

Impact of Demographic Shift and Growth Rate on Sub Divisions of District Region: A Case of Udupi District, India

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Abstract

Balanced regional development depends significantly on the spatial distribution of population, demographic transition, literacy, urbanization and growth dynamics across administrative units. Udupi District, situated in the coastal region of Karnataka, has experienced considerable demographic transformation over the last two decades, particularly after the administrative reorganization from three taluks under Census 2011 to seven taluks following the creation of new administrative units in 2016. Such changes have influenced the pattern of population concentration, urban expansion and the provision of public infrastructure, thereby affecting regional planning priorities. The present study examines the demographic characteristics of Udupi District using secondary data obtained from the Census of India 2011 and District at a Glance (2018) published by the Statistical Department of Zilla Panchayat, Udupi, representing the demographic status of the reorganized seven-taluk administrative structure. The analysis focuses on major demographic indicators including total population, sex ratio, child population, literacy rate, population density, rural and urban population distribution, caste-wise population, fertility rate and decadal growth rate. A comparative assessment has been carried out at three spatial scales: the district level, the three-taluk administrative structure of 2011 (Kundapura, Udupi and Karkala), and the seven-taluk administrative framework introduced after 2016. The findings indicate that Udupi Taluk remains the demographic and urban core of the district, recording the highest population concentration, literacy rate, urban population and population density. In contrast, Hebri and Bynduru continue to exhibit predominantly rural characteristics with comparatively lower population density. The study also identifies significant intra-district variations in growth trends, literacy and demographic composition, reflecting uneven developmental patterns across administrative units. These findings highlight the necessity for decentralized and evidence-based regional planning strategies that account for demographic diversity and changing administrative boundaries to achieve balanced regional development across Udupi District.

Key Words - Demographic Shift, Demographic Growth rate, Micro Region and Sub District, Regional Development

I. INTRODUCTION

Regional development is a multidimensional process that seeks to reduce spatial disparities while ensuring equitable access to economic opportunities, social infrastructure and public services across different geographical regions. Demographic characteristics constitute one of the most important determinants of regional development because they directly influence infrastructure requirements, resource allocation, employment generation, educational demand and urban expansion. Population growth, literacy, fertility, sex composition and settlement distribution collectively shape the developmental trajectory of any region and provide valuable insights for planning balanced and sustainable growth. The concept of balanced regional development emphasizes minimizing disparities among administrative regions by promoting equitable distribution of population, infrastructure and economic activities. Rapid demographic changes often generate unequal development patterns where urban centres attract greater investments while peripheral regions continue to depend primarily on rural economies. Consequently, understanding demographic dynamics at multiple administrative scales becomes an essential prerequisite for regional planning and policy formulation. Udupi District, located along the Arabian Sea coast in Karnataka, represents one of the fastest transforming districts in coastal India. The district possesses a unique geographical setting characterized by a narrow coastal plain, river valleys, forested uplands and the foothills of the Western Ghats. Its strategic location, high literacy, growing urban economy and expanding educational and service sectors have accelerated demographic transition over the past two decades. The district has simultaneously maintained a substantial rural population dependent on agriculture, fisheries, plantation activities and allied occupations, thereby creating a distinctive rural-urban demographic structure.

According to Census 2011, Udupi District recorded a total population of 1,177,361, comprising 562,131 males and 615,230 females, reflecting one of the favourable adult sex ratios (1094 females per 1000 males) among the coastal districts of Karnataka. The district achieved an overall literacy rate exceeding 86 percent, considerably higher than the national average, while maintaining a moderate population density of 329 persons per square kilometre. Urban population constituted approximately 28.37 percent of the total population, whereas nearly three-fourths of the inhabitants continued to reside in rural areas, indicating that the district still retained a predominantly rural demographic profile despite increasing urbanization. A significant administrative transformation occurred after 2016 when the district was reorganized from three taluks—Kundapura, Udupi and Karkala—into seven taluks comprising Brahmavara, Bynduru, Hebri, Kaup, Karkala, Kundapura and Udupi. This reorganization has provided a more detailed spatial framework for analysing demographic variations and administrative requirements. The subdivision enables planners to identify localized demographic disparities that were previously masked under larger administrative units. The newly constituted taluks differ considerably in terms of population size, literacy, urban concentration, population density and growth characteristics, thereby influencing future planning priorities.

The available demographic data indicate notable spatial differences within the district. Udupi Taluk has emerged as the principal urban and administrative centre, exhibiting the highest population concentration, population density, literacy and urbanization.

Kundapura continues to accommodate a large rural population spread across extensive geographical areas, while Karkala demonstrates relatively balanced demographic characteristics with moderate population density and literacy. Among the newly formed taluks, Hebri represents the least populated administrative unit with sparse settlement concentration, whereas Brahmavara and Kaup exhibit intermediate demographic characteristics influenced by their proximity to Udupi town.

The demographic transition observed in Udupi District also reflects broader socio-economic transformations occurring across coastal Karnataka. Increasing educational attainment, declining fertility, improved healthcare facilities and expanding urban employment opportunities have contributed to changing population structures. Simultaneously, variations in rural growth, urban expansion and population density indicate that demographic change has not occurred uniformly across all taluks. Such spatial inequalities necessitate comprehensive demographic assessment for developing decentralized planning strategies capable of addressing local developmental needs.

This study therefore investigates the demographic shift and growth pattern of Udupi District by comparing Census 2011 data with district-level demographic statistics available after the administrative reorganization. Particular emphasis is placed on analysing changes in population distribution, literacy, sex ratio, population density, rural–urban composition, caste-wise population and growth trends across different administrative units. The study further examines how these demographic variations influence balanced regional development and identifies the implications for future regional planning within the district. The findings are expected to contribute towards a better understanding of demographic heterogeneity across Udupi District while providing an empirical basis for balanced allocation of infrastructure, public services and development programmes. By integrating district-level, taluk-level and post-reorganization demographic information, the study offers a comprehensive perspective on the relationship between demographic change and regional development within a rapidly transforming coastal district.

II. LITERATURE REVIEW

The search strategy adopted for the literature review of the concerned research, dealt with the implications of the regional growth and its correlation with the respective demographic variables in the limit of a micro region. The keywords, for searching literature, in the search engine / database notified with Scopus / Web of Science / UGC and other allied, has been used extensively with a given timeline of last 50 years, given the nature of the research are, “REGIONAL GROWTH RATE” AND “DEMOGRAPHIC SHIFT” OR “DEMOGRAPHIC STUDY” AND “MICRO REGION” OR “IMPACT OF BALANCED REGIONAL DEVELOPMENT”.

(Kumar et al., 2023) advance the discourse on urban deprivation by investigating the multidimensional nature of poverty across slum settlements in Varanasi through the application of the Multidimensional Poverty Index (MPI) derived from household-level survey data. Their analysis reveals pronounced spatial disparities in deprivation, demonstrating that socio-religious identity, occupational structure, and residential location constitute the primary determinants of multidimensional poverty. The study identifies Muslim migrant households engaged predominantly in informal economic activities within the central geographical zone of the city as the most disadvantaged, thereby emphasizing the role of socio-spatial inequalities in shaping urban poverty patterns. While the research provides valuable insights into deprivation within slum communities, its scope remains restricted to informal settlements, limiting broader interpretations of demographic and socio-economic transformations across the urban agglomeration of Varanasi. The investigation primarily conceptualizes poverty through a multidimensional framework without adequately exploring the influence of demographic processes such as population growth, migration, fertility transition, household composition, age structure, literacy, and labor-force characteristics on the city's spatial evolution since the beginning of the twenty-first century. Furthermore, the cross-sectional nature of the primary survey constrains the ability to examine long-term demographic transitions and the temporal dynamics of urban development.

(Chetry, 2024) evaluates patterns of urban expansion across eighty-eight medium-sized Indian cities by integrating Urban Expansion Rate (UER), Population Growth Rate (PR), and the Population-to-Urban Expansion (PU) ratio using Census of India datasets. The study effectively distinguishes between compact urban development and sprawling growth patterns while highlighting the influence of migration, infrastructure investment, policy interventions, and economic progress on urban expansion. Nevertheless, the analysis remains largely comparative at the national scale and does not investigate the demographic mechanisms driving growth within individual cities. Although Varanasi forms part of the study sample, its unique demographic profile—including migration dynamics, age distribution, literacy transition, occupational composition, and household characteristics—receives limited attention. Moreover, the dependence on municipal boundary changes and decadal census indicators provides only a generalized understanding of urban expansion, overlooking significant neighborhood-level demographic variations and intra-urban spatial heterogeneity. The study also pays relatively little attention to the complex interactions between demographic transition, land-use transformation, and urban planning processes, particularly within historically significant heritage cities where development trajectories differ considerably from those of other urban centers. (Shukla et al., 2018) examine the interactions among population growth, land use and land cover (LULC) change, and water quality across the Upper Ganga River Basin through the integration of remote sensing, Geographic Information Systems (GIS), and statistical modelling techniques. Their findings demonstrate that rapid population increase and accelerated urbanization have substantially contributed to the expansion of built-up areas while simultaneously degrading water quality throughout the basin. Although the research successfully establishes the environmental consequences of urban growth, its analysis is undertaken at the river basin and district scales, thereby limiting insights into city-level demographic transformations and their spatial implications. Despite identifying Varanasi as one of the region's rapidly urbanizing and densely populated districts, the study does not investigate critical demographic dimensions such as migration, literacy, workforce participation, age structure, household characteristics, or the intra-city distribution of population. In addition, the research predominantly focuses on environmental impacts associated with population growth, offering comparatively limited discussion on how demographic changes influence urban planning, infrastructure provision, and sustainable urban development. Future investigations would therefore benefit from integrating detailed demographic analyses with geospatial techniques and planning perspectives to provide a more comprehensive understanding of Varanasi's evolving urban structure and to support informed, evidence-based planning strategies.

(Bhatta, 2009) develops an integrated methodological approach for investigating urban expansion by combining remote sensing, Geographic Information Systems (GIS), demographic variables, and statistical techniques to evaluate the dynamics of urban sprawl in Kolkata. The study demonstrates that spatial growth of built-up areas may continue even during periods of declining population

growth, indicating that urban expansion is influenced by factors extending beyond demographic increase alone. By incorporating indicators such as household numbers, workforce participation, and Shannon's entropy, the research provides a multidimensional framework for understanding urban growth and offers practical insights for spatial planning and policy formulation. Nevertheless, the investigation is principally methodological and geographically confined to Kolkata, thereby restricting its direct applicability to culturally and historically distinctive urban centers such as Varanasi. Although demographic indicators are incorporated into the analytical framework, the study does not explicitly evaluate the influence of migration, age composition, literacy transition, household structure, or socio-economic inequalities on long-term demographic transformation. In addition, the emphasis remains largely on the physical manifestation of urban expansion, with comparatively limited attention given to the implications of demographic change for infrastructure requirements, public service provision, heritage conservation, and sustainable urban planning. Future research should therefore adopt a longitudinal and city-specific framework that integrates demographic transition analysis with geospatial techniques and planning indicators to better understand the evolving urban structure of Varanasi. (Chadchan & Shankar, 2012) provide a comprehensive overview of urbanization and sustainable urban development in India by examining the consequences of post-liberalization economic reforms on land-use change, housing demand, transportation systems, infrastructure provision, and metropolitan expansion. The study identifies dispersed urban growth, low-density development, housing deficits, agricultural land conversion, and inadequate transport infrastructure as major constraints to sustainable urbanization. To address these challenges, the authors advocate planning strategies including compact city development, Transit-Oriented Development (TOD), smart growth principles, and inclusive urban design. Despite offering an extensive national perspective, the study remains largely generalized and pays limited attention to the demographic dynamics of individual cities. The discussion predominantly focuses on metropolitan growth patterns without examining the demographic evolution of culturally significant heritage cities such as Varanasi. While migration and population growth are acknowledged as important drivers of urbanization, demographic variables such as age composition, literacy transition, household characteristics, workforce participation, and migration patterns are not examined in sufficient detail. Furthermore, the reliance on macro-level population projections and land consumption estimates limits the understanding of neighborhood-scale demographic variability and intra-urban spatial differentiation, both of which are essential for localized planning interventions.

(Bekturganova et al., 2022) contribute to demographic research by empirically examining the relationships between demographic transition variables and demographic dividend indicators through correlation and regression analyses. The study demonstrates that fertility, mortality, the proportion of working-age population, and labor-force participation significantly influence demographic dividend outcomes. The findings indicate that urban fertility rates and rural mortality exert considerable effects on the size of the working-age population, whereas the rural male working-age population positively contributes to labor-force expansion. The authors consequently emphasize the importance of demographic policy in maximizing demographic dividends and promoting long-term economic development. Despite these important findings, the study is situated within the national context of Kazakhstan, thereby limiting the transferability of its conclusions to rapidly urbanizing Indian cities such as Varanasi. Moreover, the investigation primarily explores demographic factors in relation to labor-force participation and economic performance, while giving comparatively little attention to their implications for urban spatial growth, migration dynamics, literacy transition, household composition, or intra-city demographic variation. Consequently, the broader interactions between demographic transition and urban planning remain insufficiently explored, indicating the need for more localized and spatially explicit investigations. (Yakubenko, 2020) investigates the relationship between public infrastructure provision, population concentration, and the growth of primate cities using panel data covering eighty-eight countries between 1991 and 2014. The study establishes that improved access to essential public services, particularly water supply and sanitation, can reduce excessive population concentration within primate cities, whereas deficiencies in infrastructure tend to intensify migration flows and reinforce urban primacy. The findings further suggest that the disproportionate expansion of primate cities frequently occurs at the expense of smaller urban centres, contributing to increasing regional disparities and constraining balanced territorial development. Although the research offers valuable theoretical and empirical insights into urban concentration, its analysis is undertaken at the cross-national level and therefore focuses on national urban systems rather than the demographic evolution of individual cities. As a result, the study does not examine how demographic characteristics such as migration patterns, age structure, literacy levels, workforce composition, household characteristics, or population density influence the spatial development of heritage cities like Varanasi. Moreover, while acknowledging the role of infrastructure in shaping migration and urban concentration, the research provides only limited discussion of the interactions among demographic transition, land-use change, and local planning policies. Future investigations should therefore adopt a longitudinal, city-level approach that integrates demographic indicators, geospatial analysis, and urban planning frameworks to comprehensively evaluate demographic transformations and their implications for sustainable urban development in Varanasi.

(Wang et al., 2020) investigate the factors influencing the migration of highly skilled professionals and the development of high-technology industries within the Yangtze River Delta Urban Agglomeration (YRDUA) by employing a dynamic system Generalized Method of Moments (sys-GMM) model. Their findings indicate that the expansion of high-technology manufacturing, foreign direct investment, and talent-oriented policy incentives are the primary determinants of attracting and retaining skilled workers. In contrast, conventional macroeconomic variables, including per capita income and population density, exert comparatively weaker influences on migration decisions. The study also identifies higher education institutions as significant magnets for skilled labor, whereas healthcare facilities, information and communication technology infrastructure, and urban green spaces exhibit relatively limited effects on talent mobility. Despite offering important insights into the relationship between industrial development and skilled migration, the research remains geographically confined to the Yangtze River Delta and focuses predominantly on high-skilled labor associated with advanced manufacturing sectors. Consequently, its findings have limited applicability to heritage cities such as Varanasi, where urban development is driven largely by cultural, religious, tourism, and service-based activities. Furthermore, although population density is incorporated into the analytical framework, broader demographic dimensions—including age structure, household composition, literacy transition, socio-economic characteristics, and overall demographic dynamics—are not examined. Future research should therefore integrate these demographic variables with urban planning and spatial analysis to better understand the demographic transformation of historically significant cities. (Castells-quintana et al., 2020) provide a comprehensive theoretical and empirical examination of the phenomenon of "urbanization without growth," arguing that rapid urban expansion does not necessarily translate into sustained economic development. Through a combination of cross-country analysis, dynamic theoretical modelling, and empirical evidence from Tanzania, the authors

demonstrate that accelerated population growth, persistent rural-to-urban migration, high fertility rates, and insufficient investment in urban infrastructure often result in expanding cities characterized by low productivity and inadequate public services. Their findings suggest that demographic pressures, when unsupported by corresponding economic and infrastructural development, contribute to the emergence of poorly serviced urban centers and constrain long-term economic performance. Nevertheless, the empirical investigation is largely situated within Sub-Saharan African countries, limiting the direct applicability of its conclusions to rapidly urbanizing heritage cities in developing economies such as Varanasi. Although the study identifies migration and population dynamics as critical drivers of urbanization, it does not examine city-specific demographic characteristics such as age composition, literacy transition, household structure, workforce participation, or intra-urban population redistribution. Moreover, the authors recognize the need for future studies to incorporate endogenous fertility behavior, migration processes, differential mortality and birth rates, alongside institutional, infrastructural, and planning factors that collectively shape urban development trajectories. These limitations highlight the importance of longitudinal, city-level investigations integrating demographic analysis with geospatial and planning perspectives to better understand demographic change and sustainable urban development in Varanasi.

(Geyer et al., 2013) critically analyses the interconnections among migration, urban marginalization, and informality within African cities, contending that rapid rural-to-urban migration, increasing urban primacy, and the expansion of informal economic activities have intensified socio-economic inequality and unsustainable patterns of urban growth. The authors argue that excessive concentration of population within major metropolitan centers, coupled with inadequate investment in intermediate towns and rural regions, has reinforced unemployment, informal livelihoods, and widening spatial disparities. To promote more balanced urban systems, the study recommends strengthening secondary cities, formalizing informal economic activities, and encouraging more equitable regional development. Although the research successfully identifies migration and urban concentration as key drivers of urban transformation, it provides limited attention to demographic characteristics at the city scale, including age structure, literacy transition, household composition, workforce participation, and population density. In addition, the empirical analysis offers comparatively little discussion on the interaction between demographic transformation, land-use change, infrastructure development, and urban planning interventions. Consequently, further research is required to integrate demographic indicators with spatial planning frameworks in order to comprehensively assess the demographic and socio-spatial evolution of rapidly growing heritage cities such as Varanasi. (Cohen, 2006) presents a comprehensive review of global urbanization patterns by examining the demographic transformation of cities across developing countries and assessing the implications of rapid urban growth for sustainable development. The study identifies natural population increase, rural-to-urban migration, administrative expansion of urban boundaries, and the reclassification of settlements as the principal forces driving urbanization, while emphasizing the growing demographic significance of small and medium-sized cities. Cohen further argues that ineffective urban governance, inadequate infrastructure provision, inconsistent demographic information, and weaknesses in urban population projections continue to constrain evidence-based planning and policy formulation. Although the study provides valuable insights into global and regional urbanization processes using United Nations datasets, its broad geographical scope limits the understanding of demographic change within individual urban centers. While migration and population growth are acknowledged as central components of urban expansion, the research does not investigate demographic attributes such as age structure, literacy transition, household characteristics, workforce participation, or neighborhood-level spatial differentiation within specific cities. Furthermore, the author highlights methodological challenges arising from the absence of standardized definitions of urban areas, inconsistencies in demographic datasets, and uncertainties associated with population projections, all of which restrict accurate interpretation of urban dynamics. These limitations underscore the need for detailed city-level demographic investigations that integrate census-based indicators with spatial analytical techniques to support more effective urban planning and sustainable development strategies in cities such as Varanasi.

One of the earliest methodological contributions to regional development assessment was presented by (Ei-kammash & Pearson, 1963), who introduced the application of the Guttman Scalogram Analysis for measuring economic development through multiple variables rather than relying on a single economic indicator. The author argued that economic development is a multidimensional phenomenon encompassing demographic, social, and infrastructural characteristics, making single-variable indicators such as per capita income inadequate. Scalogram analysis was proposed as a cumulative scaling technique capable of classifying regions according to the presence or absence of development attributes, thereby establishing a hierarchical order among settlements or regions. The study further emphasized that non-parametric methods are particularly suitable where data quality is heterogeneous or semi-quantitative, making the scalogram model an effective tool for regional classification and planning. This methodological framework has since become widely applicable in settlement hierarchy analysis and the evaluation of social infrastructure distribution. Expanding the concept of settlement hierarchy from an economic perspective to a spatial-functional approach, (Abdullah, 2014) developed a theoretical model for measuring the centrality of cities within a functional region. Drawing upon Christaller's Central Place Theory, the study argued that the centrality of settlements depends not merely on their geographical position but also on the interaction between settlement size, transportation networks, and the spatial distribution of surrounding settlements. The proposed Centrality Index incorporated spatial statistical techniques within a GIS environment by integrating mean centres, weighted mean centres based on population, transportation nodes, and accessibility measures. Abdullah emphasized that transportation connectivity and population concentration together determine the functional influence of urban centres over their hinterlands. Unlike conventional centrality measures based solely on service availability, this model incorporated spatial interaction and accessibility, thereby offering a more comprehensive understanding of settlement importance within regional systems. The study significantly contributed to the development of GIS-based spatial planning methodologies capable of identifying regional growth centres and service nodes.

The institutional dimension of regional planning was comprehensively examined by (Pandey, 2016) through the framework of Integrated Planning for Metropolitan and District Areas in India. The study highlighted that balanced regional development requires effective coordination between rural and urban planning institutions established under the 73rd and 74th Constitutional Amendment Acts. Pandey argued that District Planning Committees (DPCs) and Metropolitan Planning Committees (MPCs) were conceived as mechanisms for integrating grassroots planning into broader regional development strategies. However, the study observed that the intended objectives have been only partially achieved due to inadequate institutional autonomy, weak political commitment, insufficient technical capacity, and poor coordination among planning agencies. The author emphasized that integrated planning should operate through long-term perspective plans, medium-term infrastructure development plans, and annual

action plans to ensure balanced regional growth. Furthermore, the study advocated stronger participation of local governments, civil society, and technical experts in regional planning, thereby strengthening decentralized governance and improving the equitable distribution of infrastructure and public services across metropolitan and district regions. More recent perspectives have extended regional planning beyond institutional arrangements to include demographic characteristics as fundamental determinants of socioeconomic development. (Bezverbný et al., 2025) investigated the influence of population density on the socioeconomic development of Russian regions through a comprehensive quantitative framework combining correlation analysis, principal component analysis, and cluster analysis. Contrary to the assumption that higher population density universally promotes development, the study demonstrated that the relationship is highly context-dependent. Four distinct regional clusters were identified, each exhibiting different interactions between population density and economic, demographic, and infrastructural variables. Highly urbanized metropolitan regions benefited from agglomeration economies, innovation, and improved service accessibility, whereas sparsely populated peripheral regions faced higher infrastructure costs, demographic decline, and weaker economic performance. Simultaneously, excessively dense industrial regions experienced negative outcomes associated with congestion and infrastructure pressure. The study therefore proposed a cluster-differentiated density governance framework, advocating place-specific planning strategies instead of uniform regional policies. By treating population density as a dynamic planning variable rather than merely a demographic statistic, the authors emphasized the need for adaptive governance that integrates settlement patterns, infrastructure provision, and economic development.

The commercial significance of coastal Karnataka has been extensively documented by (Rao, 2015), who argues that the region functioned as an important gateway connecting the resource-rich hinterlands of the Western Ghats with international markets across West Asia and beyond. The study demonstrates that commodities such as rice, pepper, arecanut, textiles, metals, and horses constituted the foundation of a dynamic maritime economy supported by organized trade guilds, customs stations, transport infrastructure, and port settlements. Political regimes, particularly the Vijayanagara Empire, played a crucial role in facilitating commercial activities through administrative protection, infrastructure development, and institutional support for traders. Complementing the historical perspective on trade, (Darren et al., n.d.) examine the sustainability of the traditional Suranga irrigation system in southern Karnataka and northern Kerala. Their study demonstrates that indigenous groundwater harvesting techniques have provided resilient and cost-effective irrigation for farming communities by integrating suranga tunnels with farm ponds, dug wells, and modern irrigation technologies. The research emphasizes that this traditional system enhances water security, particularly for marginal farmers living in the undulating lateritic landscapes of the Western Ghats, while offering greater resilience to seasonal droughts and climatic variability. At the same time, the authors acknowledge emerging challenges associated with increasing dependence on borewells, declining groundwater levels, labor shortages, and changing agricultural practices. Rather than advocating the replacement of traditional systems, they argue for an integrated water management approach combining indigenous knowledge with contemporary technologies and institutional support to ensure long-term sustainability. Their findings illustrate the continued relevance of traditional ecological knowledge in addressing contemporary environmental and agricultural challenges. While (Rao, 2015) focuses on the historical evolution of commercial networks and maritime exchange, Crook, Tripathi, and Jones demonstrate how sustainable water management practices have supported agricultural productivity and rural livelihoods within the same geographical setting. Both studies reveal that regional development has historically depended upon the effective integration of environmental resources, institutional arrangements, and local knowledge systems. Trade networks required reliable agricultural production and transportation infrastructure, whereas sustainable irrigation ensured the continuity of agricultural surplus that supported both local consumption and external commerce. Consequently, the literature portrays coastal Karnataka as a region where environmental adaptation and commercial expansion evolved simultaneously through mutually reinforcing processes.

III. METHODOLOGY

The present study adopts a quantitative and descriptive research design to examine the relationship between demographic characteristics and balanced regional development in Udupi District. The research is entirely based on secondary data obtained from authentic government sources and spatial analysis carried out using Geographic Information System (GIS) techniques. The methodology has been designed to facilitate comparative analysis across different administrative levels and time periods while ensuring consistency in demographic interpretation.

The primary source of demographic information is the Census of India 2011, which provides comprehensive data on population characteristics at the district and taluk levels. The Census database has been utilized to analyse demographic indicators for the three-taluk administrative structure consisting of Kundapura, Udupi and Karkala. To examine the impact of administrative reorganization and recent demographic patterns, additional data have been collected from the publication District at a Glance (2018) prepared by the Statistical Department, Zilla Panchayat, Udupi. This dataset represents demographic statistics for the reorganized seven-taluk administrative structure comprising Brahmapura, Bynduru, Hebri, Kaup, Karkala, Kundapura and Udupi.

The study considers a comprehensive set of demographic variables that directly influence regional development. These include total population, male and female population, child population, adult and child sex ratio, literacy rate (male, female and total), population density, rural and urban population distribution, Scheduled Caste population, Scheduled Tribe population, fertility rate and decadal population growth. Together, these variables provide an integrated understanding of demographic composition, human development and settlement dynamics within the district. The analysis has been carried out at three hierarchical spatial levels. The first level examines demographic characteristics of Udupi District within the broader context of the coastal districts of Karnataka by comparing Udupi with Dakshina Kannada and Uttara Kannada. This regional comparison highlights the relative demographic position of Udupi regarding population size, literacy, fertility, urbanization and growth rate.

The second level analyses demographic changes within Udupi District using the three-taluk administrative framework adopted in Census 2011. Comparative assessment has been undertaken for Kundapura, Udupi and Karkala to identify variations in population concentration, literacy, population density, sex ratio, rural-urban composition and growth patterns. This stage provides a baseline for understanding demographic characteristics before administrative restructuring. The third level investigates the demographic profile of the seven reorganized taluks introduced after 2016. The finer administrative division enables detailed

examination of localized demographic variations among Brahmavara, Bynduru, Hebri, Kaup, Karkala, Kundapura and Udupi. Particular attention has been given to identifying emerging demographic centres, urban growth corridors, sparsely populated regions and areas exhibiting rapid demographic transition.

KARNATAKA DISTRICTS (COASTAL REGION)				
S. NO.	DEMOGRAPHIC ATTRIBUTES	UDUPI	DAKSHINA KANNADA	UTTAR KANNADA
1	POPULATION			
	MALE	562,131	1,034,714	726,256
	FEMALE	615,230	1,054,935	710,913
	TOTAL	1,177,361	2,089,649	1,437,169
2	SEX RATIO			
	ADULT	1094	1020	979
	CHILD	958	947	955
3	CHILD POPULATION			
	MALE	52,689	106,985	76,794
	FEMALE	50,471	101,312	73,321
	TOTAL	103,160	208,297	150,115
4	LITERACY RATE (%)			
	MALE	91.41	93.13	89.63
	FEMALE	81.58	84.13	78.39
	TOTAL	86.24	88.57	84.06
5	POPULATION DENSITY (pp/sq.km)			
		329	430	140
6	POPULATION			
	URBAN (%)	28.37	47.67	29.15
	RURAL (%)	71.63	52.33	70.85
7	FERTILITY RATE			
		0.98	1.38	1.7
8	GROWTH RATE (%)			
	URBAN	61.89	36.58	8.01
	RURAL	-6.91	-6.41	5.43
	TOTAL	5.85	10.11	6.17

UDUPI DISTRICT			
S. NO.	DEMOGRAPHIC ATTRIBUTES	2001	2011
1	TOTAL POPULATION		
	MALE	522,231	562,131
	FEMALE	590,012	615,230
	TOTAL	1,112,243	1,177,361
2	SEX RATIO		
	ADULT	1130	1094
	CHILD	958	958
3	LITERACY RATE (%)		
	MALE	88.23	91
	FEMALE	75.19	81.58
	TOTAL	81.25	86
4	POPULATION DENSITY (pp/sq.km)		
		287	329
5	POPULATION		
	URBAN (%)	18.55	28.37
	RURAL (%)	81.45	71.63
6	GROWTH RATE (%)		
	URBAN		61.89
	RURAL		-6.91
	TOTAL	7.14	5.85

Fig. 1 – Demographic Attributes of Udupi and adjoining Coastal Districts, Decadal Growth 2001 and 2011 (Source: DCHB 2011)

UDUPI DISTRICT - 3 TALUKS (CENSUS 2011)				
S. NO.	DEMOGRAPHIC ATTRIBUTES	KUNDAPURA	UDUPI	KARKALA
1	POPULATION			
	TOTAL	398471	562,799	216091
2	SEX RATIO			
	ADULT	1124	1077	1086
	CHILD	961	965	951
3	CHILD POPULATION			
	MALE	16,671	12,916	8,315
	FEMALE	16,018	12,465	7,908
	TOTAL	32,689	25,381	16,223
4	LITERACY RATE (%)			
	MALE	87.96	91.75	90.33
	FEMALE	74.45	82.01	81.37
	TOTAL	80.73	86.60	85.62
5	POPULATION DENSITY (pp/sq.km)			
		259	760	208.8
6	POPULATION			
	URBAN (%)	10.21	46.32	15.12
	RURAL (%)	89.79	53.68	84.88
7	CASTE WISE POPULATION			
	SCHEDULED CASTES	22,759	32843	19,827
	SCHEDULED TRIBES	14,719	26,087	12,091
8	CASTE WISE POPULATION (%)			
	SCHEDULED CASTES	5.71	5.84	9.18
	SCHEDULED TRIBES	3.69	4.64	5.6
9	GROWTH RATE (%)			
	URBAN	42.26	70.79	30.12
	RURAL	2.57	-19.78	1.62
	TOTAL	5.58	6.34	5.10

UDUPI DISTRICT - 7 TALUKS (DISTRICT AT GLANCE, 2018 - STATISTICAL DEPARTMENT, ZILLA PANCHAYAT)								
S. NO.	DEMOGRAPHIC ATTRIBUTES	BRAHMAVARA	BYNDURU	HEBRI	KAPU	KARKALA	KUNDAPUR	UDUPI
1	POPULATION							
	MALE	83030	58936	22,604	63595	86179	123458	124329
	FEMALE	91042	66105	24,059	71457	94249	138972	129346
	TOTAL	174072	125,041	46663	135052	180428	262430	253675
2	SEX RATIO							
	ADULT	1096	1122	1064	1125	1094	1126	1040
	CHILD	969	947	943	943	958	970	955
3	CHILD POPULATION							
	URBAN	2,216	0	0	3828	2735	3574	16514
	RURAL	11,952	11,751	4,104	8527	13168	19889	4902
	TOTAL	14,168	11,751	4,104	12355	15903	23463	21416
4	LITERACY RATE (%)							
	MALE	90.33	89.30	87.70	95.12	91.5	88.44	94.79
	FEMALE	78.96	75.14	76.54	88.48	83.49	75.99	88.44
	TOTAL	84.35	81.75	81.91	91.58	87.29	81.8	91.54
5	POPULATION DENSITY (pp/sq.km)							
		437	214	101	614	250	296	818
6	POPULATION							
	URBAN	26710	0	0	37528	32681	40673	196469
	RURAL	147362	125041	46663	97524	147747	221757	57206
7	CASTE WISE POPULATION							
	SCHEDULED CASTES	9,343	4752	2,633	9027	17774	17427	14473
	SCHEDULED TRIBES	9,386	6,178	4,955	1859	7503	8174	14842
8	CASTE WISE POPULATION (%)							
	SCHEDULED CASTES	5.37	3.8	5.64	6.68	9.85	6.64	5.7
	SCHEDULED TRIBES	5.39	4.94	10.62	1.38	4.16	3.11	5.85
9	GROWTH RATE (%)							
	URBAN	78.52	0	0	255.38	30.12	42.25	54.55
	RURAL	-3.74	5.27	5.81	-18.25	0.73	0.91	-45.09
	TOTAL	3.57	5.27	5.81	4	5.03	5.67	9.67

Fig. 2 – Demographic Attributes of 3 and 7 Taluks / Sub Districts of Udupi, 2011 and 2016 (Source: DCHB 2011, Zilla Parishad)

Spatial analysis constitutes an important component of the research methodology. Administrative boundary maps of Udupi District have been prepared for both the three-taluk and seven-taluk configurations. Thematic maps have been generated for major demographic indicators including total population, literacy rate, adult and child sex ratio, population density, urban population, rural population and growth rate. Graduated colour schemes have been employed to illustrate spatial variation among administrative units, while proportional symbols have been used wherever appropriate to represent demographic magnitude. These GIS-based visualizations facilitate interpretation of spatial inequalities and demographic concentration across the district.

Comparative statistical analysis has been performed to evaluate demographic changes between Census 2001 and Census 2011 at the district level and to compare demographic characteristics across taluks under the two administrative structures. Descriptive statistical interpretation has been adopted for analysing demographic trends rather than inferential modelling, as the study aims to identify spatial patterns and developmental implications using complete population data rather than sampled observations.

The methodology further emphasizes interpretation of demographic indicators from the perspective of balanced regional development. Population concentration has been examined in relation to urbanization and infrastructure demand, while literacy has been considered as an indicator of human capital development. Population density has been analysed to identify areas experiencing development pressure, whereas sex ratio and child population provide insights into demographic sustainability and social

development. Urban and rural population distributions have been evaluated to understand settlement transformation and the extent of urban expansion across different administrative units. Finally, the demographic findings have been synthesized to assess their implications for balanced regional development. Variations in demographic structure across taluks have been interpreted in terms of administrative planning, infrastructure provision, educational facilities, public services and future development priorities. The integrated methodological framework combining government statistical data, spatial mapping and comparative demographic analysis enables a comprehensive assessment of demographic shifts within Udupi District and provides a reliable basis for evaluating regional disparities and planning requirements.

IV. RESULTS AND FINDINGS

The demographic assessment of Udupi District reveals distinct spatial and temporal variations in population characteristics, urbanization, literacy, population density, sex ratio, and growth patterns. The GIS-based thematic maps, prepared using Census 2011 and District Statistical Department (Zilla Panchayat) 2018 data, effectively demonstrate the changing demographic profile of the district following the administrative transition from three taluks (2011) to seven taluks (2016). The findings indicate that demographic changes are not uniformly distributed but are concentrated around the major urban centres, thereby influencing the regional development pattern.

The total population of Udupi District increased from 1,112,243 in 2001 to 1,177,361 in 2011, recording an overall decadal growth rate of 5.85%, which is comparatively moderate among the coastal districts of Karnataka. Within the district, Udupi Taluk recorded the highest population with 562,799 persons, followed by Kundapura (398,471) and Karkala (216,091). The GIS population distribution map clearly highlights Udupi Taluk as the principal population concentration, reflecting its role as the administrative, commercial and educational centre of the district. Following the 2016 reorganization, the newly constituted Kundapur Taluk possessed the highest population (262,430), followed by Udupi (253,675), Karkala (180,428), Brahmavara (174,072), Kapu (135,052), Bynduru (125,041) and Hebri (46,663). The redistribution of population across seven taluks provides a more localized understanding of demographic concentration for decentralized planning.

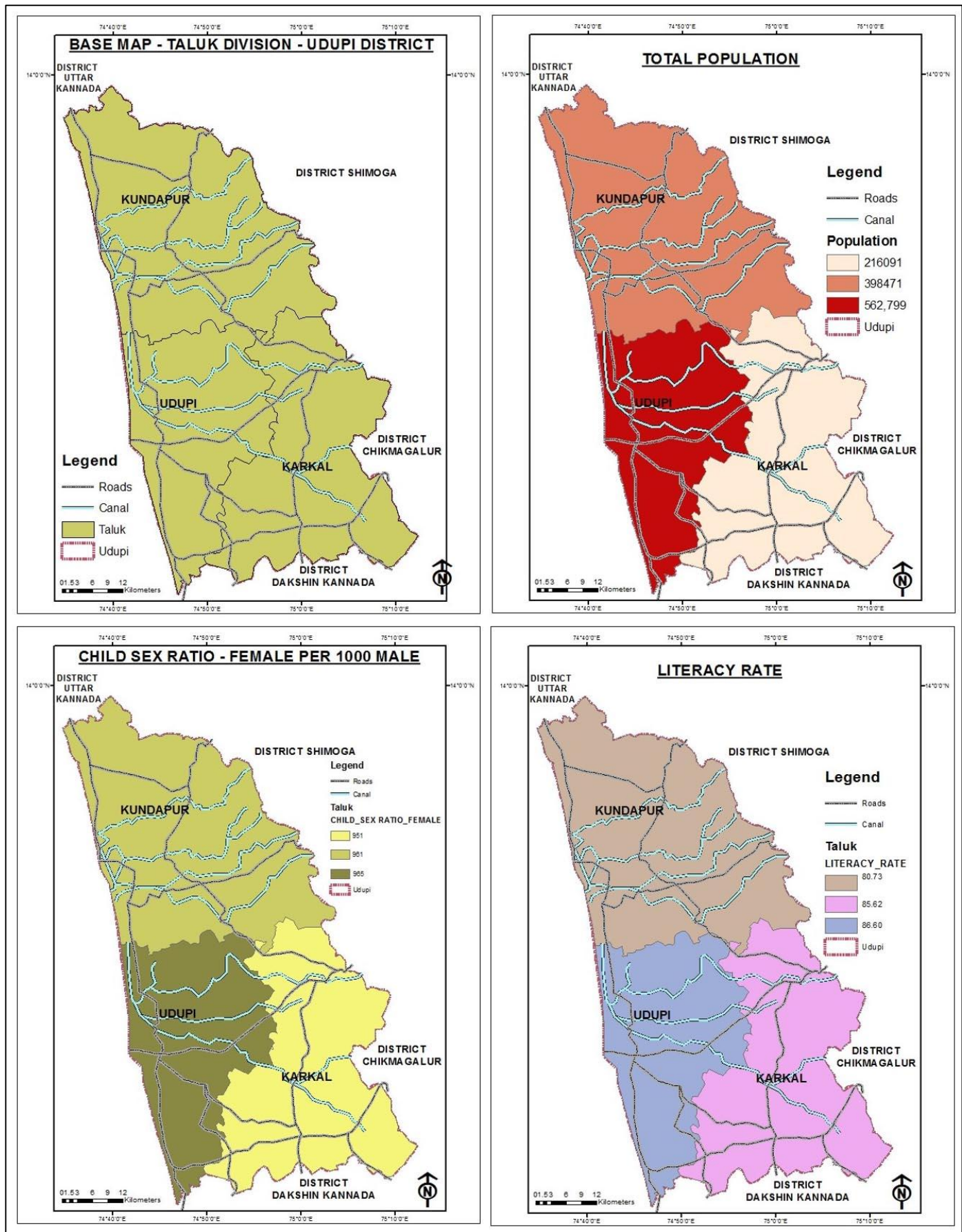


Fig. 3 – GIS Maps Showing Base Map, Total Population, Child Sex Ratio, Literacy Rate for 3 Taluks Division, Udupi District (Source: Author)

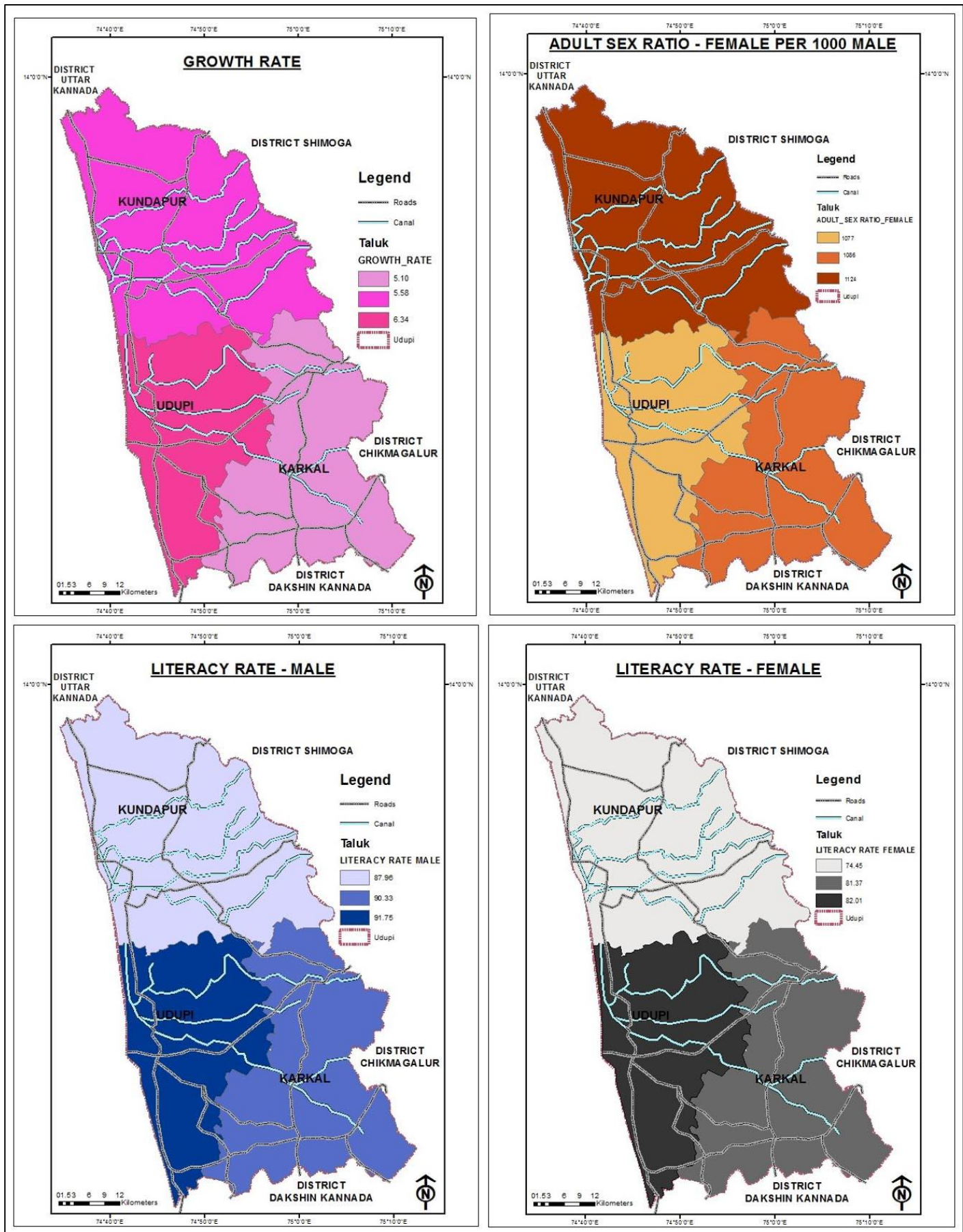


Fig. 4 – GIS Maps Showing Growth Rate, Adult Sex Ratio, Literacy Rate Male and Female for 3 Taluks Division, Udipi District (Source: Author)

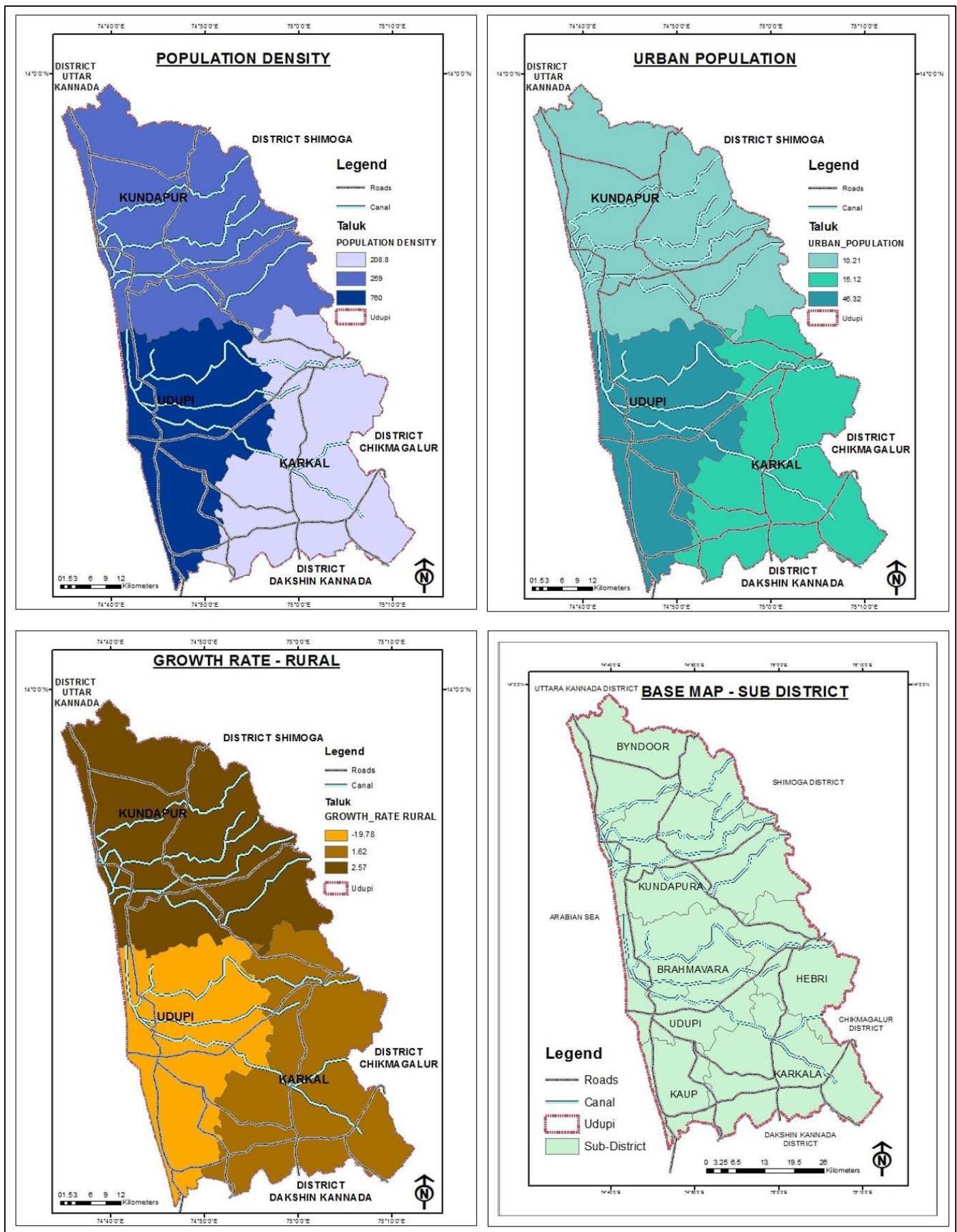


Fig. 5 – GIS Maps Showing Population Density, Urban Population, Growth Rate Rural for 3 Taluks Division and Base Map for 7 Taluks Division, Udupi District (Source: Author)

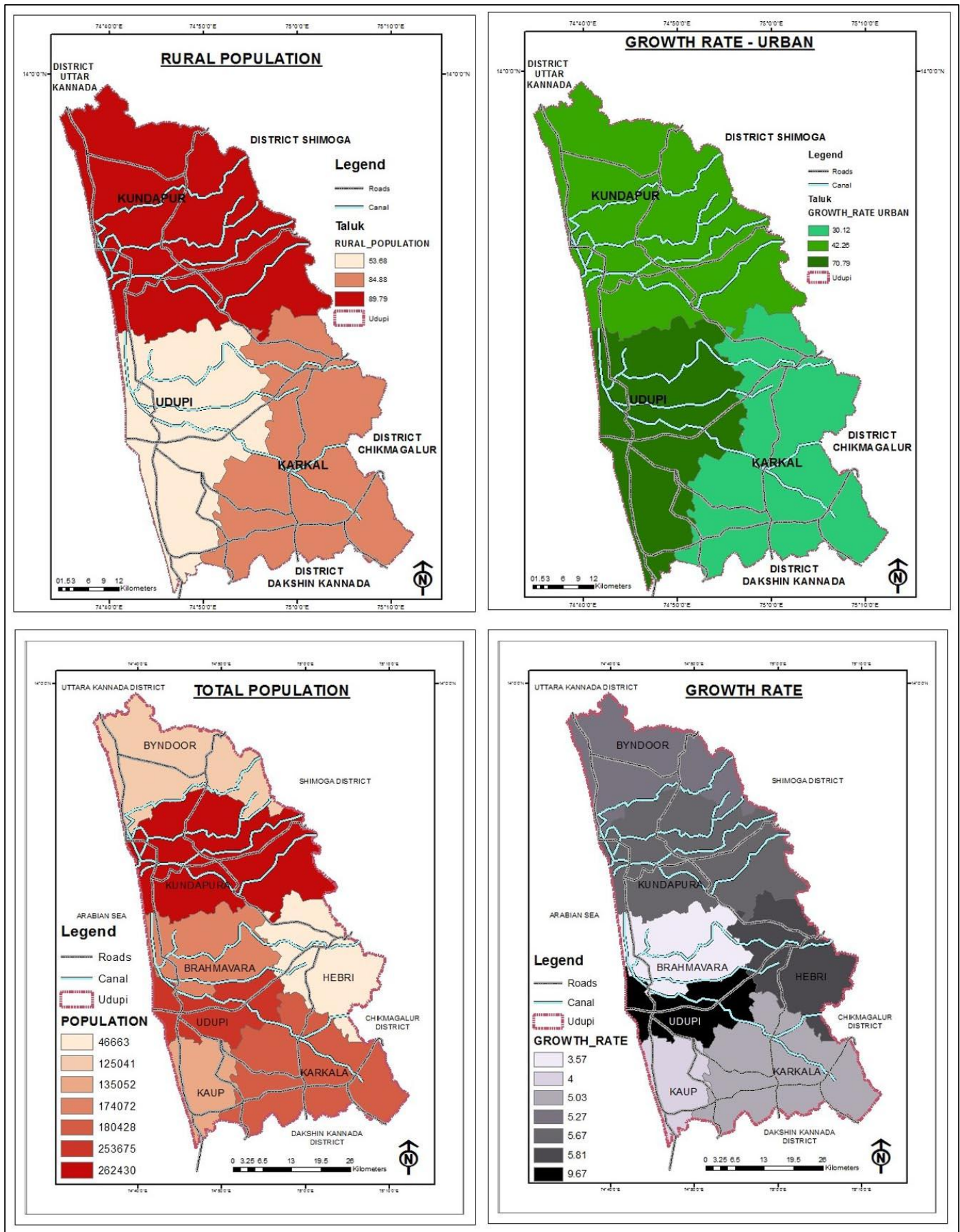


Fig. 6 – GIS Maps Showing Rural Population, Growth Rate Urban for 3 Taluks Division and Total Population, Growth Rate for 7 Taluks Division, Udupi District (Source: Author)

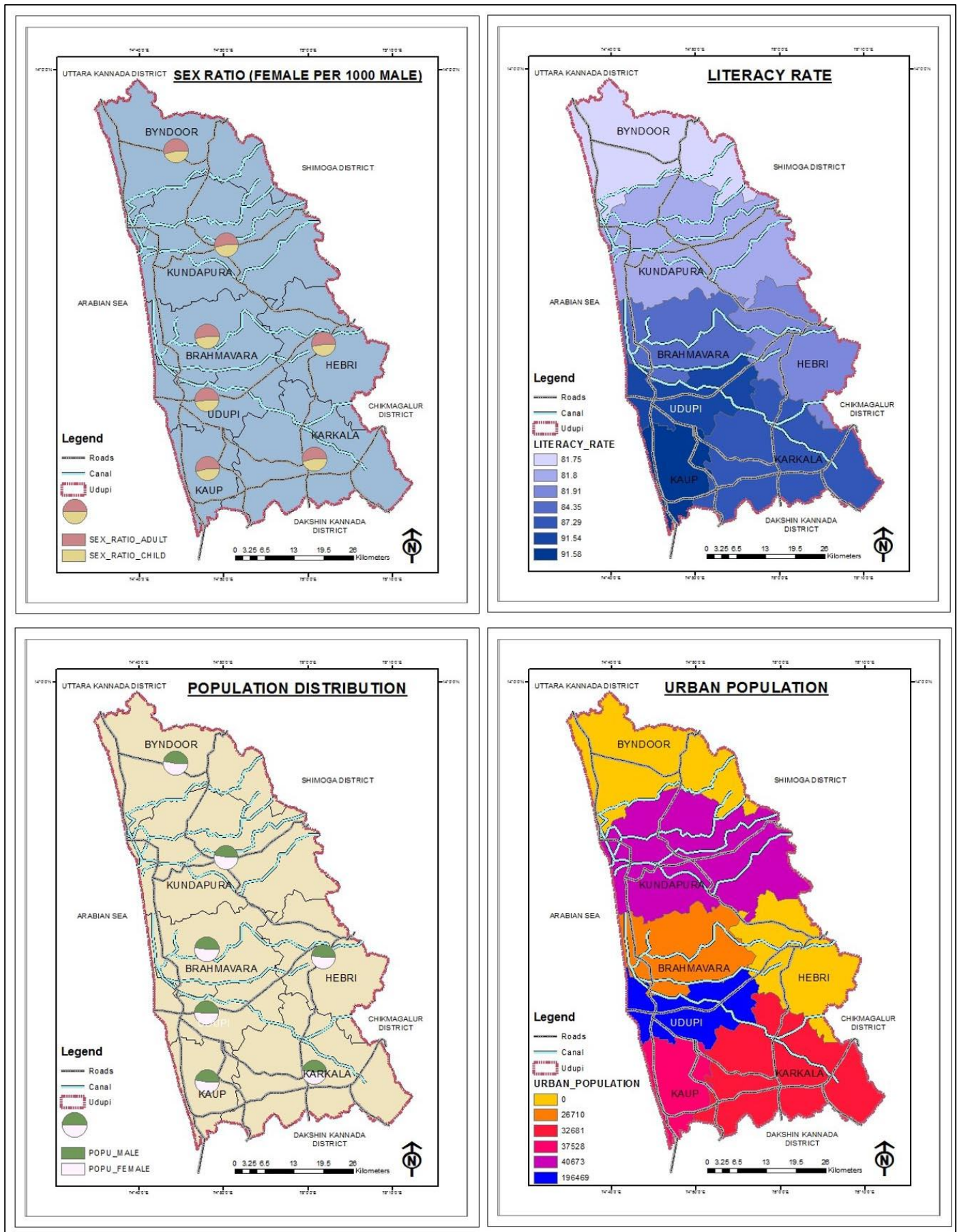


Fig. 7 – GIS Maps Showing Sex Ratio, Literacy Rate, Population Distribution, Urban Population for 7 Taluks Division, Udupi District (Source: Author)

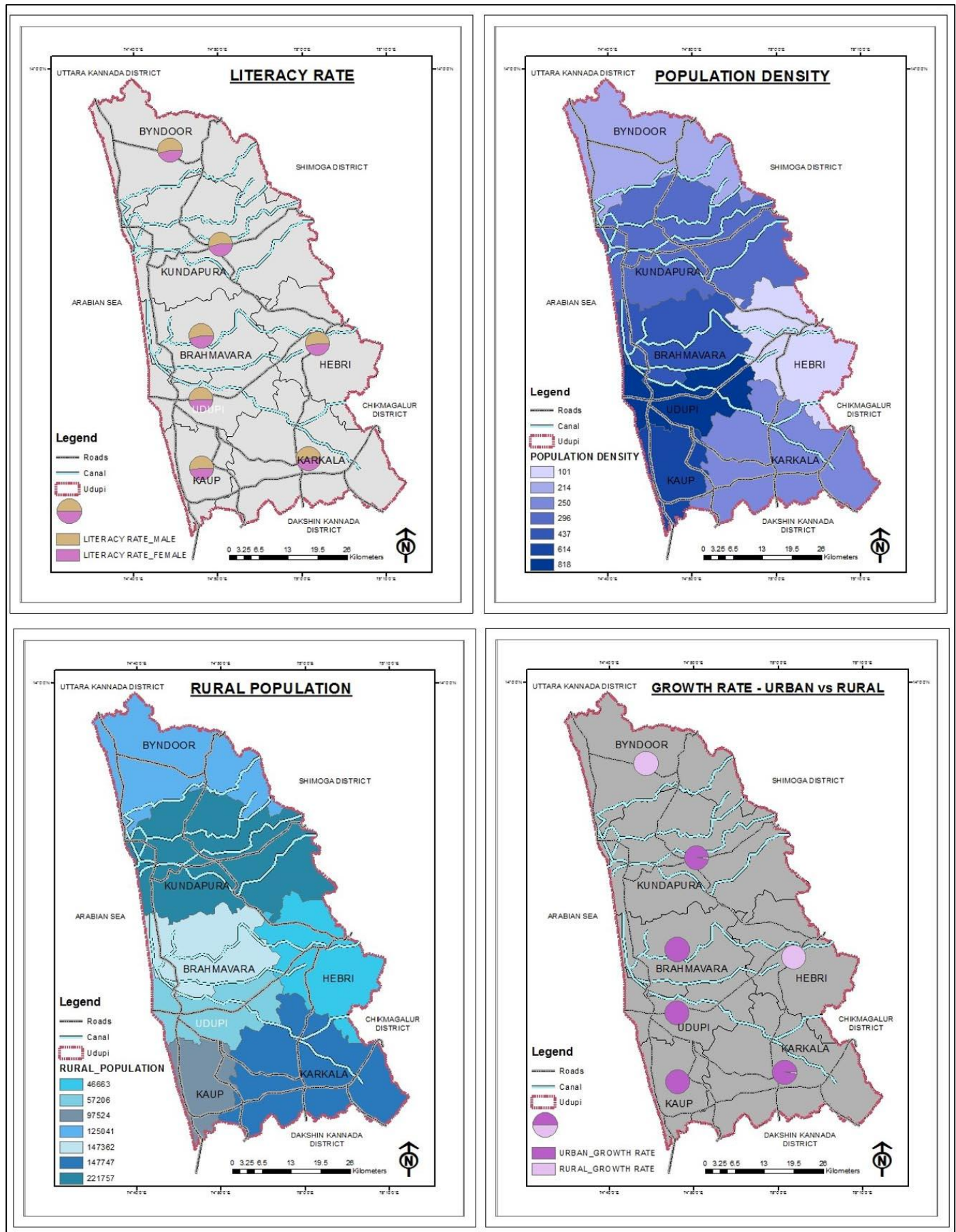


Fig. 8 – GIS Maps Showing Literacy Rate (Male, Female), Population Density, Rural Population, Growth Rate (Urban and Rural) for 7 Taluks Division, Udupi District (Source: Author)

The spatial distribution of the adult sex ratio exhibits a favourable demographic structure throughout the district. In 2011, the district recorded an adult sex ratio of 1,094 females per 1,000 males, considerably higher than both Dakshina Kannada (1,020) and Uttara Kannada (979). Among the three taluks, Kundapura registered the highest adult sex ratio (1,124), followed by Karkala (1,086) and Udupi (1,077). After bifurcation into seven taluks, Kundapur (1,126) and Kapu (1,125) recorded the highest adult sex

ratios, whereas Udupi Taluk (1,040) registered the lowest value. Conversely, the child sex ratio remained comparatively lower, ranging from 943 to 970, with Kundapur Taluk recording the highest value (970) and Hebri the lowest (943), indicating relatively balanced gender composition but requiring continued attention towards child welfare.

Literacy emerges as one of the strongest demographic indicators supporting balanced regional development. The district literacy rate increased substantially from 81.25% in 2001 to 86.24% in 2011, reflecting improvements in educational accessibility. Among the three taluks, Udupi Taluk recorded the highest literacy rate (86.60%), followed closely by Karkala (85.62%), while Kundapura (80.73%) remained comparatively lower. The 2018 taluk-wise analysis demonstrates that Kapu attained the highest literacy rate (91.58%), followed by Udupi (91.54%), whereas Bynduru (81.75%), Hebri (81.91%) and Kundapur (81.80%) recorded comparatively lower literacy levels. The GIS literacy maps illustrate a clear concentration of higher educational attainment in the southern and coastal urbanized taluks.

Population density also reflects pronounced regional disparities. At the district level, density increased from 287 persons/km² in 2001 to 329 persons/km² in 2011. Among the three taluks, Udupi Taluk exhibited the highest density (760 persons/km²), considerably exceeding Kundapura (259 persons/km²) and Karkala (208.8 persons/km²). The post-2016 scenario further emphasizes this disparity, with Udupi Taluk recording the highest density (818 persons/km²), followed by Kapu (614 persons/km²) and Brahmavara (437 persons/km²), whereas Hebri remained sparsely populated with only 101 persons/km². The GIS density maps reveal an evident coastal concentration of settlements while the eastern hilly regions remain relatively less populated.

Urbanization exhibits the most significant demographic transformation within the district. Between 2001 and 2011, the urban population increased from 18.55% to 28.37%, while the rural population declined from 81.45% to 71.63%. At the taluk level, Udupi Taluk recorded the highest urban population (46.32%) followed by Karkala (15.12%) and Kundapura (10.21%). Following administrative reorganization, Udupi remained the dominant urban centre with 196,469 urban residents, followed by Kundapur (40,673), Kapu (37,528), Karkala (32,681) and Brahmavara (26,710), while Bynduru and Hebri remained entirely rural. The urban population maps demonstrate that urban growth is concentrated primarily along the coastal development corridor.

Growth rate analysis further reinforces the uneven nature of demographic transformation. Between 2001 and 2011, urban growth reached 61.89%, whereas rural growth declined by -6.91%, indicating a gradual shift of population towards urban settlements. Among the three taluks, Udupi registered the highest total growth (6.34%), followed by Kundapura (5.58%) and Karkala (5.10%). In the seven-taluk configuration, Udupi Taluk recorded the highest total growth (9.67%), while Hebri (5.81%), Kundapur (5.67%), Bynduru (5.27%), Karkala (5.03%), Kapu (4.00%), and Brahmavara (3.57%) exhibited comparatively moderate growth. Urban growth was particularly high in Kapu (255.38%), Brahmavara (78.52%), Udupi (54.55%), and Kundapur (42.25%), whereas rural population declined significantly in Udupi (-45.09%), Kapu (-18.25%), and Brahmavara (-3.74%), reflecting continuing urban expansion and functional transformation of settlements.

Overall, the GIS-based demographic assessment reveals that Udupi District has undergone a significant demographic transition characterized by increasing literacy, favourable sex ratio, moderate population growth, rising urbanization, and spatial concentration of population along the coastal corridor. Simultaneously, the interior taluks continue to exhibit lower population density and higher dependence on rural settlements. These spatial disparities emphasize the need for balanced regional development strategies that strengthen infrastructure, social services, and economic opportunities in the relatively less developed taluks while effectively managing rapid urban expansion in the district's emerging growth centres.

Conclusion

The demographic assessment of Udupi District demonstrates that population dynamics have played a significant role in shaping the district's regional development pattern over the past two decades. The comparative analysis based on Census 2011 and the post-reorganization demographic statistics for the seven taluks reveals that although the district exhibits favourable socio-economic indicators relative to many regions of Karnataka, considerable spatial variations continue to exist across its administrative units. These demographic differences have important implications for balanced regional development, resource allocation and decentralized planning. The study highlights that Udupi District has maintained a favourable demographic profile characterized by a high literacy rate, a positive adult sex ratio and a comparatively low fertility rate, indicating substantial progress in education, healthcare and social development. Simultaneously, the district has experienced moderate population growth accompanied by rapid urban expansion, particularly around Udupi Taluk. The increase in urban population, coupled with declining rural growth in certain areas, reflects an ongoing demographic transition influenced by expanding educational institutions, service-sector employment, commercial activities and improved physical infrastructure. The comparative analysis of the three taluks under Census 2011 identifies Udupi Taluk as the principal demographic and urban centre of the district, exhibiting the highest population concentration, literacy level, population density and urbanization. Kundapura, despite having a substantial population, continues to retain a predominantly rural character, whereas Karkala represents an intermediate demographic profile with balanced rural and urban characteristics. The subsequent administrative reorganization into seven taluks provides a more refined understanding of localized demographic conditions. The newly formed taluks exhibit distinct demographic identities, with Hebri and Bynduru representing relatively low-density rural regions, while Brahmavara and Kaup demonstrate transitional characteristics due to their geographical proximity to the urban influence of Udupi. These intra-district differences confirm that demographic change has not been spatially uniform and therefore requires differentiated planning interventions.

The spatial distribution of literacy, population density, rural-urban composition and growth rate, as illustrated through GIS-based thematic mapping, further emphasizes the existence of developmental imbalances within the district. Urban-oriented taluks continue to experience higher demographic concentration and infrastructure demand, whereas peripheral and predominantly rural taluks require greater investment in connectivity, social infrastructure, healthcare, education and employment generation to minimize regional disparities. The observed decline in rural growth in selected administrative units also indicates the increasing influence of migration and urbanization, necessitating policies that strengthen rural livelihoods while ensuring sustainable urban expansion. Overall, the study establishes that demographic indicators constitute an effective framework for understanding regional disparities and identifying development priorities. The integration of demographic analysis with spatial visualization provides a comprehensive basis for evidence-based regional planning and administrative decision-making. The findings suggest that balanced regional development in Udupi District can be achieved only through decentralized planning strategies that recognize the demographic diversity of individual taluks and promote equitable distribution of infrastructure, public services and economic

opportunities. Such an approach would not only reduce intra-district disparities but also strengthen sustainable and inclusive regional development across the district in the long term.

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