration" is used to define a specific geographic region, mainly characterized by its large-scale urban and metropolitan growth. The term represents a regional economic entity featuring an active flow of resources, close economic links, and a complicated spatial pattern that has emerged in a certain region through the process of capital, information, and traffic flow(Abilov et al., 2023). The concept involves a core with one or more metropolises, surrounded by a number of peripheral towns. Globalization brings increasingly complicated and diversified interlinkages between cities. In an urban agglomeration, laborers, capitals, resources, and technologies flow freely. The complementary advantages are transformed into regional competitiveness, which promotes common development. It is also a spatial carrier for countries to participate in international trade and the international division of labor, directly promoting rational flow and effective use of production factors in their areas(Liu et al., 2025)

Urban agglomerations, a spatial reflection of growing urbanization, are among the most common and fastest-growing settlement structures of the modern world: cities, spilling over beyond the boundaries which have often been established for centuries, form new consolidated patterns of settlement with their surroundings. Russia, despite its generally sparse popula- tion

distribution in comparison with many coun- tries, has also become a country of agglomerations (Babkin et al., 2024).

Globally, these agglomerations are considered metropolitan regions or city-regions, perceived to operate like dynamic systems with strong interdependence in transport, labor markets, and service networks. In managing their spatial structure, there is a need to go beyond the monocentric model to embrace polycentric and decentralized spatial planning, where several centers share growth and functions within an integrated framework (Jombach et al., 2023).

Most of these urban agglomerations in India are still growing organically, shows migration and economic concentration around the core city. Most planning frameworks, such as the Master Plan or Development Plan, engage only with individual municipal areas and fail to address the spatial continuum presented by the agglomeration. Spatial decentralization hence becomes a necessary condition for coordinated growth with equity in the distribution of urban function.

The area of rapid urbanization is a regional concept mainly used to determine the urbanization level through the urbanization rate, that is, the proportion of urban population in the total population. The urbanization level in the area of rapid urbanization is more than 50%, with its annual growth rate of urbanization being more than 1%. (Zhang & Zhang, 2023)

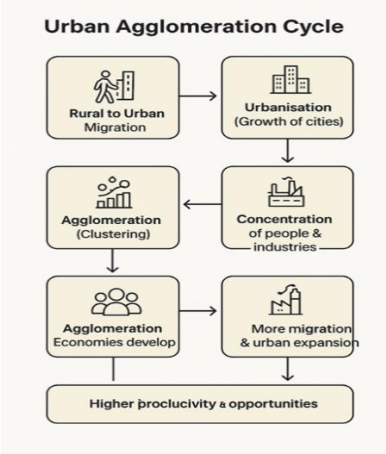

Figure 1: Urban Agglomeration Cycle .Source: (World Bank, 2023)

framework, therefore, provides an appropriate framework for guiding rebalancing growth mechanisms within urban agglomerations.

1.4 Need for the Study

Urbanization in India has been marked by the accelerated expansion of cities, unbalanced spatial concentration of economic activities, and mounting strain on scarce urban infrastructure. One of the major aspects of the growth is the overconcentration of economic, administrative, and commercial activities in the center area, especially the Central Business District (CBD) and its surrounding areas. This concentration, though useful in the form of accessibility and agglomeration economies in the early phase, has developed to the extent that it is now generating diseconomies of scale, including traffic jams, high value of land, poor infrastructure, and reduction in overall livability (Anas & Pines, 2013).The necessity of this study stems from the increasing urban congestion issue in Indian cities, directly associated with overconcentration of activity (Celinska-Janowicz et al., 2021). Congestion is not just a traffic problem; it is a multifaceted problem that impacts productivity, environment, social equity, and quality of life. Lost time spent commuting minimizes economic efficiency, fuel consumption and emissions add to environmental deterioration, and the lack of access to affordable housing close to centers of employment leads to socio-spatial segregation(Donaldson, 2001). They are especially critical in medium and major Indian cities such as Indore, Delhi, Bengaluru, and Mumbai, where planning systems have failed to completely tackle the spatial imbalance dilemma.

While current literature and initiatives like the Smart Cities Mission, AMRUT, and the National Urban Transport Policy acknowledge the requirement for balanced development and sustainable mobility, there remains a research gap in addressing overconcentration of activities in an explicit manner and considering decentralization as a viable strategy. Most existing research is either on traffic management or economic development, but hardly any combine the spatial aspect of economic concentration with outcomes of congestion. This hinders urban planners and policymakers from formulating interventions that address simultaneously both economic efficiency and livability(Jain & Tiwari, 2021).

Mitigating urban congestion is critical for sustainable urban growth in India. Though transport-oriented interventions are necessary, these give only short-term relief and do not decrease structural stress on cities. As excessive concentration of economic activity in core zones is a key factor in congestion, redistributing of activities presents a strategic solution to spread growth, ease urban centers, and improve quality of living(Tikoudis, 2023).

The development of a spatially decentralized planning framework is urgent, which ensures multi-center urban development in an agglomeration, integrates land use and transport systems, and also ensures compact, mixed-use development. It would reduce spatial inequality, enhance accessibility, and promote sustainable regional balance (Marull et al., 2023).

The study thus seeks to conceptualize spatial decentralization as a planning approach to optimize land use, distribute growth evenly, and create resilient urban agglomerations in India.

1.5 Research Problem

Urban agglomerations in India are expanding without a coherent spatial structure. Most of the plans so far have been confined to the boundaries of municipalities, which has resulted in fragmented spatial growth of cities. A high concentration of urban functions in one core is causing congestion and land scarcity, which further causes socio-economic polarization.

The research problem can be identified as the lack of an integrated spatial planning framework using Growth Foci concept as the principle for managing urban agglomerations. This study investigates the way in which spatial decentralization can be applied to structure the urban agglomeration into a balanced, polycentric urban system to enhance land-use efficiency and regional connectivity.

1.6 Aim and Objectives of the Study

1.6.1 Aim:

To assess the spatial distribution of educational and health facilities and propose a balance planning framework for equitable service distribution within the Indore Urban Agglomeration.

1.6.2 Objectives:

1.6.2.1 Dissertation Phase I

1. **To understand the concepts of planning theories.**
2. **To identify theories suitable for balance spatial distribution of Infrastructure.**
3. **To explore methods for identifying and analyzing Infrastructure gaps.**

1.6.2.2 Dissertation Phase II

1. **To Identify Growth Focii on basis of population, Infrastructure and connectivity.**
2. **To analyze the identified Growth foci's**
3. **To assess infrastructure gaps.**
4. **To propose planning framework for addressing Infrastructure gap.**

1.7 Scope and Limitations of the Study

1.7.1 Scope

The scope of the study is confined to analyzing the educational facilities existing in the chosen urban agglomeration area of Indore. The study covers a total of 125 settlement sites, which include urban and peri-urban settlements such as Rau, Mhow, Mhowgaon, Betma, Hatod, and other urban areas. The research mainly concentrates on the spatial analysis of educational facilities, their service provision, and analysis of deficiencies.

The research has covered various hierarchical educational facilities such as primary school, middle school, secondary school, senior secondary school, arts college, commerce college, science college, and arts & science college. For analysis purposes, spatial analytical methods such as buffer analysis, service coverage analysis, accessibility analysis, and interaction analysis based on the gravity model have been adopted.

Additionally, appropriate sites for further educational institutions are suggested in this study, taking into account such criteria as accessibility, connectivity by roads, central location, concentration of people, and spatial equity. This study was meant to contribute to educational facilities planning and regional development strategy planning in the study area.

1.7.2 Limitations

This study is based mainly on the existing data concerning population, boundaries of settlements, and educational infrastructure and health infrastructure; accordingly, the results of the study will be reliable only if the data obtained are accurate. Several settlements in the study area did not have any population data, which is why they were not taken into account in some stages of the study.

The emphasis here has been on the quantitative and spatial dimensions of the infrastructure of education and health and no attempt has been made to quantify the quality parameters like the state of school buildings, quality of education, availability of personnel, achievement levels of the students, and capacity of institutions.

Further, it is assumed that accessibility has been achieved via distance, while factors like socio-economic considerations, behavioral characteristics of transportation, financial

implications of transportation, and individual preferences have been ignored. Moreover, the analysis has been based on planning norms and GIS technology, which do not necessarily take into account the actual conditions on the ground.

The recommended sites for future establishment of education institutions are indicative in nature and would need further investigation and approval.

1.8 Outcomes

The analysis of urban concentration and land use efficiency in the city yields a few crucial implications. First, population and built-up density analysis picks out overconcentration areas and underutilized areas, and reveals spatial imbalances in urban expansion.

Secondly, analysis of commercial activities indicates distribution of centers of economic activity, levels of trade intensity, and possible centers of employment, thus representing economic specialization patterns and functional zoning.

Thirdly, land use analysis informs about the ratio of residential, commercial, industrial, and open spaces, indicating the effectiveness of land use and areas of suitability for mixed-use development.

Fourth, the evaluation of road network connectivity and density identifies accessibility, transport efficiency, and possible congestion locations. In general, the research provides an in-depth insight into- spatial morphology, urbanization pattern, and land use pattern, serving as a useful foundation for evidence-based planning, sustainable growth, and policy interventions for balanced and efficient urban growth.

CHAPTER 2

2. Literature Review

2.1 Introduction

Literature review is an essential step in research, which assists researchers in gaining knowledge about theoretical perspectives, past studies, methods, and approach pertaining to the research problem. Literature review serves as the basis for understanding the concept that is to be studied and highlights the areas of research gap as well. The current study is centered around the concepts of regional planning, settlement hierarchy, central place theory, growth centers, accessibility, facility distribution, Sustainable Development Goals, and GIS techniques in regional planning.

Rapid urbanization and industrialization processes have greatly influenced regional development processes in India. On one hand, cities provide access to various facilities to the people, whereas on the other hand, many rural and peripheral settlements face lack of access to basic services and facilities. The result is a significant inequality in regional development processes. Thus, planning practices related to balanced regional development and equal provision of services have gained importance.

2.2 Concept and Evolution of Urban Agglomeration

The concept of urban agglomeration was founded on classical theories in urban economics that describe cities as centers of production and innovation driven by agglomeration economies. Urban agglomerations are continuously built-up areas comprising a central city and its surrounding urban or peri-urban settlements, forming a single functional unit (United, 2024).

Urban agglomeration is both a spatial and an economic phenomenon, emerging from the benefits of proximity in terms of infrastructure, labor markets, and knowledge exchange. These benefits, usually referred to as agglomeration economies, often attract more investment and population, reinforcing growth in core urban areas (Fujita, M., and Thisse, 2014).

In fact, with the uncontrolled growth of cities, agglomeration processes have increasingly developed into metropolitan regions with features of discontinuity in space, urban

sprawl, and ecological challenges. Planning such complex entities requires going beyond municipal boundaries and treating the entire agglomerated area as a unified spatial system(Shukla et al., 2021). The concept of an urban agglomeration emanates from the varying urban economic and spatial theories that explain how cities evolve into these concentrated nodes of economic and social activities

2.2.1 Urban Agglomeration Classifications in Census Data

Urbanization in India represents a complex pattern of spatial expansion that often extends beyond administrative limits of statutory towns. The Census of India, therefore, attempted to capture this reality through certain specific urban classifications, namely, Out Growths (OGs), Census Towns (CTs), and Urban Agglomerations (UAs), which together capture the true extent of urban development. These classes are fundamental to the understanding of functional urban regions and planning interventions required for managing growth at appropriate spatial scales(A. Das et al., 2023).

Outgrowths or OGs are peripheral settlements that fall just beyond statutory town boundaries but are contiguous and functionally integrative with the parent city. In general, these areas manifest urban characteristics, including permanent housing, paved roads, basic public utilities, and a majority of the working population engaged in non-agricultural employment (Census of India, 2011). OGs reflect spillovers or peri-urban growth of cities, manifestation of increasing population, informal development, and growing demands for services. In spatial planning, OGs have been helpful for planners in identifying areas that need integration into the urban development framework-either by extending infrastructure, land use controls, or their inclusion in municipal jurisdiction in the future.

Another category that reflects bottom-up or hidden urbanization in India is that of Census Towns. These are the rural settlements that satisfy specific Census criteria for classification as urban, with a minimum population of 5,000 inhabitants, at least 400 persons per square kilometer, and no less than 75 percent of the male workforce in non-agricultural work (Dhilip et al., 2023). Normally, CTs grow without any master plan or urban governance arrangements, and thus urban growth often lags behind the institutional capacity to manage it. For spatial planners, CTs present areas where the functions of urbanization have already

emerged, and pre-emptive planning, investment in infrastructure, and possible transition to ULBs are warranted to support orderly development(Sen, 2012).

Urban Agglomerations (UAs) signify the broader continuous urban fabric and contain a statutory town and its adjoining OGs and CTs that are physically contiguous. UA becomes relevant in understanding the real metropolitan footprint, which is generally much larger than its municipal area. For example, patterns of mobility, linkages of employment, housing markets, and service networks generally operate within the UA rather than within the boundaries of administration(R. Li et al., 2024). From the perspective of planning, UAs provide the basis for integrated regional and decentralized spatial planning in that they enable planners to delineate hierarchical centers, strengthen sub-centers that are emerging, and distribute economic activities more equitably across the urban region. This approach manages the pressures of monocentric growth and promotes a more balanced and sustainable urban structure. In summary, OGs, CTs, and UAs are essential in spatial planning since they bridge the gap between administrative definitions and the functional reality of urbanisation. These categories enable planners to identify the presence of peri-urban growth, informal urban expansion, and regional urban networks; thus, they set a premise for how one could design and develop integrated, polycentric, and viable urban futures. Their relevance is notably significant to planning frameworks intended to optimize land use, control sprawl, and create resilient and inclusive agglomerations(Shohan et al., 2024).

2.2.2 Key Challenges in Urban Agglomerations

In an urban agglomeration, which is primarily one large, continuous urban development by merging cities, towns, and peri-urban areas, various structural, social, and environmental challenges weigh heavily in containing economic growth. One crucial factor is overcrowding and congestion. Large population densities and concentration of economic activities in the core city lead to pressure on the urban infrastructure, longer travel times, and reduced productivity. According to UN-Habitat (2020), congestion is further exacerbated when proportional investment in transport networks and public services does not complement urban expansion.

Another major issue is the growth of informal settlements. While migrants look to job opportunities in agglomerations, the formal housing market often cannot meet the ensuing

demand, leading to the growth of slums or unauthorized colonies. Inadequate access to water, sanitation, and secure tenure usually characterizes such settlements (World Bank, 2015). The spatial inequality between high- and low-income groups becomes increasingly visible, which reinforces socio-economic segregation within the urban fabric.

Another persistent challenge is environmental degradation. The conversion of agricultural land, the loss of green cover, and increased air and water pollution are commonly observed in urban agglomerations. Aggregated industrial activities and high vehicular density in such agglomeration lead to deteriorated air quality, whereas unplanned change in land use disrupts the natural drainage system and increases the risks of urban flooding (Zhang & Seto, 2011). These ecological impacts generally lower the livability of cities and increase vulnerability to climate change.

Agglomerations face problems of governance fragmentation. Where a number of municipalities constitute one agglomeration, various administrative jurisdictions and priorities in planning pres hinder coordinated development. In the absence of metropolitan governance, it results in inefficient allocation of resources and overlapping functions with regulatory gaps (OECD, 2015). Very often, this hampers long-term planning in terms of mobility, land use, disaster management, and environmental conservation.

Lastly, there is infrastructure strain: water supply, waste management, public transport, and energy systems are often beyond capacity in rapidly growing agglomerations. This mismatch, often typical of a rapidly growing population with inadequate infrastructure provision, leads to deficits in services, especially within the perimeter or peri-urban areas where institutional oversight is weak (Shaw, 2021).

In short, while urban agglomerations contribute greatly to economic dynamism, they also simultaneously face a number of challenges interrelated to congestion, informal housing, environmental stress, governance fragmentation, and infrastructure deficit. These call for integrated metropolitan planning, investment in sustainable infrastructure, and policy frameworks that strike a balance between growth, equity, and ecological resilience.

2.2.3 Determinants of Key Challenges in Urban agglomerations

These are influenced by many structural, demographic, economic, and institutional factors that create congestion, informal settlements, environmental degradation, and

governance ills in urban agglomerations. One of the major causes is rapid population growth, basically caused by rural-to-urban migration. Migrants are attracted by higher economic opportunities and industrial growth and improvements in services. However, when population growth surpasses the capacity of infrastructure, it leads to overpopulation, putting excessive pressure on transport systems and making public services inadequate (UN-Habitat, 2020). The inability of the cities to extend the infrastructure proportionally produces chronic congestion and deficits in services.

Other major causes include unplanned and unequal spatial growth. While urban agglomerations spread out, development related to expansion takes place before proper zoning and regulatory mechanisms are laid down. Fragmentation of land conversion, unauthorized subdivisions, and mixed use without planning control-especially in peri-urban areas-are characteristic features (Shaw, 2021). This mismatch between spatial growth and control mechanisms in space leads to informal housing, loss of agricultural land, and unregulated commercial activities.

Another force has to do with economic concentration and monocentric development: Agglomerations usually develop around a dominant urban core where employment, services, and institutions are concentrated. This results in spatial imbalance, where an excessive amount of traffic and population is attracted to small zones, whereas the peripheral areas remain underdeveloped. Economic over-concentration intensifies disparities in access and cements congestion in the core city.

Environmental problems emanate largely from industrial clustering and high consumption patterns. Industries, transport networks, and dense commercial activities generate huge volumes of emissions and waste. In the absence of suitable environmental regulations and their enforcement, pollution loads increase rapidly. It has also been estimated that urban agglomerations in developing countries, due to weak environmental management systems and dependence on fossil-fuel-based mobility, are particularly susceptible to ecological stress (Zhang & Seto, 2011).

Another root cause is institutional fragmentation and weak metropolitan governance. Most urban agglomerations spill over several administrative boundaries-municipal corporations, town councils, and development authorities-that have different plans, budgets, and priorities. Without a clear, unified governance system, land-use planning, transportation, housing, and environmental management cannot be coordinated effectively (OECD, 2015). Such fragmentation leads to inefficiencies in the articulation of region-wide solutions to congestion, pollution, and infrastructure deficiencies.

Finally, inadequate public investment and financial constraints create chronic problems. Most rapidly growing agglomerations have limited budgets, small revenues accrued, and great reliance on the state or central funds. Inadequate investment goes along with slow development of public transport, low-cost housing, waste management, and greening of infrastructure, leading to low service quality and growing urban strain (World Bank, 2015).

To sum up, rapid population growth, unplanned spatial expansion, economic over-centralization, environmental mismanagement, governance fragmentation, and strained finance are at the root of the problems in urban agglomeration. The said causative factors need to be addressed by integrated metropolitan planning, balanced regional development, and strong institutional mechanisms that plan economic growth along with environmental sustainability and social equity.

2.2.4 Urban Agglomeration and Spatial Structure in India

Historically, the process of urbanization in India has been concentrated and uneven. Major metropolitan cities like Delhi, Mumbai, and Kolkata continue to attract disproportionate shares of population and investment, while smaller towns and peripheral regions lag behind (Kundu et al., 2024). The result is a pattern of monocentric dominance and spatial imbalance within most urban agglomerations.

Thus, while the National Commission on Urbanization, 1988, and subsequent policy documents recognized the need to promote counter-magnets and growth centers to achieve regional balance, these initiatives were only partially successful due to weak institutional integration and lack of coordination across planning scale(Sami & Abozeid, 2021).

2.3 Concept of Regional Planning

Regional planning can be described as a kind of systematic process for the development of the region so as to facilitate balanced economic, social, and spatial development. The essence of regional planning lies in the integration of settlements, infrastructure, transportation, land use, and economic activities of the particular geographical region. The purpose behind regional planning is to bring balance among the underdeveloped regions and developed regions.

The idea of regional planning was developed because there is always an unequal development process in different regions. There are certain regions that have attained economic development through industrialization, transportation, and investments, whereas there are other regions that lack economic development owing to their poor infrastructure and inaccessibility.

Regional planning, therefore, attempts to establish growth centers, increase connectivity, enhance infrastructural efficiency, and reinforce settlement networks. Regional planning also facilitates integrated development by taking into consideration the functional relation that exists between urban and rural settlements. Urban settlements serve as economic and social centers, while rural settlements rely on the urban settlements for secondary facilities like health care, education, administration, and job creation.

Region planning in India has become essential due to rapid urbanization, increasing population, industrialization, and migration. Metropolitan planning, growth center planning, industrial corridors planning, and regional infrastructural planning have become popular techniques employed in attaining balance development. Plans such as Smart City Mission, AMRUT, PMAY, and regional transport planning are concerned with integrated and sustainable regional development.

The current study makes use of regional planning concept through evaluating the interrelationship of urban and rural settlements and establishing service centers in the study region.

2.3.1 Concept of Settlement Hierarchy

The size of the settlements, number of people living there, functions performed, and the capacity to provide the necessary services to the people residing there. Each settlement is unique in terms of its infrastructure, economic activities, level of accessibility, and the services provided by it. This means that settlements may be classified as metropolitan cities, towns, growth centers, service villages, and rural settlements.

The higher-order settlements offer specialized services such as university facilities, hospitals, administration facilities, and commerce. The lower order settlements are those which offer basic services like schools, local market facilities, and health care facilities.

The settlement hierarchy is significant in regional planning since it assists in determining the functional significance of settlements and their position regarding the provision of services. In addition, it plays an essential role in planning infrastructure and analyzing accessibility by identifying areas that lack critical services. With settlement hierarchy, planners are able to identify which settlements require strengthening as service centers to other areas.

The hierarchy of settlements is determined by many factors, such as size of population, accessibility through roads, presence of educational facilities, health facilities, markets, and administrative importance. Accessibility and the transport network are key since settlements that have easy accessibility tend to develop faster and attract many services. The settlement hierarchy approach is commonly applied in regional planning research.

2.4 Regional Planning Theories

2.4.1. Central Place Theory (Walter Christaller, 1933)

One of the most notable theories regarding settlement hierarchy is Central Place Theory which was formulated by Walter Christaller in 1933. The theory helps to explain how settlements are organized in space and also describes the distribution of services within a certain area. The theory postulates that settlements act as central places offering services to the surrounding people.

Some of the concepts of the Central Place Theory include threshold and range. The former concept refers to the minimum number of people necessary to offer a specific service to the inhabitants of a settlement while the latter concept indicates the maximum distance

covered by people in order to obtain some good or service. Services with higher orders like universities and specialized hospitals need higher threshold populations, and thus can be found in larger settlements while those services of lower orders like grocery shops and primary schools have low threshold populations.

Christaller's settlement hierarchy is based on higher order centers servicing a greater hinterland while lower order centers servicing small hinterlands. Christaller's theory also included the idea of a six-sided figure for maximizing accessibility and minimizing overlap in service areas.

Despite its unrealistic assumptions, Central Place Theory still enjoys significant importance in regional planning and planning for services centers. Researchers have been modifying this theory for many different regions to study the issues of accessibility and distribution of facilities.

In our current research, we adopt the basic framework of settlement hierarchy and service center as outlined in Central Place Theory.

Core Idea:

Explains how settlements are spatially distributed and the way in which they provide goods and services to surrounding areas.

Key Concepts:

- Settlements (central places) provide services to surrounding hinterlands.
- Hierarchical system: from small villages to large cities.
- Based on market principle, transport principle, and administrative principle.

Planning Relevance:

- Helps planners to identify service centers.
- Used for the location of growth centers and urban hierarchy planning.

According to Christaller's Central Place Theory of 1933, settlements organize in a hierarchy for efficient provision of goods and services within a region. The hierarchy thus defines the basis for understanding the spatial organization of the urban system(Angel et al., 2011).

2.4.2. Growth Pole Theory (François Perroux, 1955)

The idea of growth poles was first propounded by François Perroux, who suggested that there is no uniform development pattern in economics. Economic development takes place in certain active centers called growth poles, which stimulate the development of the economy of the area through industrial activity, creation of employment, transportation, and other infrastructural development(Perroux, 1955).

Growth poles generally develop because of industry concentration, transport, and economic development. This effect gets extended to the neighboring towns through economic and spatial interactions. The theory was subsequently adopted in regional planning for creating balanced development by developing some specific growth centers.

Growth centers serve as service centers for the nearby settlements. The centers offer educational institutions, health care facilities, markets, administration, and means of communication. Development of growth centers will help bridge regional imbalances and ensure better access to rural areas.

In the Indian context, the application of growth center strategy has been made for industrial development, regional planning, and rural development schemes. Pithampur is an example of growth centers created because of industrial concentration and means of transport.

In the current research, settlements are studied based on their functions and growth centers affecting the nearby settlements in the study area are selected.

Core Idea:

Development is not uniform in space; it occurs around an attractor or a center (industry and city) responsible for regional development.

Key Concepts:

• Growth diffuses via backward and forward linkages.

• "Poles" attract investments and labor.

Planning Relevance:

• Used for developing industrial corridors, special economic zones, and regional growth centers.

Example: Delhi–Mumbai Industrial Corridor (DMIC) in India.

The Growth Pole Theory, by Perroux (1950), elaborated that economic development tends to concentrate around dominant centers, or "growth poles," which are stimulating development in their immediate environment. Over time, excessive concentration at such poles can cause regional imbalance, raising the need for strategies of decentralizing growth. (Pacione, 1990).

2.4.3. Core–Periphery Model (John Friedmann, 1966)

Core Idea:

Development is spatially unequal: "core" regions command the leading positions in economy and innovation, while "peripheries" remain dependent.

Key Concepts:

• Core developed, industrialized, innovative.

• Periphery: underdeveloped and resource-dependent.

• Development diffuses from core to periphery over time.

Planning Relevance:

• Used to address regional disparities.

• Policies for balanced regional development and decentralization.

Core–Periphery Model by Friedmann (1972), This explains spatial inequality within regions, whereby the core accumulates the resources while the periphery remains underdeveloped(Nosova & Salvati, 2025).

Polycentric Development Theory by Kloosterman & Musterd, (2001), Underlines the development of various connected centers within the region-a balanced alternative to the pattern of monocentric growth(R. Li et al., 2024).

2.5.4. Cumulative Causation Theory (Gunnar Myrdal, 1957)

Core Idea:

Economic growth in one region reinforces itself through positive feedback-spread effects-but may also cause other regions to lag through so-called backwash effects.

Key Terms:

• Spread effects: The benefits of growth diffuse to the surrounding area.

• Backwash effects: drain of labor, capital, and resources from less developed areas.

Planning Relevance:

• Explains why regional imbalances persist.

• Informs redistributive planning and policy efforts that effectively reduce inequalities.

New Economic Geography stressed the importance of agglomeration economies in later formulations, arguing that the drivers of spatial concentration are scale economies and market access advantages. When these forces grow stronger, however, diseconomies of agglomeration such as congestion, shortage of land, and high cost of living start to favor dispersion and decentralization (Fujita, M., and Thisse, 2014).

It is in this way that such theoretical development, moving from monocentric concentration to polycentric or decentralized spatial structures, reflects the continuous search for balance between efficiency and equity in urban and regional development.

2.5.4. Growth Foci Concept by R.P. Mishra

The Growth Foci Concept is another important contribution of R.P. Mishra to regional planning in India. According to the Growth Foci Concept, certain settlements become growth foci because of their location, accessibility, and availability of services(Mishra, 1992).

The function of growth foci is to serve as service centres for other nearby settlements in the region. The settlements become focal points due to better services available in these places. Therefore, it should be kept in mind that planning should aim at enhancing the strength of these foci so that development could reach surrounding areas.

Growth Focii methodology has great significance when it comes to studying the hierarchy of settlements along with analyzing service distribution within the region under consideration. Settlements are ranked using parameters such as population, connectivity, infrastructure, and presence of facilities. In accordance with the ranking obtained, the settlements are categorized as growth centers, growth points, service villages, and rural settlements.

This methodology helps in achieving balanced development of the region by making infrastructure investments in important settlements. It is also useful in recognizing the areas that lack services.

In the current study, Growth Focii methodology is used for studying education and health facilities' distribution along with settlement hierarchy.

2.5 Case Studies

2.5.1 Case I: South Asian Context (Dhaka, Bangladesh)

Measuring Urban Transformation Through Nighttime Lights

Focus Area: Dhaka Metropolitan Area (DMA), Bangladesh

Context and Methodology

Dhaka, too, is a rapidly growing megacity in South Asia, suffering from enormous pressure due to continuous population growth and the fast establishment of industrial centers. The study on Dhaka was conducted to quantify and analyze the urban transformation of the city using remote sensing techniques, similar to that in large global contexts. The methodology adopted in this context predominantly used the VIIRS Nighttime Light datasets combined with the ISODATA clustering algorithm to extract the urban areas in two time slices: 2012-2017 and 2017-2022.

Key Findings

The analysis provided by NTL clearly shows the spatial evolution of Dhaka:

Continued Growth: The findings confirm that Dhaka has continued its physical expansion.

Physical Growth Pattern: Most of the physical growth of Dhaka was observed outside the main city and occurred mainly in the western, northern, and eastern parts of the metropolitan area. From Monocentric to Polycentric: Like many global cities experiencing restructuring due to globalization and shifting economic processes, the Dhaka mega-metropolitan system is in the process of transforming from a monocentric to a polycentric structure. The new centers that are emerging seemingly point towards a more diffused urban function wherein global cities become command and control centers for subordinate production centers. Implications The case of Dhaka underlines that, in the developing world where traditional data sources are usually incomplete, remote sensing and NTL data may be the very means for keeping track of the spatial dynamics of megacities. The now-confirmed shift toward a polycentric structure presents both opportunities for regional balance and challenges related to coordinating infrastructure and services across numerous new centers-a recurring theme in urban agglomerations globally.

2.5.2 Case II: Yangtze River Delta Urban Agglomeration (YRDUA), China

The Yangtze River Delta Urban Agglomeration is one of the most comprehensive cases of spatial decentralization within a polycentric urban structure. It transformed from a highly monocentric system with the predominance of Shanghai into a functionally balanced network of several interconnected sub-centers such as Nanjing, Hangzhou, and Suzhou.

Spatial decentralization was therefore encouraged by infrastructural integration, intercity transport linkages, and policies of industrial relocation with the aim of dispersing economic activities from the core to peripheral cities. Empirical analysis by Chen et al. (2019) shows that while economic polycentricity has increased, social and service functions remain centralized. The "One Nuclear Five Circles Four Belts" development policy focused on strengthening Shanghai's core competitiveness while promoting functional specialization among surrounding cities. However, full spatial balance has not been wholly realized due to the persistence of hierarchical planning and unequal distribution of public services(Chen et al., 2019).**Key Planning Insight:** A polycentric, spatially decentralized framework requires not only economic redistribution but also an equitable distribution of social infrastructure and governance capacity across the agglomeration.

National spatial planning policies in Japan have targeted de-concentration from Tokyo by creating regional growth corridors and sub-centers through transport connectivity and industrial relocation. Likewise, the Seoul Metropolitan Area of South Korea implemented policies of spatial decentralization by creating satellite cities such as Suwon and Seongnam aimed at alleviating urban congestion(Babkin et al., 2024).

In developing countries, initiatives on spatial decentralization often appear as part of metropolitan restructuring. To date, multi-core development policies have been considered as one way to accommodate large-scale urban agglomeration, such as combining market-driven decentralization with state-led spatial planning in the Pearl River Delta and Yangtze River Delta areas in China (Zhao & Long, 2016).Among these examples, spatial decentralization has served as a planning mechanism for polycentric metropolitan regions, enhancing connectivity for the purposes of territorial cohesion.

2.5.3 Case III: Guangdong–Hong Kong–Macao Greater Bay Area (GHMGBA), China

GHMGBA is a cross-jurisdiction urban agglomeration with spatial decentralization realized through functional specialization and networked economic integration. It has an overall polycentric structure with multiple global and regional nodes (Hong Kong, Shenzhen, Guangzhou), supported by an advanced transport network and industrial complementarity.

The research conducted by Li et al. (2024) shows that the spatial-economic structure presents a "core–periphery" pattern, which is gradually moving towards a network formation. The sub-core cities, such as Foshan and Zhuhai, are gaining their importance with targeted regional cooperation, showing spatial rebalancing.

Key Planning Insight:

Connectivity infrastructure and economic planning across administrative boundaries combine to provide effective spatial decentralization in urban agglomerations.

2.5.4 Case I: Siliguri Urban Agglomeration (UA), India

Focus Region: Siliguri Urban Agglomeration (UA), India

Context and Methodology

The rapid pace of urbanization across medium-sized cities represents an apparent and often under-investigated process in developing countries like India, since researchers generally focus on larger cities. Such a gap is to be addressed by the case study of Siliguri, a fast-growing medium-sized city in Eastern India, aimed at assessing and predicting urban growth by means of satellite imagery, statistical techniques, and the Future Land Use Simulation (FLUS) model for up to 2030.

Key Findings

The study underlines the main challenges of the rapid, unplanned expansion common in many intermediate-sized Indian cities:

Spatial metrics and Shannon entropy results clearly indicate that the Siliguri UA is facing rapid sprawl. Uncontrolled urban sprawl and land-use conflict

Planning Gap: The research indicated a wide gap between observed and planned urban development.

Unsustainable Growth: The simulation model indicates that this trend cannot be sustained and the built-up area would increase further by 2030. Environmental Impact: Critical consequences of sprawl include the potential loss of major cultivated land, fallow land, and flora. Policy and National Implications The Siliguri case study is a proxy for the urbanization challenge in India's tier-2 and tier-3 cities, which are undergoing high growth but without proper planning oversight. The key policy implication is the urgent need for satisfactory policies specifically tailored for medium-sized cities. These policies are to be implemented toward managing the urban growth, checking unsustainable sprawl, and protecting the surrounding agricultural land and natural resources(Roy & Kasemi, 2022).

2.5.5 Case II: Bengaluru Metropolitan Area, India

Uncontrolled Sprawl and Fragmented Governance in a Megacity

Focus Area: Bengaluru (formerly Bangalore) Metropolitan Area, India

Context and Methodology

Bengaluru, India's "Silicon Valley," is one of the largest megacities in the country and an epicenter of technology and economic growth. This rapid transformation has put the physical and institutional structure under tremendous pressure, thereby making it one of the most critical case studies with regard to managing growth in the Global South. Researchers have quantified growth in Bengaluru using Geographical Information Systems (GIS) and multi-temporal satellite imagery, such as from Landsat. Common methods include:

- Land Use/Land Cover LULC Classification
- Shannon's Entropy Method for measuring dispersed development or sprawl
- Using NTL data to assess socioeconomic disparity and development patterns.

Key Findings and Challenges

Bengaluru typifies classic, high-speed growth patterns common to fast-urbanizing Indian megacities:

Hyper-Sprawl: Indeed, the trend of a dispersed development pattern in Bengaluru's urban sprawl has been confirmed with an increasing trend in Shannon's Entropy values. The growth in built-up area is about 87.62% in just 20 years-from 2001 to 2021.

Environmental Degradation: All these increases in built-up area come at a higher environmental cost, which includes a decline in vegetation cover-a reduction of 313.68 km² in 20 years-and a substantial decline in water bodies/lakes.

Structural Fragmentation or Polycentricity: The governing of the city-at-large is typified by institutional fragmentation and a partial polycentric system where no one authority holds a monopoly on command. However, this polycentricity-meaning multiple decision-making centers-can introduce greater flexibility at times but also introduces adverse outcomes such as a lack of alternative analysis in big project decisions and a deficiency in user participation. Disparity and Development Gaps: Utilization of NTL and NLDI has shown large developmental gaps between well-lit downtowns and poorly illuminated peripheral areas, including slums. Implications for India Bengaluru represents a strong case study for holistic land-use and transport planning for Indian megacities. Unplanned rapid sprawl and the resulting loss of green cover and water bodies call for urgent sustainable urban planning policies. Further, its case underlines the challenge in translating de jure polycentric governance into effective functional polycentricity that coordinates services and meets intra-city socio-economic disparities (Sen & Dum, 2025).

The spatial inequalities between core and periphery are marked in the case of urban agglomerations like Delhi NCR and Mumbai Metropolitan Region (MMR). In Delhi NCR, despite several planning agencies, the dominance of Delhi remains, while its smaller towns like Ghaziabad, Gurgaon, and Faridabad remain functionally dependent on the core (Deepthi et al., 2024). In MMR, efforts at spatial decentralization have been tried with the growth of Navi Mumbai and Thane; however, integration between such sub-centers remains incomplete (M. Q. Li et al., 2025).

Medium-sized agglomeration cases like Indore UA and Bhopal UA in Madhya Pradesh are emerging, where decentralization could perform a transformative function in distributing growth in space while bringing about improvements in regional accessibility (NIUA, 2022).

2.6 Facilities Distribution and Accessibility

Facilities distribution is defined as the distribution pattern of public facilities and amenities across an area. Examples of facilities include schools, hospitals, transportation, water provision, and markets which are very important for development.

The unevenness in facility distribution gives rise to issues related to accessibility. Urban areas always tend to have better infrastructure and facility accessibility, whereas rural

areas face difficulties in accessing educational and medical facilities. These factors ultimately affect literacy levels and health standards as well as employment prospects.

Analysis of accessibility is an important aspect of regional planning due to the ease or difficulty that residents face when accessing facilities. High accessibility is important since it promotes social and economic inclusion while poor accessibility causes isolation and poor development.

Accessibility can be facilitated through good connectivity through transport routes. The settlements linked through significant roads and transport routes have experienced rapid growth and development due to high accessibility. This is the reason why distance and road networks are important parameters in facility location studies.

The study of accessibility and service location is useful in identifying the gaps in provision of essential facilities within a region to promote development.

2.6.1 Planning of Educational and Health Infrastructure

Educational and health infrastructure facilities are one of the major elements indicating the state of development of any region. Educational infrastructure helps in improving literacy, skills, empowerment, and human resource development. On the other hand, health infrastructure contributes towards improved health conditions, lower mortality, and better quality of life of people(Pacione, 2009).

It is extremely crucial to have sufficient numbers of schools, colleges, hospitals, and health centers for sustainable development. However, due to the process of rapid urbanization and uneven development, there might be imbalances in infrastructure. Several rural areas fail to have enough educational or health infrastructure facilities.

Education planning involves ensuring that educational institutions are made available to everyone. Health care planning includes making sure that health care facilities are available to both rural and urban communities. Appropriate location of facilities is needed for the purpose of equitable social development.

This current study is based on the analysis of the distribution pattern of educational and health facilities.

2.7 SDG Goal 3 & SDG Goal 4 in Regional Planning

The Sustainable Development Goals formulated by the UN lay down the blueprint of sustainable development and inclusiveness. SDG Goal 3 aims to ensure healthy lives and promote well-being for all, whereas SDG Goal 4 concerns the promotion of quality education and inclusiveness.

Proper distribution and availability of healthcare and education facilities can help achieve the above goals. Unequal distribution of healthcare and education facilities often leads to inequalities among different sections of society. Hence, there exists the need for regional planning to enhance accessibility of facilities.

It is relevant for the present study considering SDG Goal 3 and SDG Goal 4 because it deals with the analysis of distribution patterns of facilities.

2.8 Application of GIS in Settlement Hierarchy and Facility Distribution Analysis

GIS is an important tool in regional planning and spatial analysis. It is useful in the management, visualization, and analysis of data associated with various settlements, infrastructure, transport networks, and services.

Weighted overlay analysis, buffer analysis, proximity analysis, and network analysis are some of the important methods used in GIS application in settlement hierarchy and facility distribution studies. Weighted overlay analysis assists in determining the functional importance of settlements based on weighted parameters like population size and facilities present in the region.

Buffer analysis aids in determining the coverage area of certain facilities such as hospitals and schools in the study area. Buffer analysis helps determine both the covered and uncovered areas in a given region. GIS-assisted accessibility analysis assists in making decisions through spatial analysis.

Application of GIS in settlement hierarchy provides a scientific technique for identifying growth centers and service distribution.

2.9 Previous Researches Review

A few researchers have conducted studies on the topic of service centre, hierarchy of settlements, and facility location in regional planning. In the past researches, accessibility,

connectivity, and availability of infrastructure has been highlighted as important determinants in establishing settlement hierarchy.

Earlier researches have used theories like Central Place Theory and Growth Centre concept for spatial analysis of services and facilities(Christaller, 1966). Many researches have applied geographical information systems (GIS) to identify underserviced locations and accessibility of healthcare and education facilities.

Regional planning studies in the Indian context have stressed on the significance of developing intermediate settlement centres to relieve pressure on metropolitan cities and promote balanced development. Also, the earlier studies concerning industrial corridors showed that industrialization plays an important role in development of settlements, migration, and facilities.

Uneven distribution of facilities is one of the problems faced by a rapidly urbanizing region. Hence, identification of service centres and analysis of accessibility is crucial for regional planning.

2.10 Research Gaps Identified

While there is extensive research carried out on the subject of settlement hierarchy, facility allocation, and regional planning, not many researchers have worked on the combined study of educational and health facilities in the Indore-Dewas-Pithampur region. Studies carried out till date primarily deal with the issues of urbanization, industrialization, or transportation planning, leaving behind the detailed study of facility distribution and settlement hierarchy. Also, not many studies have used the Growth Focii approach along with the GIS-based spatial analysis technique for identifying growth centers and facility deficiencies in the region. The current research aims to fill this knowledge gap.

2.11 Conclusion

In summary, the review reveals that regional planning, settlement hierarchies, accessibility studies, and service centre planning play vital roles in ensuring balanced regional development. Concepts like the Central Place Theory, Growth Pole Theory, and Growth Focii Concept explain how settlements should function and how facilities should be allocated. Furthermore, the literature review reveals that access to educational and health facilities is

crucial in ensuring sustainable development and minimizing regional disparities. Geographic Information Systems (GIS) has increasingly become an important technique in studying spatial relationships, locating unserved regions, and making well-informed planning decisions. This current research, thus, will apply this theory to study the spatial distribution of facilities and locate growth focii in the Indore-Dewas-Pithampur region.

CHAPTER 3

3. Research Methodology

3.1 Introduction

Research methodology offers a structured way of ensuring that objectives of research are achieved. This includes the methods of data collection, analysis, interpretation and presentation of findings. In this study, the objective is to evaluate the spatial distribution of educational and healthcare facilities and establish the Growth Focii in Indore Urban Agglomeration, Dewas Planning Area and Pithampur Planning Area. This will be done by the use of a methodology involving settlement hierarchy, scoring, classification of Growth Focii and identification of gaps in the infrastructure.

The methodology used in this study involves quantitative and spatial analysis through secondary data and Geographical Information System (GIS). Factors such as population attributes, educational and health facilities as well as transport links were considered when determining the functional importance of settlements.

3.2 Research Design

This research design follows a mixed-method approach, where both qualitative and quantitative approaches are combined to gain a comprehensive understanding of spatial distribution of Social Infrastructure within an urbanagglomerations.

• Qualitative Analysis focuses on the theoretical understanding of spatial decentralization and the evaluation of planning policies, frameworks, and global best practices.

• Quantitative analysis: Spatial structure of urban agglomerations reflects measurable indicators related to population distribution, service distribution, connectivity, and land-use diversity.

The dual approach gives the assurance of conceptual depth and provides empirical grounding to identify parameters relevant to spatial distribution within urban agglomerations(M. Q. Li et al., 2025).

3.3 Research Methodology

A descriptive and analytical research design is adopted for the present study. While the descriptive part will concentrate on analyzing the current settlement pattern in terms of their distribution, nature, population, availability of facilities and transportation, the analytical part will assess the relative significance of these settlements using the method of weighted score and composite index methods.

The proposed methodology includes the following steps:

- Delineation of study area.
- Collection of secondary data.
- Classification of settlements according to their population.
- Analysis of education and health facilities.
- Road connectivity assessment.
- Calculation of weighted scores.
- Identification of Growth Focii.
- Infrastructure gap analysis.
- Planning recommendations.

3.4 Research Objectives

1. **To identify and analyze Growth Foci's on basis of population, Infrastructure and connectivity.**
2. **To determine Growth Foci's.**
3. **To assess Infrastructure gaps at Growth Foci' s.**
4. **To propose Infrastructure for addressing the gaps.**

3.5 Conceptual Framework

This paper is conceptually underpinned by the notions that urban agglomerations evolve as spatially connected systems and that spatial distribution is an effective distributive mechanism for growth within such systems.

The framework integrates three dimensions:

1. Spatial Structure: To understand the morphological pattern of built-up areas, sub-centres, and connectivity.

2. Functional Structure: It defines how economic and social activities are distributed across nodes.

3. Planning Structure: An assessment of the institutional and strategic instruments that can achieve distribution through zoning, transport integration, and land-use policies.

The theoretical setting of this study is that polycentric spatial organization is more efficient, accessible, and resilient compared to monocentric or sprawled forms (Elburz et al., 2025).

3.6 Research Approach and Methods

The research moves through four successive steps:

Stage 1: Literature Review and Theoretical Analysis

Review of global and Indian literature pertaining to Urban agglomeration, Regional planning theories

Identification of theoretical concepts: central place theory, growth pole, polycentricity, and sustainable urban form.

Stage 2: Indicator Identification

Selection of measurable parameters for spatial planning including:

- Population
- Accessibility and connectivity
- Infrastructure

These parameters are informed by international studies(United, 2024)and regional planning frameworks.

Stage 3: Development of Analytical Framework

- Establishing the relationship between Population and Infrastructure.
- Synthesizing findings from the literature, spatial models, and planning principles into a conceptual matrix that links agglomeration typology to planning strategies.

3.7 Data Sources

As the research is conceptual and generalized, secondary as well as derived data are used.

3.7.1 Secondary Data

- Global and National Reports: UN-Habitat, OECD, World Bank, European Spatial Development Perspective (ESDP), and Indian policy documents such as National Commission on Urbanization, Smart Cities Mission, among others.
- Peer-reviewed journals, books, and academic reports related to spatial planning, polycentricity, and urban systems.
- Conceptual Indicators: Spatial Databases-open access sources such as Global Human Settlement Layer (GHSL), WorldPop, and national census datasets (Census of India, 2011)

3.7.2 Derived Data

Conceptual analysis of spatial relationships and indicators of distribution are synthesized from existing studies and planning models.

2. The results may differ when applied to different urban contexts due to differences in governance, planning instruments, and economic structures.

3. The framework offers generalized spatial guidelines, not site-specific design prescriptions.

3.8 Selection of Indicators

Indicator selection plays an important role in the analysis of hierarchical order of settlements and identification of Growth Focii. Indicators are the means by which the functional importance, accessibilty and service capability of settlements can be assessed in the context of a regional hierarchy. The purpose of the present study is to find out the growth focii and infrastructure gaps of the study area, which comprises the regions of Indore Urban Agglomeration, Dewas Planning Area, and Pithampur Planning Area. Hence, indicators have been selected that reflect demographic strength, services and transportation accessibility.Three main indicators have been selected based on the objectives of the study, literature survey and secondary data availability.

The process of selecting Growth Focii necessitates the use of some demographic factors, infrastructure factors, and accessibility factors as indicators. Three major indicators that were considered for the purpose are:

3.8.1 Population

The population factor is one of the key criteria in settlement hierarchies. Population indicates the extent to which the town is occupied and hence, the degree of potential services requirement. Generally, bigger towns have more functional activities and more facilities than smaller towns. The population criterion also affects the availability of schools, hospitals, markets, transport, etc. In the present case, population is selected as the main criterion as it is a measure of the extent of people concentration in the settlement and also the extent to which services are required. Higher populated towns were ranked highly on account of their greater hierarchical significance. On this basis, Growth Poles, Growth Centres, Growth Points, Service Centres and Central Villages could be identified.

Population is an index of demographic strength and service requirement of the settlement. Larger settlements usually provide a wide range of facilities/services.

3.8.2 Educational and Health Facilities

Educational & Health Facilities Educational and health facilities were chosen as an indicator because they are the indicators that reflect the services provided by the settlement along with their importance. The presence of such facilities as schools, colleges, hospitals, and healthcare facilities indicates how well a particular settlement is able to serve not only itself but the hinterland as well. In terms of the educational facilities, the following have been considered: primary schools, secondary schools, senior secondary schools, colleges, and professional colleges. Regarding health facilities, the following were taken into account: dispensaries, primary health centers, family health care centers, maternity homes, and hospitals. Higher order facilities tend to provide services to more number of people as well as wider areas of services, therefore, were assigned higher weights during the process of evaluation.

Educational and health facilities denote the service capability of settlements. Such facilities are significant in determining settlement hierarchy and regional development.

3.8.3 Road Accessibility

Road connectivity is one of the key indicators used to evaluate accessibility and regional interaction. The transportation network affects the movement of people, goods, and services and determines the growth potential of settlements. The better the connectivity of the settlements, the more chances they have for attracting economic activities, public services, and development projects. In the current study, four types of roads have been considered such as NH – National Highways; SH -State Highways; MDR – Major District Roads; ODR -Other District Roads. The measure of connectivity has been evaluated by considering the number and road hierarchies passing through the settlement under consideration. Settlements having high road hierarchies were considered to be more accessible and important in the region. The combination of population, facilities and connectivity helps to build the settlement hierarchy model and identify Growth Foci

Road accessibility defines the inter-relationship between settlements and determines whether settlements are better linked for interaction or economic activities.

3.9 Criteria for Assessment and Normative Assessment Framework

In order to conduct a systematized and objective evaluation, an assessment criterion and normative standard were established for assessing settlement sites. This is because the aim of the assessment framework was to assess the relative significance of the settlement sites in relation to demographic attributes, infrastructure presence, and transportation links.

3.9.1 Criteria for Population Assessment

The criterion for assessing population was the use of scoring where the settlements were categorized into various population groupings. High population areas were scored high since they have a higher demand and significance of services. The initial evaluation of growth poles, growth centres, growth points, service centres, and central villages was on the basis of the population indicators. The population indicator is very significant in the hierarchy of settlements since the large settlements serve as service centres for their rural environments.

Settlement Classification Based on Population

Settlements were categorized depending on their population sizes. Classes were formulated for population with respective scores assigned to each class in terms of their relative importance within the regional settlement hierarchy. More populous settlements received high scores since they are likely to be more functional than less populous settlements. Population score is then used as one of the major parameters for identifying Growth Foci.

3.9.2 Facility Assessment Criteria

Assessment of educational and health facilities was done based on weighted scores. Weights were allocated differently depending on the significance and level of service provided by the facility. High-order facilities had higher weights since they served more people and offered specialized services. When assessing educational facilities, low weights were allocated to primary schools, while high weights were allocated to colleges and professional schools. In terms of the health facilities, dispensaries and primary health centers were allocated lower weights while maternity homes and hospitals were allocated higher weights. Facility scores for each community were obtained through addition of weights of all facilities. This helped in identifying communities that had high service capabilities and regional influence. Assessment was made on educational and health facilities to identify the service capabilities of each Settlement.

Educational Facilities

The following educational facilities were included:

- Primary school
- Secondary school
- Senior secondary school
- College
- Professional college

Health Facilities

The following health facilities were considered:

- Dispensary

- Primary Health Centre (PHC)
- Family health care centre
- Maternity home
- Hospital

3.9.2.1 Weighted Sum Method

Weighted Sum Method (WSM) was used for computing the facility score of each settlement. This involves giving weights to various facilities on the basis of their significance.

The formula used for the facility score is as follows:

$FS = \Sigma(Si \times Wi)$

Where,

FS = Facility Score

Si = Number/availability of facility i

Wi = Weight of facility i

The weighted facility scores were added up to compute the total facility score for each settlement.

More important facilities like hospitals, maternity homes, professional colleges, and colleges had been given higher weights because of the greater number of people they cater to and the wider area they cover.

3.9.3 Criteria for Road Connectivity

Road connectivity was measured taking into consideration the levels of transportation network hierarchy found in each settlement. National Highways are the first order in the network hierarchy in terms of accessibility and connectivity of a region, followed by State Highways, Major District Roads, and Other District Roads. Settlements that had access to several levels of transport network hierarchy in terms of connectivity were considered more important compared to settlements that had access to only one type of road category. Thus connectivity values were allocated depending upon the connectivity level and hierarchy in individual settlements.

The following criteria have been used for calculating the connectivity scores of various roads:

National Highway (NH) = 4

State Highway (SH) = 3

Major District Road (MDR) = 2

Other District Road/Village Road = 1

Scores were given accordingly on the basis of their connectivity to roads belonging to the above categories.

Connectivity scores were computed for all settlements using weighted sum method.

3.9.3.1 Connectivity Factor

Connectivity of the road network was measured based on the classification and variety of road networks available in each village. There were four types of roads that were taken into consideration, which include National Highway (NH), State Highways (SH), Major District Roads (MDR), and Other District Roads (ODR). The villages were categorized based on the number and classification of road types that were connecting each of the villages. Villages that had all the four types of road networks were considered highly accessible, thus important regionally, while those having lesser number of road networks were ranked lower for connectivity. The road connectivity of the settlements was analyzed based on their hierarchy in the transportation network.

3.10 Relationship Analysis

In order to study the functional characteristics of the settlements, relationships between population, facilities and connectivity were studied.The following relationships were studied:

Population and Infrastructure

Population and Connectivity

Infrastructure and Connectivity

Classified tables were created in order to classify the settlements having strong and weak relationships between the selected indicators.

3.11 Composite Weighted Index Method

Composite Assessment Approach

The final classification for Growth Focii was derived using a composite approach to the assessment of population, facilities, and connectivity. In order to emphasize the significance of each of these variables, the approach included assigning different weights to each variable. Thus, population was allocated a weight of 40%, connectivity was allocated a weight of 35%, and facilities were allocated a weight of 25%. This led to the derivation of a composite index that assessed the functional significance of each town. Based on this composite score, towns were categorized as Growth Poles, Growth Centres, Growth Points, Service Centres, and Central Villages.

Once each of the selected indicators has been analyzed, the next step in order to find out Growth Focii was the Composite Weighted Index Method.

The following weightages were assigned to each indicator:

- Population: 40%
- Connectivity: 35%
- Facilities: 25%

The Growth Focii Index formula is given below:

GFI = (PS × 0.40) + (CS × 0.35) + (FS × 0.25)

Where:

GFI = Growth Focii Index

PS = Population Score

CS = Connectivity Score

FS = Facility Score

3.12 Classification of Growth Focii

On the basis of the above composite scores, the settlements were classified as follows:

- Growth Pole
- Growth Centre
- Growth Point
- Service Centre
- Central Village

The classification enabled the identification of settlements acting as major service centers in the regional system. The hierarchy thus generated served as the foundation for further assessment of infrastructure needs.

3.13 Infrastructure Gaps Assessment

Basis for Infrastructure Deficiency Evaluation Having established Growth Focii, Infrastructure Deficiency Evaluation was carried out to compare existing educational and medical facilities against the anticipated service demands of settlements considering their status hierarchy. The evaluation was based on planning norms, standards of services, and the function performed by settlements in the regional network. Shortages in the development of education and healthcare infrastructure were uncovered, thus specifying investment needs in this regard. The conclusions drawn from the evaluation became the basis for developing planning solutions to enhance accessibility and equality of services in the region.

After the classification of Growth Focii, the Infrastructure Gaps Assessment was performed.

The Infrastructure Gap Assessment involved comparing existing infrastructure facilities in the areas of education and health services to the required needs for each classification.

The results revealed:

- Deficiencies in Educational Infrastructure
- Deficiencies in Health Infrastructure
- Overall Infrastructural Deficiencies

3.14 GIS-Based Approach

Use of GIS-based approaches was done for visualization, spatial analysis, and map preparation.

Variables in the GIS database were:

- Settlement locations
- Administrative boundaries
- Road network
- Education facilities
- Health facilities

The use of GIS helped generate maps indicating the hierarchy of settlements, Growth Focii locations, and infrastructure shortages.

3.15 Methodology Approach

Methodological approach involved:

Data collection -> Indicator selection -> Population assessment -> Facilities' analysis -> Connectivity assessment -> Weighted sum approach -> Composite weighted index -> Growth Focii classification -> Infrastructure shortage assessment -> Planning recommendations

3.16 Conclusion

The methodological approach used in this study involves the integration of demographic, infrastructural, and connectivity criteria to assess Growth Focii and infrastructural needs in the study area. The incorporation of Weighted Sum and Composite Weighted Index methods allows an objective assessment of the hierarchy of settlements and regional planning. The outcomes of this approach provide the grounds for planning intervention to achieve regional balance in development.

Methodology

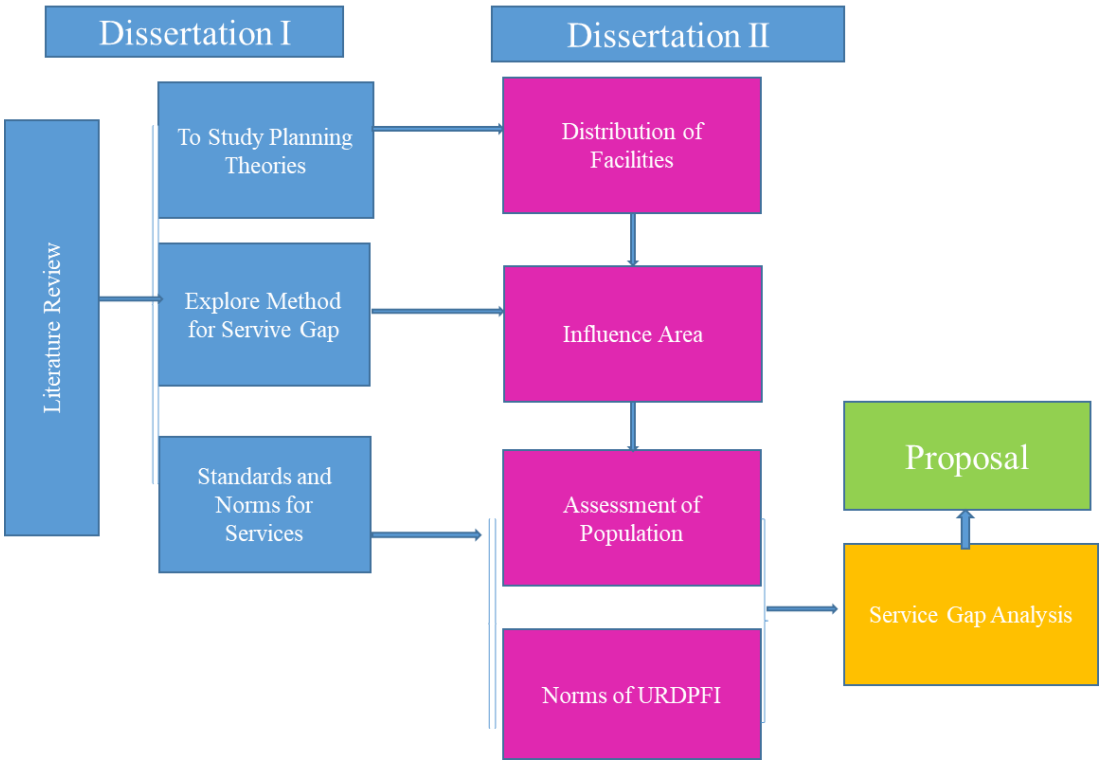

Figure 2 :Methodology

PLANNING FRAMEWORK FOR URBAN AGGLOMERATION THROUGH ….DECENTRALIZATION

CHAPTER 4

4. Conceptual Planning Framework

4.1 Introduction

The conceptual framework developed to guide the planning of urban agglomerations using spatial decentralization as a tool is presented in this chapter. The framework puts together theoretical insights, spatial analysis parameters, and global best practices into a coherent planning structure that supports balanced, polycentric, and sustainable urban growth.

It therefore treats urban agglomeration not as a stand-alone settlement but as an integrated spatial system composed of a core city, sub-centers, and peripheral towns. In this light, spatial decentralization becomes an important strategy for managing growth within an agglomeration by promoting functional distribution, hierarchical centers, and integrated regional connectivity.

4.2 Conceptual Basis

There is a high possibility that urban agglomerations will expand continuously as built-up regions because of economic concentration, migration, and infrastructural development. However, this ultimately causes spatial imbalance, congestion, and unsustainable land consumption if the concentration around a single core is too high.

By rearranging population, employment, and infrastructure across several centers, spatial decentralization of the agglomeration tackles these problems. Theoretical underpinning for this is provided by the following theories:

• **Central Place Theory Christaller 1933**: A hierarchy of settlements exists based on service functions and accessibility.

• **Growth Pole Theory:** This theory, introduced by Perroux in 1950, focuses on development induced through dynamic centers whose influence radiates to the surrounding areas.

• **Polycentric Development Concept:** Hall & Pain, 2006; Camagni & Capello, 2015-a polycentric development concept advocating interconnected centers as a means towards achieving efficiency and spatial equity.

The integration of these ideas forms the theoretical basis necessary for devising a spatially decentralized planning framework that ensures the growth of urban agglomerations in a sustainable manner.

4.3 Conceptual Framework Structure

The Planning Framework for Urban Agglomeration through Spatial Planning is designed based on three interrelated components:

4.3.1 Spatial Structure Component

Focuses on the morphological and locational organization of the agglomeration. It identifies:

Primary Core: The central urban node with the dominant economic and administrative functions.

Secondary Centers: Sub-cities or towns that share complementary urban functions.

Tertiary nodes are small towns and service centers connecting the rural hinterlands with the urban system.

Corridors and linkages: Transportation and infrastructure connectivity that allows flow between centers.

Spatial structure analysis will provide the demarcation of the urban hierarchy and spatial balance necessary for decentralization.

4.3.2 Functional Structure Component

Examines the distribution of activities and services across the agglomeration:

Land use allocation, residential, industrial, institutional, and commercial according to hierarchy.

Identification of specialized functions - education, health, industry, and trade in sub-centers

Promoting employment clusters and mixed land-use zones to reduce the dependency on commuting to the core.

This element provides full complementarity between the poles, excluding double plants and fostering economic synergy(Farooq & Ahmad, 2008).

4.3.3 Connectivity and Integration Component

Integration of infrastructure, transport, and communication systems forms the backbone of spatial planning.

Multi-modal connectivity by road, rail, and public transit between centers.

Regional mobility corridors that guarantee access to goods, people, and services.

Transit-Oriented Development -TOD and compact nodes to prevent sprawl.

An integrated connectivity network strengthens access and cuts travel times to support balanced spatial interaction within the agglomeration(Kundu et al., 2024).

4.4 Guiding Principles of the Framework

The framework works on a set of guiding principles that connect spatial planning and regional development objectives:

1.Polycentric Development:

Promote several growth centers within the agglomeration to distribute population and functions in space.

2.Spatial Hierarchy:

Establish clear levels of centers, such as primary, secondary, tertiary, based on the size, functions, and areas they serve.

3. Complementarity:

Encourage the specialization of each node and develop an interdependent network rather than isolated growth poles.

4. Connectivity and Accessibility:

Develop robust transportation and digital connectivity within the region for better integration and mobility.

5. Land-use Optimization:

Promote compact and mixed-use development to reduce the pressure on the core and achieve more efficient land use.

6.Sustainability and Resilience:

Ensure that there is environmental balance, resource efficiency, and disaster resilience in spatial planning.

7. Regional Integration:

Strengthen the links between urban and rural areas for better balanced territorial development.

These constitute the conceptual pillars for the design and implementation of the spatial planning model.

4.5 Framework Model: Stages of Spatial Distribution in Urban Agglomeration

The proposed framework can be visualized as a multi-stage planning process applied to any urban agglomeration:

Stage Focus Area Planning Actions Expected Outcomes

Stage 1: Spatial Diagnosis - Urban form assessment, density gradient, functional concentration - Identification of monocentric pattern and pressure zone

Stage 2: Node Identification: Map potential sub-centers based on land availability, connectivity, service levels. Recognition of Spatial Hierarchy and Growth Nodes.

Stage 3: Infrastructure Integration Developing transport corridors, logistics hubs, and public transit connectivity. Improved access and efficiency in movement.

Stage 4: Land-use and Functional Distribution: Strategically allocate land uses at nodes considering comparative advantages; diffuse concentration and balanced land use.

Stage 5: Regional Coordination: Combine local bodies' plans into regional planning frameworks. Institutional coherence/governance alignment

Stage 6: Monitoring and Feedback; Performance Evaluation: through spatial indicators (density, connectivity, service access) Adaptive Planning and Long-term Sustainability

This is a staged process that makes distribution not only theoretical but also operational, linking planning instruments with measurable spatial outcomes.

4.6 Policy and Planning Implications

The proposed framework offers insights into how regional and urban planners might integrate spatial distribution into policy and plan-making processes:

• At the Urban Level: Encourage multi-nodal planning within master plans and integrate sub-centers and corridor development.

• At the Regional Level: Coordinate metropolitan and district-level plans to achieve territorial cohesion.

• At the Policy Level: Promote national and state policies supporting polycentric and spatially balanced development, for instance, Smart Cities Mission, AMRUT.

• Institutional Level: Enhance the coordination mechanisms between municipal and regional planning bodies for proper management of agglomerations.

Spatial distribution, therefore, is both a conceptual philosophy of planning and a policy instrument in practice to attain the goal of balanced regional development.

4.7 Anticipated Outputs of the Framework

The implementation of the proposed framework is expected to result in:

1. A polycentric urban agglomeration structure that promotes spatial balance.

2. Better land utilisation through planned allocation of activities.

3. Reduced congestion and environmental stress on the core urban areas.

4. Improved accessibility and connectivity within the urban area.

5.Integrated regional planning promoting economic and spatial equity.

The framework ultimately presents a vision for an efficient, inclusive, and sustainable urban spatial structure that assures conformance to global planning paradigms and the SDG 11 goals.

4.8 Conclusion

This paper developed a conceptual model for planning urban agglomerations through spatial decentralization. The framework highlighted polycentric spatial structure, functional complementarity, and integrated connectivity as the core pillars for balanced urban growth.

By embedding decentralization into the spatial dimension of planning, rather than merely administrative governance, the framework suggests a strategic pathway toward more resilient and sustainable urban systems.

The next chapter presents the findings and recommendations that detail the way this conceptual framework can help inform actual planning practices in the management of urban agglomerations in developing contexts.

CHAPTER 5

5.Study Area Profile

5.1 Introduction

The Study area comprises of one urban agglomeration, one city and one town that are functionally interconnected. Pithampur is considered one of the significant industrial towns in Madhya Pradesh, which has been nicknamed “Detroit of India.” The reason for this nickname is the presence of extensive automobile and manufacturing industries in Pithampur. The town is close to Indore and is an important constituent of the Indore Metropolitan region and urban cluster. There has been considerable growth witnessed in the town after the setting up of industrial estates by MPIDC (Madhya Pradesh Industrial Development Corporation).

The economy of Pithampur can be understood on the basis of its economic base, which is primarily oriented towards exports and manufacturing. Secondary sector activities play a dominant role in the economic activities of the town and include auto-manufacturing, engineering industries, pharmaceuticals, textiles, and processing industries. The presence of many industries has created a lot of employment opportunities, leading to a large inflow of migrants from surrounding rural and urban settlements.

Urban planning wise, Pithampur is a higher-level industry-oriented growth pole in the settlement system. The important factor regarding the location of Pithampur is that it enjoys better connectivity due to its locational advantages with respect to major transport routes that connect it with other cities like Indore and Dhar and other towns within the region. The effects of industrialization have led to a change in the settlement system characterized by mixed development, development of housing colonies for workers, commercialization, and expansion of peripheral area of the town. Nevertheless, urbanization has brought about problems like traffic pollution and lack of adequate public services.

Dewas is an industrially advanced and economically productive city that is situated in the Malwa area of Madhya Pradesh state. This city exists between the cities of Indore and Ujjain. The economic and industrial growth of Dewas can be attributed to its diversified nature, which

includes industrial, agriculture and trade sectors. National highways and railways networks connect Dewas with other parts of the region, thus promoting economic integration and industrialization.

From an economic base point of view, Dewas boasts a diversified economy, which consists of industries as well as the service sector. Some industries include engineering industries, pharmaceuticals industries, food processing industries, soy processing, textiles industries and banking note press industries. In addition, the economy of Dewas also includes agriculture and agrarian trading.

From the perspective of urban planning, Dewas can be termed as a regionally focused service and industrial center, which affects other rural and urban centers around the city. The process of industrialization and development in the city has seen urban growth in the form of population increase and growth in geographical coverage. Urban developments have taken place in terms of housing colonies, business centers, education centers, health centers, and improved transport connectivity. Nevertheless, urban growth has posed numerous problems in relation to pressure on infrastructure, traffic, environment, and increased demands for services.

5.2 Location of Study Area

The site for our research shown inFigure 3, Indore, is found at the geographical center of Madhya Pradesh, India. This place can be located somewhere near the latitude of 22.72° N and longitude of 75.86° E. Indore is the biggest city in the state, which acts as an important economic, industrial, and educational center in central India. The city enjoys connectivity to various parts of the country via highways, railways, and aviation facilities. This locational advantage has resulted in a spurt in urban development activities and migration, making it an important place

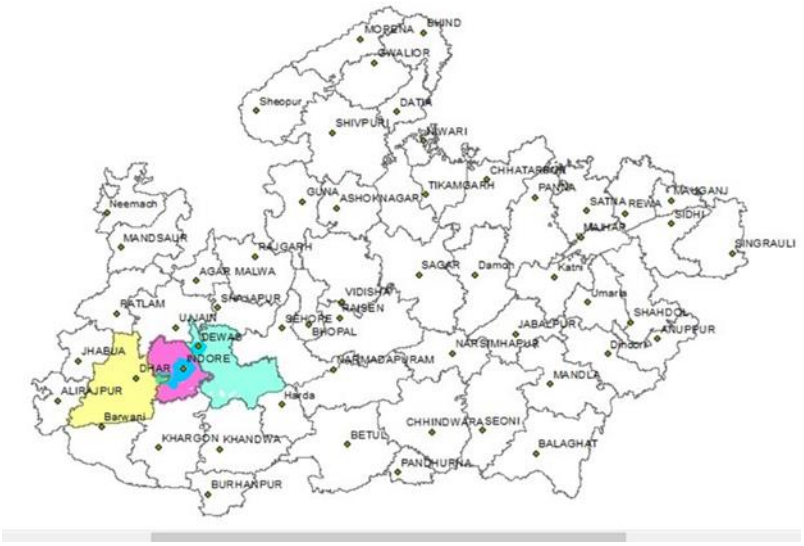

Figure 3:Location Map of Study Area

5.3 Physical Characteristics of the Study Area

The study area, comprising portions of Indore, Dewas, and Dhar districts of Madhya Pradesh, has a terrain consisting mostly of plateaus, being a part of Malwa Plateau. There is a gently undulating topography in the area having an elevation of about 500-550 meters above mean sea level. The area has a landscape which can be considered favorable for habitation as well as agriculture due to stable and moderate slopes.

The drainage in the area comprises small rivers and streams, which include the Khan River and Saraswati River, flowing in the area providing water resources. There is a typical dendritic pattern of drainage prevailing in the area, which reflects homogeneous geology of the area. Most of the water bodies in the area are seasonal and dependent on monsoon rains.

The study area is covered mostly by agriculture, with extensive farming on its land. There is also presence of urban development mainly at Indore city and its peri-urban areas, with the rest being rural in nature having open farmlands and sparse settlement. Regur soils dominate the land, which is fertile enough to grow soybean and wheat crops.

In conclusion, the physical attributes of the study area that include stable plateau topography, fertile soils, and good drainage have been favorable for the development of agriculture and urban areas, especially in Indore. Nonetheless, water availability during seasons and increased urbanization are the challenges faced.

5.3.1 Study Area Climate

The study area falls within the state of Madhya Pradesh and has a climate that can be described as subtropical. The climate is marked by the existence of three different seasons, including summer, monsoon, and winter. Summer periods fall between March and June when temperatures exceed 40 degrees Celsius. Winter months fall between November and February when temperatures range from 10 to 25 degrees Celsius.

Annual rainfall in the study area averages between 900 and 1000 millimeters, which is primarily experienced during the southwest monsoon period (June to September).

In this regard, there is heavy dependency on rainwater for various purposes, such as agriculture and domestic consumption. Seasonal rainfall is likely to influence water resource management within the study area.

Climatic conditions have implications for settlement patterns and economic activities. Favorable winter climates encourage settlement and urban activities. On the other hand, hot climatic conditions during summer months present water resource challenges. These challenges are compounded in cities undergoing rapid urbanization, such as Indore.

Short Analysis

- Plateau + flat terrain = easy urbanization
- Rich soils = agricultural development
- Seasonal river = reliance on monsoon rains
- Concentration of settlement = peri-urbanization

Inference

The physical environment facilitates urbanization; nevertheless, growing stress on land and water resources necessitates planned and decentralized urban development.

5.3.2 Connectivity in the Study Area

The study area has a well-established network of roads and means of communication, thus making it an important place from the perspective of development. Indore acts as the major connection point connecting other nearby districts like Dewas and Dhar via roadways.

The area has an established network of national and state highways, helping to facilitate transportation and the movement of goods and people. Major transport routes such as the Indore-Dewas route and the Indore-Pithampur route play a vital role in supporting economic activities within the region, especially in the Pithampur industrial estate.

Railway connections are available through major railway stations like Indore Junction railway station, which helps connect the region to all parts of the country. The area has air connections from Devi Ahilya Bai Holkar airport, allowing easy access at a national level.

5.4 Settlement Structure of Study Area

The study area *Table 1*comprises 125 settlements, which include 111 villages, 6 census towns, and 8 towns/cities, with the total population being 2,874,791. While villages have the largest number of settlements, they have only 8.2 percent (235,919) of the total population in an extensive land area of 547.63 sq. km, producing a fairly low density of 430.79 persons per sq. km. The census towns, which have only six settlements, contribute 1.9 percent (54,532) of the total population in an area of 25.41 sq. km, reflecting a relatively high density of 2,146.08 persons per sq. km. On the other hand, urban settlements (towns/cities) are characterized by the highest percentage of 89.9 percent (2,584,340) of the total population in 421.72 sq. km of space, making the population density extremely high at 6,128.09 persons per SqKm.

Table 1:Sructure of Settlements

No. of Settlements	Type of Settlements	Population	%of Population	Area (Sq km)	Population Density
111	Rural	235919	8.20%	547.63	430.79
6	Census Town	54532	1.90%	25.41	2146.08
8	Urban	2584340	89.90%	421.72	6128.09
125		2886750	100%	994.76	2889.93

Source: Census of India 2011

5.4.1 Density of Study Area

The total number of settlements that exist in the study region includes 111 villages, 6 census towns, and 8 towns or cities having a total population of 2,874,791. Although the number of villages is highest among all the settlement types, they have accommodated only 8.2% of the total population (i.e., 235,919) in an area of 547.63 sq. km. As a result, the total population density in the villages has been estimated at 430.79 persons per sq. km. The same holds true for the 6 census towns, which despite being classified as rural are occupied by just 1.9% of the total population (i.e., 54,532). Nevertheless, their density level is significantly higher (i.e., 2,146.08 persons per sq. km) compared to the villages due to their transitional nature.

On the other hand, the number of towns or cities is relatively lower, occupying only 421.72 sq. km of the total land area; however, the population density there is extremely high at 6,128.09 persons per sq. km because they house 89.9% of the total population.

- The density is extremely high in urban areas (89.9%) — urban predominance
- Density is low in villages despite large area — scattered settlement pattern
- Census towns have extremely high density but small percentage — possible urban centers of the future
- Enormous difference in densities (430 against 6128) — uneven distribution of space

5.5 Administrative Profile of the Study Area

The study area falls within the central region of Madhya Pradesh and stretches over three districts namely Indore, Dewas, and Dhar. The total geographical area of the study area spans 994.76 sq. km which includes both rural and urban areas that are scattered in various tehsils such as Indore, Depalpur, Mhow, Sawer, Dhar, and Dewas.

From the administrative point of view, there are a total of 125 settlements in the study area, out of which 111 settlements are villages, 6 are census towns and 8 are statutory towns/cities. Among these, villages have an area of 547.63 sq. km showing high dominance of rural geography, whereas census towns span an area of 25.41 sq. km, and towns/cities occupy an area of 421.72 sq. km.

Indore Municipal Corporation dominates the urban system. Secondary urban systems include Pithampur and Dewas Municipalities, with other secondary urban centers being Nagar Panchayats of Betma, Rau, Hatod, and Mhowgaon. Furthermore, emerging urban centers include census towns such as Sinhasa and Bank, which have features of both rural and urban areas. Mhow Cantonment is yet another secondary urban system within the area.

Tehsils are the second level administrative unit within the study area. Subsequently, tehsils are subdivided into villages and urban clusters. Tehsils such as Depalpur and Dhar have a predominance of villages, implying that most of the land within the two tehsils is under rural settlement. On the other hand, Indore and Mhow tehsils have greater influence from urban centers since they are closer to the city center. Examples of villages within the study area include Salampur (476027), Kishanpura (476023), Nalrai (476250), and Sindodi (476249).

5.5.1Urban classification of Towns

Existence of highly concentrated urban node: The Indore Municipal Corporation emerges as the major economic-administrative hub.

Urban fringe growth: Nagar Panchayats of Rau, Betma, and Hatod along with census towns of Sinhasa and Bank signify rapid urban sprawl.Rural hinterland connections: A large number of villages in different tehsils such as Depalpur, Mhow, and Dhar appear to be economically dependent on the city of Indore.

Administrative zoning and organization: Presence of hierarchical organization at district > tehsil > town/village level.

Census towns suggest ongoing transition from rural to urban land uses.

5.6 Characteristics of Population in the Study Area

The total population in the study region is 2,874,791, consisting of residents residing both in rural and urban regions in an extremely unevenly spread pattern. The vast majority of the population lives in urban areas shown in Figure 4, which make up 89.9% of the total population of 2,584,340. On the other hand, rural areas make up only 10.1% of the total population. More specifically, the proportion that lives in villages is 8.2%, totaling 235,919 residents, while 54,532 live in census towns.

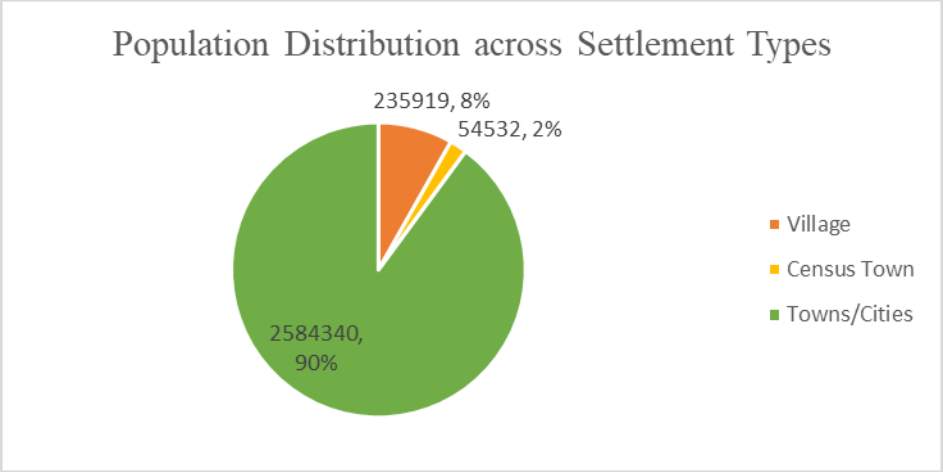

Figure 4:Population Distribution across Settlement Types

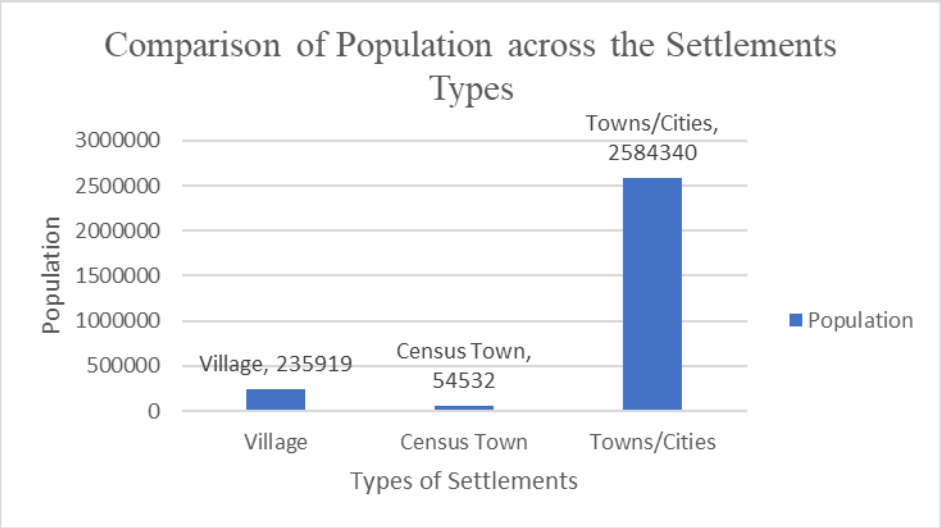

Figure 5:Comparison of population across the Settlement Types

"The population distribution *Figure 4* has a very clear skewed distribution, indicating that cities/towns contribute to a larger percentage of the total population compared to villages and census towns. The hypothesis that the region is dominated by the presence of an urban population is thus confirmed."

Villages are the most extensive in terms of geographic area (547.63 sq. km) yet the least densely populated, with only 430.79 persons per square kilometer of area. Urban areas/towns/cities are characterized by a smaller geographic extent of 421.72 sq. km but extremely high population density, at 6,128.09 persons per square kilometer. As regards census towns, their small geographic extent and relatively small population make them somewhat dense regions, with population densities of 2,146.08 persons per square kilometer

5.6.1Population Growth Trend

The analysis of population growth in various towns from 1901 to 2011 shows that there is a great disparity in the growth of urban areas in the region. The town of Indore has turned out to be a primate city because of its fast-growing population. While in 1901, the population of the town was 97,804, in 2011, it reached 1,994,397 people. It can be said that this rapid increase in population has occurred mainly since 1951. There are examples of peripheral town growth, like those seen at Rau and Mhowgaon, which also show considerable growth in the period 2001 to 2011, showing some kind of spillover effect from Indore. On the other hand,

growth at Mhow is rather sluggish and inconsistent, even declining in the last decade, probably because of restrictions imposed by the fact that it is a cantonment town. The development of another urban center like Dewas shows moderate but consistent growth. Another point to be noted is that there are new census towns like Manglaya Sadak and Sinhasa emerging after 2001.

Industrial Growth at Pithampur & Peri-urban Towns

There is an abrupt increase in population at Pithampur after 1991, i.e., (11,980 → 68,080 → 1,26,200).

This is an example of industrialized growth (effect of SEZ & industrial hub).

Similarly, there is rapid growth at Rau & Mhowgaon during 2001-2011 (by 50-70%).

Steady but Moderate Growth – Cantonment Town

Mhow has experienced a moderate growth, more particularly, the growth has been less consistent.

Even negative growth occurred in 2011 (-11.54%) which indicates restricted development due to defense land.

Growth of Secondary City – Dewas

Dewas has shown steady growth, especially from 1971 to 1991 (50-96%).

It is developing as a secondary urban center, but at comparatively slower pace than Indore.

Census Towns

The emergence of census towns like Manglaya Sadak, Sinhasa & Bank since 2001 indicates rural urban transformation, an aspect of peri-urban expansion.

Spatial Pattern

Growth pattern is mainly concentrated around Indore (peri-urban zone).

This trend justifies the process of urban sprawl and decentralization requirement.

Indore As Primacy City

Population of Indore increased from 97,804 (1901) to 19,94,397 (2011).
The rate is always high (in 30-50% range), more particularly after 1951.
This clearly indicates that urban concentration is highly dominant in case of Indore.

CHAPTER 6

6. Data Collection and Data Analysis

6.1 Overview of Data Collection

The current research is concerned with the urban agglomeration of Indore, along with its urban nodes, which include Dewas and Pithampur. For the collection of data in the current research, the use of secondary data sources is only made, mainly from the Census of India.

The database includes important parameters like population and settlement type, such as villages, towns, and urban areas. Moreover, data related to the educational institution category have also been incorporated, which include primary schools, upper primary schools, secondary schools, and senior secondary schools.

The standards used to evaluate the need for and distribution of these educational infrastructures have been derived from the URDPFI Guidelines and RADPFI Guidelines. These guidelines contain standardized standards according to population cut-off points and service delivery.

6.1.1 Types of Data Used

Due to the fact that all of the information used in this study is secondary, consistency and reliability can be guaranteed. The use of Census data in conjunction with national guidelines makes it possible to carry out an objective assessment of any infrastructure deficiencies, thereby assisting in the formulation of strategies for regional development.

Secondary data, gathered from the Census of India, will be used in the research. The data set will contain variables such as population and area that will help determine the population density and spatial pattern of settlement in the study area. Data regarding the number of educational institutions, from primary level to senior secondary level, will also be analyzed for determining the provision of educational services.

Data on road networks in the region will also be included and depicted spatially for the context of connectivity in the region. However, this variable is not expected to be used in the analysis section of the research paper.

The data used in this study is secondary in nature and derived from Census of India. Important variables include the number of people and the area. Using this information, calculations for population density have been done and used to analyze the spatial distribution of settlements in the study area. Data on the number of educational institutions, including primary and senior secondary, have also been taken into consideration to gauge educational infrastructure.

Furthermore, road network information has been included and shown spatially; however, it has not been used in the analysis part of this study. Taken together, the data variables aid in analyzing demographic features and infrastructure in different settlements.

The methodology used for analyzing the research includes quantitative and spatial analysis through the use of secondary data from Census of India. Different methodologies have been adopted for determining the distribution and need of educational institutions in the study region.

Population density has been determined using the data on population and area.

Population Density= Total Population/ Total Area

For estimating the need for the schools, the threshold population approach has been considered taking into account the norms available in the URDPFI guidelines and RADPFI guidelines. Through this approach, it is possible to find out the number of institutions needed in the various levels of education like primary, upper-primary, secondary, and senior secondary depending upon the population numbers.

6.1.2 Methodology of Analysis

Comparison has been done between the existing number of schools and the needed number of schools in order to find out any gap in the existing educational infrastructure facilities. In this way, it will be possible to classify the region into under-developed and adequately developed region with respect to educational infrastructure.

Although the data on road networks have been plotted, yet it has not been included in the calculations.

The purpose of the data collection in the current research study lies in identifying the spatial distribution of population and educational institutions within the Indore urban agglomeration along with its subcenters like Dewas and Pithampur. The gathered data have been studied in order to determine the density of population and activities within the urban areas and also determine the adequacy of the number of schools within different categories.

According to the findings of the analysis, the provision and requirements of schools as per the planning standards are mismatched even though the urban centers possess extremely high density and concentration of population and activities. Despite being more densely populated and offering more amenities, some urban centers have under-staffed schools due to rising populations.

Thus, it can be stated that the purpose of data collection was not just limited to establishing the presence of activities within the urban centers but also proving its consequences.

6.1.3 Purpose of Data Collection

The findings from the study show that although there was a high level of concentration, some urban centers have been poorly served with education infrastructure. This shows that the development of infrastructure has not been fast enough to match the rate of urbanization in these areas. Thus, one can conclude that the objective of this research study is not only about finding out about the patterns of concentration but about the resultant disparities too.

There is a very strong justification for applying a decentralized approach towards planning in order to relieve pressure from the core areas. Planning models, such as the URDPFI and RADPFI Guidelines, focus heavily on balanced regional development and balanced infrastructure distribution.

6.2. Norms Used for Education Facilities

Table 2:Norms used for Education Infrastructure

Standards for Education Facilities-URDPFI Guidelines	
Facility	Population Served
Pre-Primary /Nursery School	5000
Primary School	5000
Middle School	5000 - 15000
Secondary School	5000 - 15000
Senior Secondary School	5000 -15000
College	1 Lakhs
Engineering College	10 Lakhs
Medical College	10 Lakhs
Professional College	10 Lakhs

Source: URDPFI

6.3 Norms Used for Health Facilities

Table 3: Norms Used for Health facilities

Standards for Health Facilities-URDPFI Guidline	
Facilities	Population Served
Primary Health Center	5000
Dispensary	5000 -15000
Nursing Home	1 lakhs
Child Welfare and Maternity Center	1 lakhs
Polyclinic	1 lakhs
Family Welfare Center	1 lakhs
Intermediate Hospital	1 lakhs
General Hospital	5 lakhs

Source: URDPFI

6.4 Distribution of Infrastructure and Population at Growth Foci

Table 4:Distribution of Infrastructure and Population at Growth Foci' s

Distribution of Population and Infrastructure and Roads at Growth Foci			
Order of Growth Foci	Population Served	**Infrastructure**	Roads
Growth Pole	20 -30 Million	Primary School, Dispensary, Secondary School, College, Engineering College, Medical College, Management College, Law College, Technical Institute, Primary Health Center, Family Welfare Home, Maternity Home, Intermediate Hospital, Nursing and Paramedical Institute, Hospital, Speciality hospital, General Hospital	(NH+SH+MDR+ODR)
Growth Center	10 to 12lakhs	Primary School, Dispensary, Secondary School, College, Technical Institute, Primary Health Center, Family Welfare Home, Maternity Home, Intermediate Hospital, Nursing and Paramedical Institute, Multi Speciality Hospital	(NH+SH+MDR), (NH+SH+ODR)
Growth Point	1.5lakhs	Primary School, Dispensary, Secondary School, College, Primary Health Center, Family Welfare Home, Maternity Home, Intermediate Hospital	(NH+MDR+ODR), (SH+MDR+ODR), (SH+MDR+ODR)
Service Center	30000	Primary School, Dispensary, Secondary School, Primary Health Center, Family Welfare Home, Child welfare and Maternity home	(NH+MDR), (NH+ODR) + (SH+MDR)
Central Village	6000	Primary School, Primary Health Care	(MDR+ODR), (SH+ODR)

Source: RP Mishra Growth Foci Theory

6.5 Distribution of Settlements based on Population

Table 5:Distribution of Settlements based on Population

Sr. No	Population	No. of Settlements
1	Above 5lakhs	1
2	1lakhs- 5lakhs	2
3	15000 - 1lakhs	5
4	5000-15000	17
5	< 5000	100
	Total	125

6.6 Distribution of Settlements based on Infrastructure

Table 6:Distribution of Settlements based on Infrastructure

Sr. No.	Infrastructure	No. of Settlements
1	Primary	118
2	Secondary	45
3	Senior Secondary	24
4	College	5
5	Engineering	10
6	Medical	1
7	Manage. College	5
8	Law college	3
9	Dispensary	11
10	PHC	16
11	Family Welfare	13
12	Maternity Home	12
13	General Hospital	3
14	Specialized Hospital	3

Source: Census 2011

6.7 Distribution of Settlements based on Road Hierarchy

Table 7: Distribution of Settlements based on Road Hierarchy

Distribution of Settlements Based on Road Hierarchy	
Classification of Roads	No. of Settlements
National Highway	34
State Highway	14
Major District Road	20
Other District Road	37
Total	105

Source: Census 2011

6.5 Data analysis

The current section contains results of analysis of hierarchical structure and identification of growth foci in the research region. Three main criteria used for such analysis include population, infrastructural elements, and connectivity. The chapter studies spatial distribution of all above mentioned parameters, analyzes interrelation between them and defines possible growth foci.

6.6 Growth Foci' s based on Population

The population hierarchy shown in Table 8 was determined based on population values attributed to the respective settlements. Following the attained values, the settlements were grouped into six classes, namely Growth Pole, Growth Centre, Growth Point, Service Centre, Central Village, and Individual Village.

Table 8: Growth Foci based on Population

Growth Foci based on Population			
Order of Growth Foci	No. of Settlements	Score Range	Population
Growth Pole	1	19 to 25	Above 5lakhs
Growth Center	2	15 to19	1lakhs- 5lakhs
Growth Point	5	10 to 14	15000 - 1lakhs
Service Center	9	6 to 9	5000 -15000
Central Village	22	1 to 5	< 5000

According to the assessment, it is observed that only one settlement qualifies for the Growth Pole class owing to having the greatest population among all the settlements in the study area. There are two Growth Centre and four Growth Point settlements respectively. A total of eight settlements serve as Service Centers, while twenty-two settlements belong to the Central Villages. Eighty-eight settlements qualify as Individual Villages.

The analysis highlights an extremely uneven distribution pattern for the population within the study region. It can be observed that a considerable number of people live in only a few higher-level settlements, while the remaining villages are inhabited by very few people. The two Growth Poles and Growth Centers play the role of important demographically centers and could sustain other settlements economically and otherwise.

6.7 Growth Foci's Based on Infrastructure

Infrastructural hierarchy in Table 9 is based on scores for educational and health infrastructure facilities. Availability of school, college, health centre, hospital, and other social infrastructural facilities is taken into account in determining the hierarchies.

Table 9: Growth Foci' s based on Infrastructure

Growth Foci's Based on Education and Health Infrastructure			
Order of Growth Foci	Infrastructure Score	No. of Settlements	Infrastructure
Growth Pole	Above 100	1	Primary School, Dispensary, Secondary School, College, Engineering College, Medical College, Management College, Law College, Technical Institute, Primary Health Center, Family Welfare Home, Maternity Home, Intermediate Hospital, Nursing and Paramedical Institute, Multi Speciality Hospital, Speciality hospital, General Hospital
Growth Center	51 - 100	2	Primary School, Dispensary, Secondary School, College, Technical Institute, Primary Health Center, Family Welfare Home, Maternity Home, Intermediate Hospital, Nursing and Paramedical Institute, Multi Speciality Hospital
Growth Point	21 to 50	8	Primary School, Dispensary, Secondary School, College, Primary Health Center, Family Welfare Home, Maternity Home, Intermediate Hospital
Service Center	6 to 20	13	Primary School, Dispensary, Secondary School, Primary Health Center, Family Welfare Home, Child welfare and Maternity home
Central Village	1 to 5	20	Primary School, Primary Health Care

Findings reveal that one settlement constitutes the Growth Pole, and two settlements are Growth Centers. Eight settlements have been classified as Growth Points, thirteen as Service

Centers, and twenty as Central Villages, whereas eighty-one settlements fall in the Individual Villages category.

Interpretations

The infrastructure is concentrated within a few settlements. The higher order settlements have more facilities related to education and health; thus, they act as service centers for their regions. The dominance of Individual Villages shows that there are a lot of settlements that lack adequate services and depend upon the higher order settlements for education and healthcare requirements.

6.8 Connectivity Analysis

6.8.1 Growth Foci' s Based on Connectivity

Connective analysis Table 10 was performed through road connectivity in form of NHs, SHs, MDRs, and ODRs. Connectivity ratings for each settlement were established depending on road connective ability.

Table 10: Growth Foci Based on Connectivity

Growth Foci' s based on Connectivity			
Order of foci	No. of Settlements	Score Range	Roads
Growth Pole	4	14	(NH+SH+MDR+ODR)
Growth Center	4	11 to 12	(NH+SH+ MDR), (NH+SH+ODR)
Growth Point	12	9 to 10	(NH+MDR+ODR), (SH+MDR+ODR), (SH+MDR+ODR)
Service Center	18	7 to 8	(NH+MDR), (NH+ODR) + (SH+MDR)
Central Village	26	5 to 6	(MDR+ODR), (SH+ODR)
Village	61	0 to 4	NH, SH, MDR, ODR

Based on the findings, four settlements fall under growth poles, four others as growth centres, and twelve as growth points. Eighteen settlements serve as service centres, while twenty-six settlements are central villages. Finally, sixty-one settlements constitute individual villages.

Interpretation

Unlike the case of population and infrastructures, connectivity Table 10 exists in greater abundance in the study area than the other two factors. This means that the areas endowed with high connectivity levels have good accessibility, which makes them favorable for development. Nonetheless, there exist numerous settlements with low connectivity levels.

6.9 Relationship Analysis

Relationships were analyzed between the population, infrastructure, and connectivity to determine the development pattern of the region. From the analysis, it was observed that a number of settlements having a higher population had good infrastructure in terms of education and healthcare facilities. However, a number of settlements were discovered which had a higher population but poor infrastructure. This suggests that there is an inadequacy of services available. At the same time, there are certain settlements having good infrastructure but fewer populations.

A further investigation into infrastructure and connectivity revealed that settlement sites which had high road connectivity tended to have better infrastructure access. Nonetheless, there were also instances where there were high levels of connectivity but with relatively few people concentrated within the settlement site, implying that infrastructure and connectivity do not necessarily lead to increased population numbers.

The results provide important insights on the presence of spatial disparities when it comes to population numbers, infrastructure, and connectivity within the study area.

6.9.1 Relative Analysis for Central Village

When comparing the results from different factors, six settlements showed up in **Error! Reference source not found.** both population and infrastructure analyses, meaning they have a lot of people and good facilities. Additionally, three settlements stood out for combining population size and connectivity, indicating a strong demographic presence and easy access. Lastly, when look

In at infrastructure and connectivity, seven settlements overlapped, showing a close link between available services and transport convenience.

Just one place met all three requirements: population, infrastructure, and connectivity. This spot shows a good mix of people, facilities, and access, making it the best place to handle central village tasks.

The analysis shows that while lots of settlements met one criterion for population, infrastructure, or connectivity, fewer places satisfied more than one at the same time. Surprisingly, just one settlement met all three criteria, suggesting it has a good balance in all areas. Because of this, it's seen as the best choice for a Central Village. Meanwhile, the others that matched two out of three could be great candidates for developing in the future.

Table 11:Relative Analysis for Central Village

Relative Analysis for Central Village	
Relationship Between Population Infrastructure and Connectivity	
Relationship Category	No. of Settlements
Population and Infrastructure and Connectivity	4
Population and Connectivity	8
Infrastructure and Connectivity	5
Population	2
Connectivity	1
Total	20

Conclusion

In the end, the comparison showed that many settlements met population, infrastructure, and connectivity standards separately, but fewer matched more than one at the same time. Only one place passed all three tests, suggesting it stands out for having a solid population, decent infrastructure, and good connections.

Thus, this standout location makes the cut as the best Central Village. Still, the others that came up in two of the tests could work as backup options for future growth and reinforcement.

6.9.2 Relative Analysis for Service Center

Interpretation

A relative analysis Table 12 was carried out to examine the relationship between population, infrastructure, and connectivity for the identification of potential Service Centers. The individual analysis identified **9 settlements** based on population, **13 settlements** based on infrastructure, and **18 settlements** based on connectivity as suitable for functioning as service centers.

When the results were compared, **three settlements** were found to be common between the population and infrastructure criteria, indicating that these settlements possess both a sufficient population base and the necessary infrastructure to provide services to surrounding areas. Similarly, **four settlements** were common between the population and connectivity criteria, suggesting that these settlements combine demographic strength with good accessibility. The relationship between infrastructure and connectivity showed **five common settlements**, reflecting that well-connected settlements are generally better equipped with infrastructure facilities and have greater potential to serve nearby settlements.

Table 12: Relative Analysis for Service Center

Relative Analysis for Service Center	
Relationship Between Population Infrastructure and Connectivity	
Relationship Category	No. of Settlements
Infrastructure and Connectivity	0
Population and Connectivity	6
Population, Infrastructure and Connectivity	2
Total	**8**

Furthermore, two settlements were found to be common across all three criteria—population, infrastructure, and connectivity. These settlements exhibit a balanced combination of demographic concentration, service infrastructure, and accessibility, making them the strongest candidates for performing service center functions within the study area.

Conclusion

The relative analysis demonstrates that while a considerable number of settlements qualify individually under population, infrastructure, and connectivity criteria, only a limited number satisfy multiple criteria simultaneously. The identification of **two settlements**

common to all three criteria indicates that these settlements possess the most balanced development characteristics and the highest potential to function as effective Service Centers. These settlements can therefore be prioritized for service concentration and future development interventions. The remaining settlements that satisfy two criteria may also be considered secondary service centers and can be strengthened through targeted infrastructure and connectivity improvements.

6.9.3 Relative Analysis for Growth Point

Interpretation

A relative analysis **Error! Reference source not found.** was conducted to examine the r elationship between population, infrastructure, and connectivity for the identification of potential Growth Points within the study area. The individual assessment identified **4 settlements** based on population, **8 settlements** based on infrastructure, and **12 settlements** based on connectivity as suitable for functioning as growth points.

Table 13: Relative Analysis for Growth Point

Relative Analysis for Growth Point	
Relationship Between Population Infrastructure and Connectivity	
Relationship Category	No. of Settlements
Infrastructure and Connectivity	1
Population and Connectivity	1
Population, Infrastructure and Connectivity	2
Total	4

The comparative analysis revealed that two settlements were common between the population and infrastructure criteria, indicating that these settlements possess both demographic strength and adequate infrastructure facilities. In contrast, only one settlement was found to be common between the population and connectivity criteria, suggesting a relatively weaker overlap between population concentration and accessibility. The analysis of infrastructure and connectivity identified two common settlements, demonstrating that some settlements benefit from both service availability and good transport linkages.

Furthermore, **one settlement** was found to be common across all three criteria—population, infrastructure, and connectivity. This settlement exhibits a balanced combination

of population concentration, infrastructure provision, and accessibility, making it the most suitable candidate for functioning as a Growth Point within the study area.

Conclusion

The relative analysis indicates that the number of settlements satisfying multiple criteria is relatively limited compared to those identified under individual criteria. The presence of only one settlement common to all three criteria highlights its strategic importance and higher development potential. This settlement can be considered the most appropriate Growth Point for promoting local development and stimulating economic activities in surrounding areas. The settlements identified under two criteria may also be regarded as potential growth points and can be further strengthened through targeted infrastructure development and improved connectivity to enhance their future growth potential.

6.9.4 Relative Analysis for Growth Center

The relative analysis Table 14 of population, infrastructure, and connectivity was conducted to identify potential Growth Centers in the study area. The individual assessment identified **2 settlements** on the basis of population, **2 settlements** on the basis of infrastructure, and **4 settlements** on the basis of connectivity. When these criteria were compared, **one settlement** was found to be common between population and infrastructure, **one settlement** between population and connectivity, and **two settlements** between infrastructure and connectivity. Furthermore, **one settlement** was common across all three criteria, indicating a balanced level of population concentration, infrastructure availability, and accessibility. The results suggest that this settlement possesses the highest potential to function as a Growth Center and can serve as a focal point for regional development and service provision within the study area.

Table 14: Relative Analysis for Growth Center

Relative Analysis for Growth Center	
Relationship Between Population Infrastructure and Connectivity	
Relationship Category	No. of Settlements
Infrastructure and Connectivity	0
Population and Connectivity	1
Population, Infrastructure and Connectivity	1
Total	2

Interpretation

A relative analysis was undertaken to examine the relationship between population, infrastructure, and connectivity for the identification of potential Growth Centers within the study area. The individual analysis identified **2 settlements** based on population, **2 settlements** based on infrastructure, and **4 settlements** based on connectivity as suitable for functioning as growth centers.

The comparative analysis showed that **one settlement** was common between the population and infrastructure criteria, indicating that this settlement possesses both a significant population base and adequate infrastructure facilities. Similarly, **one settlement** was common between the population and conn ectivity criteria, demonstrating the presence of both demographic strength and accessibility. The relationship between infrastructure and connectivity identified **two common settlements**, suggesting a strong linkage between service availability and transport accessibility.

Most importantly, **one settlement** was found to be common across all three criteria—population, infrastructure, and connectivity. This settlement demonstrates a balanced combination of demographic concentration, infrastructure provision, and connectivity, making it the most suitable location to perform the functions of a Growth Center and support the development of surrounding settlements.

Conclusion

The relative analysis indicates that only a few settlements satisfy the requirements of a Growth Center under multiple criteria. The identification of **one settlement common to all three criteria** highlights its strategic importance and superior development potential. This settlement can be considered the most suitable **Growth Center** within the study area due to its balanced population, infrastructure, and connectivity characteristics. The remaining settlements identified under two criteria also possess development potential and may be strengthened through targeted investments in infrastructure and connectivity to enhance their role in the regional settlement hierarchy.

6.9.5 Relative Analysis for Growth Pole

The relative analysis Table 15 of population, infrastructure, and connectivity was undertaken to identify potential Growth Poles in the study area. The individual assessment

identified **1 settlement** based on population, **1 settlement** based on infrastructure, and **4 settlements** based on connectivity. The comparison of these criteria revealed that **one settlement** was common between population and infrastructure, **one settlement** between population and connectivity, and **one settlement** between infrastructure and connectivity. Moreover, **one settlement** was common across all three criteria, indicating a balanced level of population concentration, infrastructure availability, and accessibility. The results suggest that this settlement possesses the highest development potential and is best suited to perform the role of a Growth Pole, acting as the primary driver of regional growth and development within the study area.

Table 15: Relative Analysis for Growth Pole

Relative Analysis for Growth Center	
Relationship Between Population Infrastructure and Connectivity	
Relationship Category	No. of Settlements
Population, Infrastructure and Connectivity	1
Total	1

Interpretation

A relative analysis Table 15 was conducted to examine the relationship between population, infrastructure, and connectivity for the identification of potential Growth Poles within the study area. The individual analysis identified **1 settlement** based on population, **1 settlement** based on infrastructure, and **4 settlements** based on connectivity as suitable for functioning as a Growth Pole.

The comparative analysis revealed that **one settlement** was common between the population and infrastructure criteria, indicating that the settlement possesses both a strong population base and adequate infrastructure facilities. Similarly, **one settlement** was found to be common between population and connectivity, demonstrating the presence of both demographic strength and accessibility. The analysis of infrastructure and connectivity also identified **one common settlement**, reflecting the integration of service availability and transport connectivity.

Furthermore, **one settlement** was found to be common across all three criteria—population, infrastructure, and connectivity. This indicates that the settlement exhibits a

balanced combination of demographic concentration, infrastructure provision, and accessibility, making it the most suitable location to function as a Growth Pole within the regional settlement hierarchy.

Conclusion

The relative analysis highlights that the identification of Growth Poles is highly selective, with only **one settlement** satisfying all three criteria simultaneously. The overlap of population, infrastructure, and connectivity in a single settlement demonstrates its strategic importance and superior development potential. Therefore, this settlement can be considered the most suitable **Growth Pole** in the study area and can serve as the principal center for economic growth, service provision, and regional development. Its strengthening and prioritization in planning interventions can further enhance balanced and sustainable regional development.

CHAPTER 7

7.Results and Discussion

7.1 Introduction

This chapter presents the results of the settlement hierarchy analysis carried out for the study area. The hierarchy was developed using selected indicators related to population, educational facilities, healthcare infrastructure, welfare services, and transportation connectivity. The analysis aimed to identify settlements with varying levels of service provision and determine their functional role within the regional development framework.

Based on the adopted criteria, settlements were classified into five hierarchical levels: Central Villages, Service Centres, Growth Points, Growth Centres, and Growth Pole. Each level represents a different degree of functional importance, service concentration, and population-serving capacity. The identified hierarchy provides a structured framework for understanding the spatial distribution of facilities and services within the region.

The chapter discusses the characteristics of each hierarchical level and evaluates their strengths and deficiencies in terms of educational, healthcare, and welfare infrastructure. The findings are further interpreted to assess their implications for regional planning and balanced development. The results serve as the basis for identifying future infrastructure priorities and formulating strategies for sustainable regional development.

7.2 Identification of Central Villages

Results

Assessment of settlements on the basis of educational, health and transportation indicators led to the identification of 20 Central Villages in the study area. Analysis shows that all 20 selected settlements possess primary school facilities, indicating that they already function as basic educational service centres for the surrounding population. In terms of healthcare infrastructure, only 4 of the 20 Central Villages have Primary Health Care facilities, while the remaining settlements depend on nearby villages or higher-order centres for healthcare services.

The transportation analysis reveals that all identified Central Villages are located along important road corridors, with connectivity provided through either Major District Roads (MDR) and Other District Roads (ODR) or State Highways (SH) and Other District Roads (ODR). This level of connectivity enhances accessibility and supports their role as service centres within the settlement system.

Table 16:Identification of Central Villages

Sr.No.	Population of Central village	Central Village	No. of Settlements Served	Population Served	Population	Infrastructure	Connectivity
1	3984	ASRAWAD KHURD	6	13929			
2	1998	DEOGURADIA	5	9292			
3	3790	MACHAL	4	8799			
4	1526	RANMALBILUOD	7	5328			
5	3877	GHATABILLOD	5	10368			
6	2266	ALWASA	4	7003			
7	2044	BUDHANIA cv	4	8107			
8	3248	KALODHALA	4	7415			
9	4366	BHATKHEDI	4	7807			
10	3091	DONGARGAON	3	8009			
11	3355	UMARIYA	6	14372			
12	880	NARLAI	6	8139			
13	2347	BISANAWADA	6	7464			
14	3799	BARLAI JAGIR	5	9406			
15	1855	KAWTI	6	10234			
16	1676	Ekalduna (Digthan)	6	8303			
17	2430	Sulawad	7	6261			
18	2760	Lebad	4	5401			
19	2285	Khandwa	4	3806			
20	2425	NAGUKHEDI	3	3232			

Discussion

The results Table 16:Identification of Central Villagesindicate that educational facilities are relatively well distributed among the identified Central Villages, as all selected settlements have primary schools. This suggests that education was one of the key factors contributing to their emergence as local service centres. However, the availability of healthcare infrastructure is comparatively limited, with only 20 percent (4 out of 20) of the Central Villages possessing Primary Health Care facilities. This highlights a significant gap in healthcare accessibility within the study area.

Road connectivity appears to be a major determinant in the selection of Central Villages. The presence of MDR, ODR and SH connections provides these settlements with better accessibility compared to surrounding villages, enabling them to serve a wider hinterland. The findings support the concept of settlement hierarchy, where settlements with better infrastructure and accessibility tend to function as service centres for neighbouring settlements.

The analysis also suggests that future investments in healthcare and higher-order facilities should be prioritized in these Central Villages to strengthen their service delivery capacity and support balanced regional development.

Conclusion

The identified 20 Central Villages possess basic educational infrastructure and good road connectivity, making them suitable service centres within the study area. However, the limited availability of healthcare facilities indicates the need for targeted infrastructure development. Strengthening these settlements can improve service accessibility and contribute to a more balanced settlement hierarchy and regional development pattern.

7.3 Identification of Service Center

Results

Based on the assessment of educational, healthcare, and social infrastructure indicators, eight settlements were identified as Service Centre within the study area. These settlements exhibit a higher concentration of facilities and are capable of serving the needs of the surrounding settlements.

The analysis Table 17:Identification of Service Center indicates that all eight Service Centre possess adequate primary and secondary educational facilities, demonstrating their importance as educational hubs within the settlement hierarchy. With respect to healthcare infrastructure, three settlements have adequate Primary Health Centre (PHC) facilities, four settlements have inadequate PHC facilities, and one settlement lacks a PHC altogether. This variation highlights disparities in the distribution of healthcare services among the identified Service Centre.

The assessment of social welfare infrastructure reveals that Family Welfare Centre are adequately available in six settlements, while two settlements do not possess such facilities. Similarly, Maternity Homes are adequately available in four settlements, whereas the remaining four settlements show deficiencies in maternity care facilities.

Table 17:Identification of Service Center

SR. No.	Population	Service Center	Central Village	No. of Settlements Served	Population Served	Population	Infrastructure	Connectivity
1	8606	Dehrisaray (CT) sc	3	17	38630			
2	10757	KALIBILLOD	3	19	31145			
3	14830	KODRIYA sc	0	4	36067			
4	8652	RANGWASA sc	2	13	31163			
5	5384	DUDHIYA sc	3	18	38839			
6	10425	HATOD (NP) sc	3	16	38049			
7	5593	DAKACHYA sc	3	15	36829			
8	8313	BANJARI sc	3	13	33186			
	36	Total	20	115	283908	8	2	8

Discussion

The identified eight Service Centre serve a population ranging from approximately 30,000 to 35,000 persons, indicating their significance as higher-order service nodes within the settlement hierarchy. The presence of adequate primary and secondary schools in all eight

settlements demonstrates their strong role in providing educational services to a large population and the surrounding settlements.

Despite their importance, the distribution of healthcare infrastructure is uneven. Only three Service Centre possess adequate Primary Health Centre (PHC) facilities, while four settlements have inadequate PHCs and one settlement lacks a PHC altogether. Considering the large service population of 30,000–35,000 persons, the existing healthcare infrastructure may not be sufficient to meet present and future demands. This may increase dependence on higher-order urban center for healthcare services.

The assessment of welfare facilities further reveals disparities among the identified Service Centre. Family Welfare Centre are adequately available in six settlements, while two settlements lack such facilities. Similarly, only four settlements have adequate Maternity Homes, whereas the remaining four settlements are deficient in maternal healthcare infrastructure. These deficiencies may affect the accessibility and quality of reproductive, maternal, and child healthcare services within the service area.

Overall, the results indicate that educational facilities are well developed across all Service Centre, whereas healthcare and welfare infrastructure require substantial improvement. Given their ability to serve a population of 30,000–35,000 persons, these settlements have considerable potential to function as growth centre and should be prioritised for future infrastructure investment and service enhancement.

Conclusion

The analysis identified eight Service Centres that serve populations ranging from approximately 30,000 to 35,000 persons. All identified settlements possess adequate primary and secondary educational facilities, confirming their role as important educational and service nodes within the study area.

However, the assessment highlights significant deficiencies in healthcare and welfare infrastructure. Adequate Primary Health Centres are available in only three settlements, while Family Welfare Centres and Maternity Homes are unevenly distributed. These shortcomings reduce the effectiveness of the Service Centres in providing comprehensive services to their hinterland population.

Therefore, future planning efforts should focus on strengthening healthcare and welfare infrastructure in the identified Service Centres. Enhancing these facilities will improve service accessibility, support the needs of the growing population, and reinforce the role of these settlements in achieving balanced regional development.

7.4 Identification of Growth Point

Result

Based on the assessment of educational, healthcare, and welfare infrastructure, four settlements were identified as Growth Points within the study area. These settlements have the potential to serve a population of approximately 100,000 persons and function as higher-order service centres within the regional settlement hierarchy.

The analysis Table 18 reveals that all four Growth Points possess adequate primary and secondary educational facilities. However, higher educational infrastructure is unevenly distributed, with only two Growth Points having adequate college facilities, while the remaining two settlements have inadequate college infrastructure.

In terms of healthcare services, all four Growth Points have adequate Primary Health Centres (PHCs) and Family Welfare Centres, indicating satisfactory provision of basic healthcare and welfare services. However, Maternity Homes and Child Welfare Centres are adequately available in only two Growth Points, while the other two settlements show deficiencies in these facilities. Furthermore, Intermediate Hospital facilities are absent in all identified Growth Points.

Table 18:Identification of Growth Point

SR. No.	Population	Growth point	Service Center	Central Village	No. of Settlements Served	Population Served	Population	Infrastructure	Connectivity
1	15999	Betma	2	6	38	104308			
2	36055	Rau	2	5	32	118006			
3	30012	Mhowgaon	2	3	20	169018			
4	10393	Mangalya sadak	2	6	32	85271			

Discussion

The identification of four Growth Points capable of serving approximately 100,000 persons highlights their strategic importance in the regional development framework. The availability of adequate primary and secondary educational facilities in all Growth Points demonstrates their capacity to support basic and secondary education for a large service population. However, the inadequate distribution of college facilities limits opportunities for higher education and may lead to dependency on larger urban centres.

The healthcare assessment indicates that all Growth Points possess adequate PHCs and Family Welfare Centres, suggesting a satisfactory level of primary healthcare service provision. Nevertheless, deficiencies in Maternity Homes and Child Welfare Centres in half of the identified Growth Points indicate gaps in maternal and child healthcare services. These deficiencies may affect the quality and accessibility of specialized healthcare for women and children within the service area.

A significant finding of the analysis is the complete absence of Intermediate Hospitals in all four Growth Points. Considering that these settlements are expected to serve nearly 100,000 persons, the lack of intermediate-level healthcare facilities represents a major infrastructure gap. Residents requiring specialized medical treatment are likely to depend on higher-order urban centres, which may increase travel distance, time, and healthcare costs.

The results suggest that while the identified Growth Points possess a strong foundation of educational and primary healthcare infrastructure, substantial improvements are required in higher education and secondary healthcare facilities. Strengthening these services would enhance their role as regional growth centres and improve the overall efficiency of the settlement hierarchy.

Conclusion

The analysis identified four Growth Points with the capacity to serve approximately 100,000 persons and function as major service centres within the study area. All identified Growth Points possess adequate primary and secondary schools, as well as adequate Primary Health Centres and Family Welfare Centres, indicating a relatively strong foundation of educational and basic healthcare infrastructure.

However, deficiencies exist in higher education, maternal and child healthcare, and secondary-level healthcare services. Only two Growth Points have adequate college facilities, while Maternity Homes and Child Welfare Centres are deficient in two settlements. Moreover, the absence of Intermediate Hospitals in all Growth Points represents a critical infrastructure gap.

Therefore, future planning interventions should prioritize the establishment of colleges, maternity and child welfare facilities, and intermediate hospitals in the identified Growth Points. Such improvements will strengthen their service delivery capacity, reduce dependence on higher-order urban centres, and support balanced and sustainable regional development.

7.5 Identification of Growth Centers

Based on the assessment of educational, healthcare, and welfare infrastructure, two settlements were identified as Growth Centres within the study area. These Growth Centres have the capacity to serve a population of approximately 500,000 persons and represent the highest level in the proposed settlement hierarchy.

The analysis Table 19 indicates that both Growth Centres possess adequate primary schools, secondary schools, colleges, professional colleges, Primary Health Centres (PHCs), Family Welfare Centres, and Maternity Homes. This demonstrates a strong provision of educational, healthcare, and social welfare facilities capable of supporting a large population.

However, differences were observed in the availability of higher-order healthcare infrastructure. One Growth Centre lacks Intermediate Hospital and Multi-speciality Hospital facilities. The second Growth Centre lacks Intermediate Hospital, Multi-speciality Hospital, Speciality Hospital, and General Hospital facilities. These deficiencies indicate gaps in advanced healthcare services despite the overall adequacy of basic and intermediate-level facilities.

Table 19:Identifivcation Growth Center

SR. No.	Population	Growth Center	Growth point	Service Center	Central Village	No. of Settlements Served	Population Served	Population	Infrastructure	Connectivity
1	289550	Dewas	1	2	6	33	374821			
2	126200	Pithampur	3	6	14	91	517532			
	415750		4	8	20	124	892353	2	1	2

Discussion

The identification of two Growth Centres capable of serving approximately 500,000 persons highlights their strategic importance as major regional service hubs. The availability of adequate primary, secondary, higher, and professional educational institutions in both settlements reflects a well-developed educational structure capable of supporting human resource development and higher learning opportunities within the region.

Similarly, the presence of adequate PHCs, Family Welfare Centres, and Maternity Homes indicates satisfactory provision of primary healthcare and welfare services. These facilities contribute significantly to improving the quality of life and meeting the basic health needs of the population within their service areas.

Despite these strengths, the assessment reveals deficiencies in advanced healthcare infrastructure. The absence of Intermediate Hospitals in both Growth Centres represents a significant gap in the healthcare hierarchy. Furthermore, the lack of Multi-speciality Hospitals in both settlements and the absence of Speciality and General Hospitals in one Growth Centre limit access to specialized and referral healthcare services. Given that each Growth Centre is expected to serve nearly 500,000 persons, these deficiencies may result in increased dependence on larger metropolitan centres for advanced medical treatment.

The findings suggest that while the identified Growth Centres possess a strong foundation of educational and basic healthcare infrastructure, further investment in advanced healthcare facilities is necessary to ensure comprehensive service provision. Strengthening higher-order medical facilities would enhance their functional role and improve the efficiency of the regional settlement system.

Conclusion

The analysis identified two Growth Centres that serve populations of approximately 500,000 persons and function as the highest-order service centres within the study area. Both Growth Centres possess adequate primary and secondary schools, colleges, professional colleges, PHCs, Family Welfare Centres, and Maternity Homes, indicating a strong level of educational and basic healthcare infrastructure.

However, important deficiencies exist in advanced healthcare facilities. Intermediate Hospitals are absent in both Growth Centres, while Multi-speciality Hospitals are also lacking. In addition, one Growth Centre does not possess Speciality and General Hospital facilities. These gaps reduce the capacity of the Growth Centres to provide comprehensive healthcare services to their large service population.

Therefore, future planning interventions should prioritize the establishment and upgradation of Intermediate, Multi-speciality, Speciality, and General Hospitals in the identified Growth Centres. Such improvements would strengthen their role as regional growth hubs, enhance healthcare accessibility, reduce dependency on external urban centres, and promote balanced and sustainable regional development.

7.5 Identification of Growth Pole

Results

The hierarchical analysis of settlements resulted in the identification of **one Growth Pole** within the study area. The selected settlement possesses the highest concentration of educational, healthcare, welfare, and other higher-order facilities among all identified settlements. Owing to its superior infrastructure and service provision capacity, the Growth Pole is capable of serving a population of approximately **3 million persons**.

The assessment indicates that all required educational facilities, healthcare facilities, and welfare services are adequately available within the Growth Pole. Compared to the lower-order centres identified in the settlement hierarchy, the Growth Pole exhibits the highest level of functional specialization and service provision. Consequently, it serves as the principal regional centre and acts as the focal point for administrative, economic, educational, and healthcare activities within the study area.

Discussion

The identification of a single Growth Pole serving a population of approximately **3 million persons** indicates its dominant position within the regional settlement hierarchy. As the highest-order centre in the study area, the Growth Pole functions as the principal node for economic, social, administrative, educational, and healthcare activities.

The assessment reveals that all educational facilities, including primary schools, secondary schools, colleges, and professional colleges, are adequately available within the Growth Pole. This demonstrates its capacity to provide educational services at all levels and attract students from lower-order settlements and surrounding regions.

Similarly, the Growth Pole possesses adequate healthcare and welfare infrastructure, including Primary Health Centres, Family Welfare Centres, Maternity Homes, Intermediate Hospitals, General Hospitals, Speciality Hospitals, and Multi-speciality Hospitals. The availability of these facilities ensures comprehensive healthcare services ranging from primary care to advanced medical treatment. This reduces dependency on external urban centres and strengthens the self-sufficiency of the regional service system.

The concentration of higher-order facilities within the Growth Pole reflects its role as the primary centre for service delivery, employment generation, investment, and regional development. Its ability to serve approximately 3 million people highlights its significance as the major growth engine of the region. The findings support the principles of growth pole theory, which suggest that development tends to concentrate in strategically located centres possessing superior infrastructure and service provision capability.

Conclusion

The analysis identified one Growth Pole with the capacity to serve approximately **3 million persons**, making it the highest-order settlement within the regional hierarchy. The settlement possesses adequate educational, healthcare, and welfare facilities at all levels, enabling it to provide comprehensive services to a large population.

The availability of primary, secondary, higher, and professional educational institutions, along with a complete range of healthcare facilities from Primary Health Centres to Multi-speciality Hospitals, demonstrates its strong functional capacity and regional importance.

Therefore, the identified Growth Pole serves as the principal centre for regional development and acts as the focal point for economic growth, service delivery, and infrastructure development. Its strong infrastructure base and service provision capacity make it the key driver for balanced and sustainable development across the study area.

Discussion

The settlement hierarchy reveals a clear progression in service provision and functional importance from Central Villages to the Growth Pole. Educational facilities are relatively well distributed across all hierarchical levels, whereas healthcare facilities become increasingly concentrated in higher-order settlements. The analysis demonstrates that accessibility, population concentration, and facility availability are the primary determinants influencing the emergence of higher-order centres.

The hierarchy supports the principles of central place theory and growth pole theory by illustrating how higher-order settlements provide specialized services to lower-order settlements within their spheres of influence. The identified hierarchy therefore provides a rational framework for guiding future infrastructure investments and promoting balanced regional development.

Conclusion

The study successfully established a five-tier settlement hierarchy consisting of 20 Central Villages, 8 Service Centres, 4 Growth Points, 2 Growth Centres, and 1 Growth Pole. The hierarchy reflects the spatial distribution of population and services within the study area and highlights significant variations in the availability of educational, healthcare, and welfare facilities.

While lower-order settlements require improvements in basic healthcare infrastructure, higher-order settlements require investment in advanced educational and healthcare facilities. Strengthening the identified centres according to their hierarchical role will improve service accessibility, reduce regional disparities, and contribute to sustainable and balanced regional development.

CHAPTER 8

8. Proposal for Infrastructure at Growth Foci's

The identification of Growth Foci was carried out using the Growth Foci Concept proposed by R.P. Mishra to assess the adequacy of educational and healthcare infrastructure within the study area. Based on population size, settlement hierarchy, service availability, and accessibility, settlements were classified into Central Villages, Service Centres, Growth Points, and Growth Centres. Existing facilities were evaluated against prescribed service norms to identify infrastructure deficiencies and service gaps.

The assessment revealed that primary and secondary educational facilities are generally adequate across most levels of the settlement hierarchy. However, significant deficiencies were observed in healthcare and welfare infrastructure, particularly in Primary Health Centres, Family Welfare Homes, Child Welfare and Maternity Homes, and Intermediate Hospitals. Accordingly, infrastructure development proposals have been formulated to address these deficiencies and ensure equitable distribution of services throughout the region.

The proposed interventions aim to strengthen the identified Growth Foci, improve accessibility to essential services, promote balanced spatial development, and enhance the overall quality of life of the population served by the regional settlement system.

8.1Central Village Infrastructure Assessment

Based on the assessment of primary education and primary health care facilities using the Growth Foci approach, 20 Central Villages were identified to serve 99 surrounding settlements with a total population of 162,675. The analysis indicates that primary educational infrastructure is generally adequate across the identified Central Villages, with a total of 222 existing primary schools serving the population. Therefore, no additional primary schools are proposed. However, the assessment of primary health care facilities reveals a significant deficiency. Only four Central Villages—Ghatabillod, Narlai, Bisanawada, and Deoguradia—currently possess Primary Health Care (PHC) facilities, while the remaining villages lack such services. To ensure equitable access to basic healthcare, a total of 20 new PHCs are proposed across the identified Central Villages. Villages serving larger populations, such as Asrawad

Khurd, Umariya, and Kawti, require two PHCs each, whereas the remaining villages require one PHC each. The proposed interventions aim to strengthen healthcare accessibility, reduce service gaps, and improve the overall quality of life for the population within the study area.

Table 20:Assessment of Infrastructure for Central Villages

Sr. No.	Central Village	No. of Settlements Served	Population Served	Primary School		Primary Health Care	
				Existing	Proposed	Existing	Proposed
1	ASRAWAD KHURD	6	13929	16	0	0	2
2	DEOGURADIA	5	9292	11	0	0	1
3	MACHAL	4	8799	10	0	0	1
4	RANMALBILUOD	7	5328	7	0	0	1
5	GHATABILLOD	5	10368	15	0	2	0
6	ALWASA	4	7003	10	0	0	1
7	BUDHANIA	4	8107	11	0	0	1
8	KALODHALA	4	7415	10	0	0	1
9	BHATKHEDI	4	7807	8	0	0	1
10	DONGARGAON	3	8009	13	0	0	1
11	UMARIYA	6	14372	14	0	0	2
12	NARLAI	6	8139	14	0	1	0
13	BISANAWADA	6	7464	12	0	1	0
14	BARLAI JAGIR	5	9406	10	0	0	1
15	KAWTI	6	10234	9	0	0	2
16	EKALDUNA (DIGTHAN)	6	8303	15	0	0	1
17	SULAWAD	7	6261	14	0	0	1
18	LEBAD	4	5401	13	0	0	1
19	KHANDWA	4	3806	5	0	0	1
20	NAGUKHEDI	3	3232	5	0	0	1
	Total	99	162675	222	0	4	20

Interpretation:

The results Table 20 suggest that while primary education facilities are adequately distributed within the settlement hierarchy, primary healthcare infrastructure remains insufficient. The

proposed PHCs will help establish a balanced distribution of health services and support the development of the identified Central Villages as effective service centres for their surrounding settlements. This will contribute to improved regional accessibility and support sustainable rural development.

8.2 Service Center Infrastructure Assessment

The assessment of educational and healthcare infrastructure at the Service Centre level identified eight Service Centres serving 115 settlements with a total population of 283,908. The analysis reveals that primary educational facilities are adequately available, with a total of 319 existing primary schools distributed across the service area; therefore, no additional primary schools are proposed. Similarly, the availability of secondary schools is found to be sufficient, with 76 existing secondary schools serving the population, and no further secondary schools are required.

However, the assessment highlights deficiencies in healthcare and welfare facilities. A total of 18 Primary Health Centres (PHCs) currently exist within the identified Service Centres, while an additional 29 PHCs are proposed to ensure adequate healthcare coverage for the population served. Family Welfare Homes are also inadequate, with only seven existing facilities; consequently, two additional Family Welfare Homes are proposed. Furthermore, Child Welfare and Maternity Homes are insufficiently distributed across the service centres. Out of the existing seven facilities, four additional Child Welfare and Maternity Homes are proposed to improve maternal and child healthcare services.

The results Table 21 indicate that the educational infrastructure at the Service Centre level is generally adequate and capable of serving the population effectively. In contrast, healthcare and welfare facilities require substantial strengthening to meet the service requirements of the settlements within the study area. The proposed additions of PHCs, Family Welfare Homes, and Child Welfare and Maternity Homes will enhance accessibility to essential health services, improve maternal and child healthcare outcomes, and reinforce the role of the identified Service Centres as intermediate growth foci within the regional settlement hierarchy. These interventions will contribute to balanced regional development and improve the overall quality of life of the population served

Table 21: Assessment of Infrastructure for Service Center

Population	Service Center	Primary School		Secondary School		Primary Health Center		Family Welfare Home		Child welfare and Maternity home	
		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
8606	Dehrisaray (CT) sc	55	0	8	0	4	3	2	0	1	0
10757	KALIBILLOD	36	0	5	0	1	3	0	1	0	1
14830	KODRIYA sc	26	0	13	0	4	2	1	0	1	0
8652	RANGWASA sc	34	0	8	0	4	2	1	0	0	1
5384	DUDHIYA sc	41	0	10	0	0	7	0	1	1	0
10425	HATOD (NP) sc	44	0	16	0	2	4	1	0	4	0
5593	DAKACHYA sc	44	0	8	0	1	5	1	0	0	1
8313	BANJARI sc	39	0	8	0	2	3	1	0	0	1
		319	0	76	0	18	29	7	2	7	4

8.3 Growth Point Infrastructure Assessment

The Growth Foci analysis identified four Growth Points—Betma, Rau, Mhowgaon, and Manglaya Sadak—as higher-order service centres within the regional settlement hierarchy. Together, these Growth Points serve 122 settlements through 8 Service Centres and 20 Central Villages, covering a total population of 476,603. The assessment of educational infrastructure indicates that primary and secondary educational facilities are adequately available across all Growth Points, with a total of 383 primary schools and 136 secondary schools. Therefore, no

additional primary or secondary schools are proposed. However, higher education facilities are limited, with only five existing colleges distributed among the four Growth Points. To strengthen access to higher education, one additional college is proposed at Betma.

Table 22:Assessment of Infrastructure for Growth Point

	Growth Point							
	Betma		Rau		Mhowgaon		Manglaya sadak	
Population	15999		36055		30012		10393	
Service Center	2		2		2		2	
Central Village	6		5		3		6	
No. of Settlements Served	38		32		20		32	
Population Served	104308		118006		169018		85271	
Infrastructure	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Primary School	11	0	96	0	78	0	98	0
Secondary School	0	0	35	0	1	0	30	0
College	0	1	1	0	3	0	1	0
Primary Health Center	6	10	3	14	7	14	4	10
Family Welfare Home	3	1	2	1	3	3	2	1
Child welfare and Maternity home	2	1	1	2	2	4	4	1

Intermediate Hospital	0	1		0	1			1		0	1

The assessment of healthcare infrastructure reveals significant inadequacies relative to the population served. A total of 20 Primary Health Centres (PHCs) currently exist across the identified Growth Points, whereas 48 additional PHCs are proposed to ensure adequate healthcare coverage. Family Welfare Homes are also insufficient, with ten existing facilities and six additional facilities proposed. Similarly, Child Welfare and Maternity Homes require strengthening; while nine facilities currently exist, eight additional facilities are proposed to improve maternal and child healthcare services. Furthermore, none of the identified Growth Points currently possess an Intermediate Hospital. Considering their role as major service centres within the regional hierarchy, one Intermediate Hospital is proposed at each Growth Point, resulting in a total of four proposed hospitals.

The findings Table 22 indicate that educational facilities at the Growth Point level are generally adequate, while healthcare and welfare infrastructure remain deficient in relation to the population served. The proposed additions of colleges, PHCs, Family Welfare Homes, Child Welfare and Maternity Homes, and Intermediate Hospitals will enhance service accessibility, strengthen healthcare delivery, and improve regional service efficiency. These interventions will reinforce the role of the identified Growth Points as major growth foci capable of supporting balanced regional development and improving the quality of life of the population within the study area.

8.4 Growth Center Infrastructure Assessment

The Growth Foci analysis identified two Growth Centres, Dewas and Pithampur, as the highest-order service centres within the study area. Dewas serves one Growth Point, two Service Centres, and six Central Villages, covering 33 settlements with a total served population of 374,821. Pithampur functions as a larger regional centre, serving three Growth Points, six Service Centres, and fourteen Central Villages, covering 91 settlements with a total population of 517,532.

Table 23:Assessment of Infrasructure for Growth Center

	Growth Center			
	Dewas		Pithampur	
Population	289550		126200	
Growth point	1		3	
Service Center	2		6	
Central Village	6		14	
No. of Settlements Served	33		91	
Population Served	374821		517532	
Infrastructure	Existing	Proposed	Existing	Proposed
Primary School	280	0	328	0
Secondary School	103	0	113	0
College	9	0	6	0
Engineering	6	0	7	0
Medical	0	0	0	0
Manage. College	3	0	1	0
Law College	1	0	0	0
Primary Health Center	5	0	17	0
Family Welfare Home	3	0	8	0
Child welfare and Maternity home	5	0	10	0
Intermediate Hospital	0	1	0	1
General Hospital	2	0	3	0
Specialized Hospital	1	0	3	0

The assessment of educational infrastructure indicates that both Growth Centres possess adequate educational facilities at all levels. Dewas contains 280 primary schools, 103 secondary schools, 9 colleges, 6 engineering colleges, 3 management colleges, and 1 law college. Similarly, Pithampur has 328 primary schools, 113 secondary schools, 6 colleges, 7 engineering colleges, and 1 management college. Since the existing educational infrastructure is sufficient to serve the population within their respective spheres of influence, no additional educational institutions are proposed.

The healthcare assessment reveals that basic and secondary healthcare facilities are generally adequate. Dewas possesses 5 Primary Health Centres, 3 Family Welfare Homes, 5

Child Welfare and Maternity Homes, 2 General Hospitals, and 1 Specialized Hospital. Pithampur is equipped with 17 Primary Health Centres, 8 Family Welfare Homes, 10 Child Welfare and Maternity Homes, 3 General Hospitals, and 3 Specialized Hospitals. However, neither Growth Centre currently has an Intermediate Hospital, which is an important component in the hierarchical distribution of healthcare services. Therefore, one Intermediate Hospital is proposed at both Dewas and Pithampur to strengthen referral services and bridge the gap between primary healthcare facilities and higher-order specialized medical institutions.

Overall, the analysis Table 23 demonstrates that Dewas and Pithampur are well-developed Growth Centres with sufficient educational and most healthcare facilities to support their extensive service areas. The only major deficiency identified is the absence of Intermediate Hospitals. The proposed hospitals will enhance the healthcare network, improve accessibility to intermediate-level medical services, and strengthen the functional role of these Growth Centres within the regional settlement hierarchy. Consequently, Dewas and Pithampur will continue to function as major growth foci, promoting balanced regional development and improving the quality of life of the population served.

8.5 Growth Pole Infrastructure Assessment

The Growth Foci analysis identified Indore as the sole Growth Pole of the study area. As the highest-order centre in the regional settlement hierarchy, Indore serves two Growth Centres, four Growth Points, eight Service Centres, and twenty Central Villages, covering a total of 125 settlements with a served population of 2,886,750. The city possesses a comprehensive range of educational and healthcare facilities and functions as the principal regional service hub.

The assessment indicates that educational infrastructure at the Growth Pole level is fully adequate. The city contains 491 primary schools, 118 secondary schools, 19 colleges, 46 engineering institutions, 29 medical institutions, 7 management colleges, and 8 law colleges. These facilities are sufficient to meet the educational requirements of both the resident population and the wider region served by the Growth Pole. Therefore, no additional educational facilities are proposed.

Table 24:Assessment of Infrastructure for Growth Pole

	Growth Pole	
	Indore	
Population	1994397	
GrowthCenter	2	
Growth point	4	
Service Center	8	
Central Village	20	
No. of Settlements Served	125	
Population Served	2886750	
Infrastructure	Existing	Proposed
Primary School	491	0
Secondary School	118	0
College	19	0
Engineering	46	0
Medical	29	0
Manage. College	7	0
Law College	8	0
Primary Health Center	8	0
Family Welfare Home	11	0
Child welfare and Maternity home	10	0
Intermediate Hospital	10	0
General Hospital	2	0
Specialized Hospital	12	0

Similarly, healthcare infrastructure is adequately developed. Existing facilities include 8 Primary Health Centres, 11 Family Welfare Homes, 10 Child Welfare and Maternity Homes, 10 Intermediate Hospitals, 2 General Hospitals, and 12 Specialized Hospitals. The availability of these higher-order healthcare facilities ensures comprehensive medical coverage and provides referral services for lower-order settlements within the regional hierarchy. Consequently, no additional healthcare facilities are proposed at the Growth Pole level.

The proposal for the Growth Pole therefore focuses on maintaining and strengthening the existing infrastructure network, enhancing service quality, and supporting the efficient

functioning of Indore as the apex centre of the regional settlement system. By continuing to provide advanced educational, medical, administrative, and economic services, the Growth Pole will sustain balanced regional development and support future population growth within the study area.

Interpretation

The analysis Table 24 shows that Indore possesses adequate higher-order educational and healthcare infrastructure and is capable of serving the entire regional settlement hierarchy. Hence, no additional facilities are proposed, and the Growth Pole will continue to function as the apex service centre of the region

8.6 Interpretation

The infrastructure assessment indicates a clear variation in the distribution of facilities across different levels of the settlement hierarchy. At the Central Village level, primary education facilities are adequately distributed, while healthcare facilities are insufficient. Therefore, proposals mainly focus on establishing additional Primary Health Centres to provide basic healthcare services to the surrounding rural population.

At the Service Centre level, both primary and secondary educational facilities are adequate; however, healthcare and welfare facilities remain inadequate. Additional Primary Health Centres, Family Welfare Homes, and Child Welfare and Maternity Homes have been proposed to strengthen healthcare accessibility and improve maternal and child welfare services.

The Growth Point level functions as an important intermediate service tier serving a large population and numerous lower-order settlements. Although educational infrastructure is largely sufficient, healthcare infrastructure requires substantial improvement. The proposals include additional Primary Health Centres, welfare facilities, Child Welfare and Maternity Homes, Intermediate Hospitals, and a college at Betma to enhance higher education accessibility.

At the Growth Centre level, Dewas and Pithampur possess adequate educational and most healthcare facilities. However, the absence of Intermediate Hospitals creates a gap in the healthcare referral system. Therefore, one Intermediate Hospital has been proposed at each

Growth Centre to strengthen regional healthcare delivery and support the higher-order functions of these centres.

Overall, the proposals demonstrate a progressive strengthening of facilities according to settlement hierarchy, ensuring that each level performs its designated service role efficiently while supporting balanced regional development.

8.7 Conclusion

The proposed infrastructure development framework is based on the principles of settlement hierarchy and the Growth Foci approach. The analysis confirms that educational infrastructure within the study area is generally adequate, requiring only limited additions at higher levels. In contrast, healthcare and welfare infrastructure exhibit significant deficiencies, particularly in lower and intermediate-order settlements.

The proposed facilities are intended to bridge existing service gaps, improve accessibility to essential social infrastructure, and create a more balanced distribution of development opportunities across the region. By strengthening Central Villages, Service Centres, Growth Points, and Growth Centres according to their functional roles, the proposals establish an integrated service network capable of supporting present and future population demands.

The implementation of these proposals will contribute to improved healthcare delivery, enhanced educational access, better maternal and child welfare services, and a stronger regional settlement structure. Ultimately, the proposed development strategy will promote balanced regional growth, reduce spatial disparities, and improve the overall quality of life within the study area.

PLANNING FRAMEWORK FOR URBAN AGGLOMERATION THROUGH ….DECENTRALIZATION

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ANNEXURE – I

1.1 Introduction to Study Area

1.2 Location Map

1.3 Growth Foci based Population

1.4 Growth Foci based Infrastructure

1.5 Growth Foci based Connectivity

1.6 Analysis based Central Villages

1.7 Analysis based Service Center

1.8 Analysis based Growth Point

1.9 Analysis based Growth Center and Growth Pole

2.0 Proposal Based on Assessment of Educational and Health Infrastructure.

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ANNEXURE – II

2.1 Plagiarism Report