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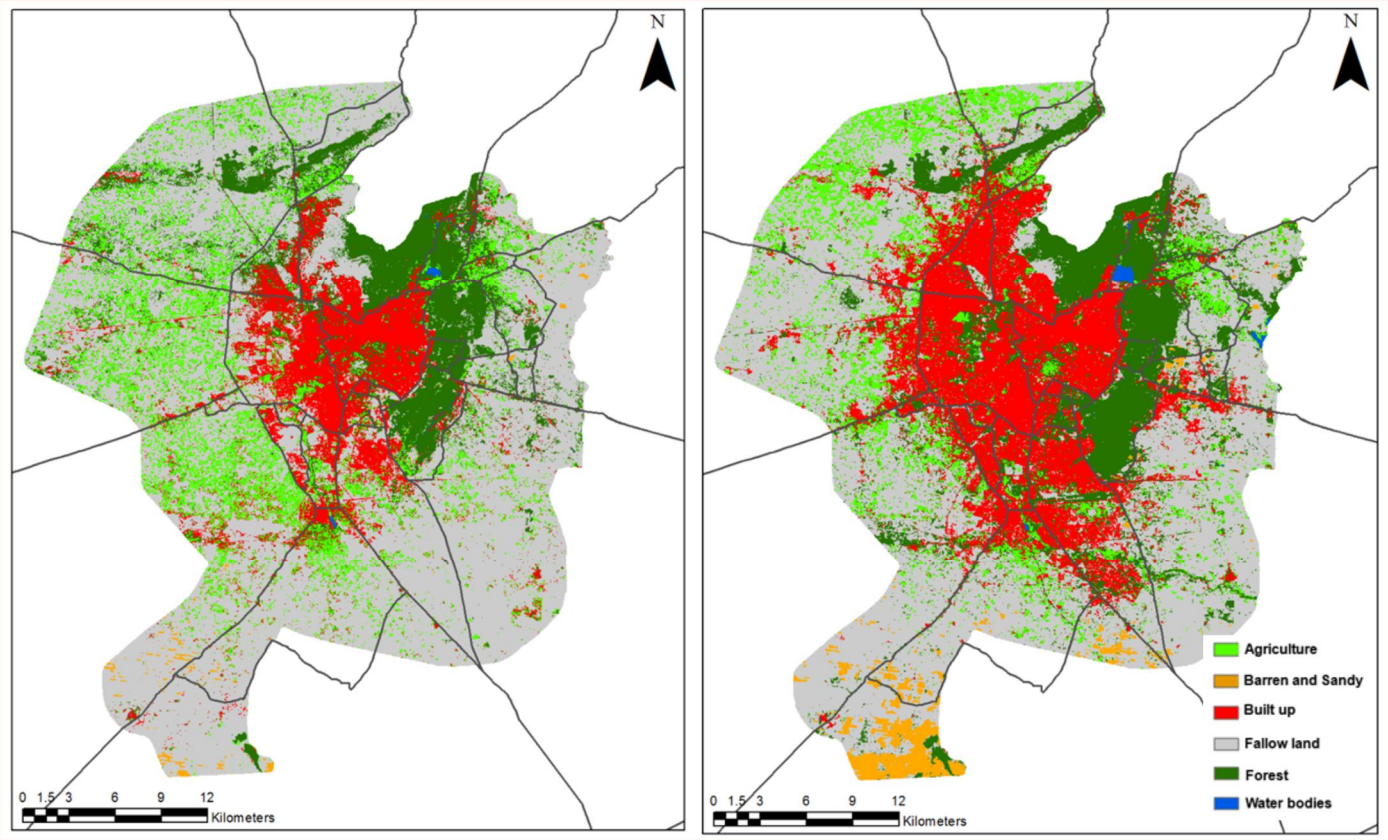


Bulletin

Smart Metropolitan Regional Development - Economic and Spatial Design Strategies

3 / 3 Year 2017, 1st of September

Presented in this Bulletin

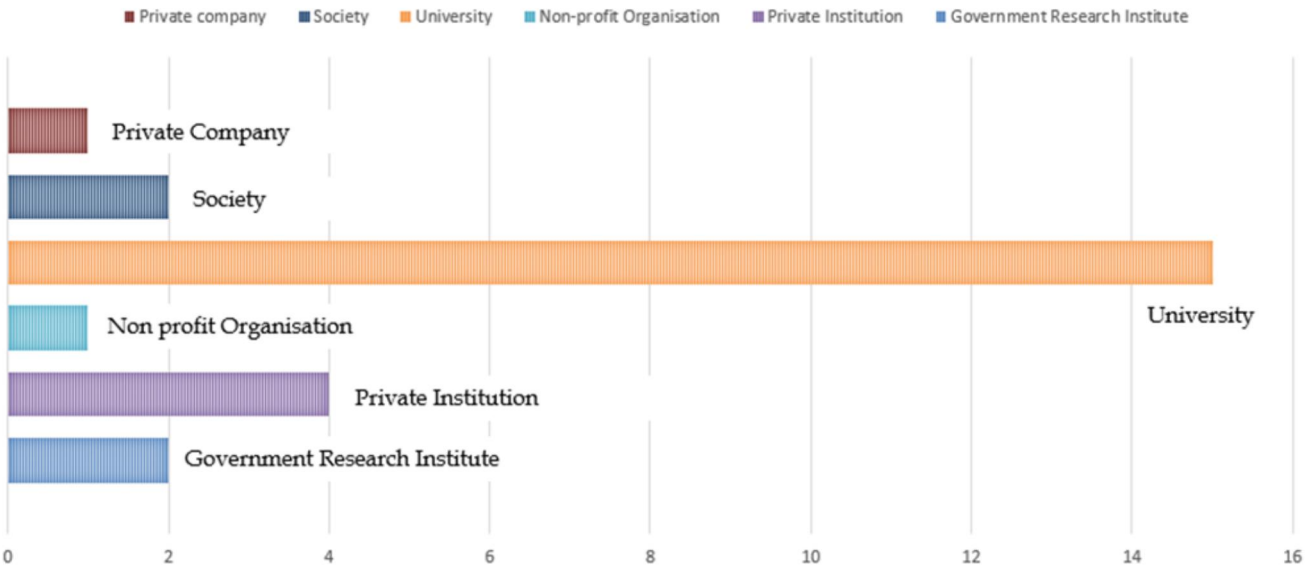
AHMEDABAD-GANDHINAGAR ~ BANGALORE ~ CHANDIGARH

HONG KONG ~ JAIPUR ~ KOZHIKODE ~ NEW DELHI ~ SURAT

By Authors: Jignesh G. Bhatt, Omkar K. Jani, Krupesh A. Chauhan, Leena Garg, Bhasker Vijaykumar Bhatt, T M Vinod Kumar, Mohd. Firoz C., Namratha Radhakrishnan, H. B. Singh, Prabh Bedi, Neha Goel Tripathi, Asfa Siddiqui, Pramod Kumar, Ashok Kumar, Amit Chatterjee- Binayak Choudhary, Premjeet Dasgupta, Gaurav Vaidya, Sujata Govada, Timothy Rodgers

STUDY AREAS *Our research project consist now of 16 Metropolitan Regions*

INSTITUTIONS *There are 25 different institutions involved*



MILESTONES

BULLETIN			BOOK	
Bulletin 1 (USA and Europe)	Pittsburgh, Naples, Stuttgart	15th March, 2017	Chapters Draft 1	15th November, 2017
Bulletin 2 (Africa)	Dakar, Conakry, Abuja, Johannesburg, Nairobi	1st June, 2017	Chapters Final draft	31st December, 2017
Bulletin 3 (Asia)	Ahmedabad-Gandhinagar, Bangalore, Chandigarh, Hong Kong, Jaipur, Kozhikode, New Delhi, Surat	1st September, 2017	Manuscript Submission to Publisher	1st January, 2018
			Publication of book	April, 2018

Maps on the cover: Jaipur (1993 to 2013). Source: In-house research at IIRS (Thunyaporn Thoopthimthean, Asfa Siddiqui, Sadhana Jain, "Spatio-temporal pattern of Land Surface temperature in Jaipur City")

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13.	Delhi	India	Prof. Ashok Kumar et al.	School of Planning and Architecture, New Delhi
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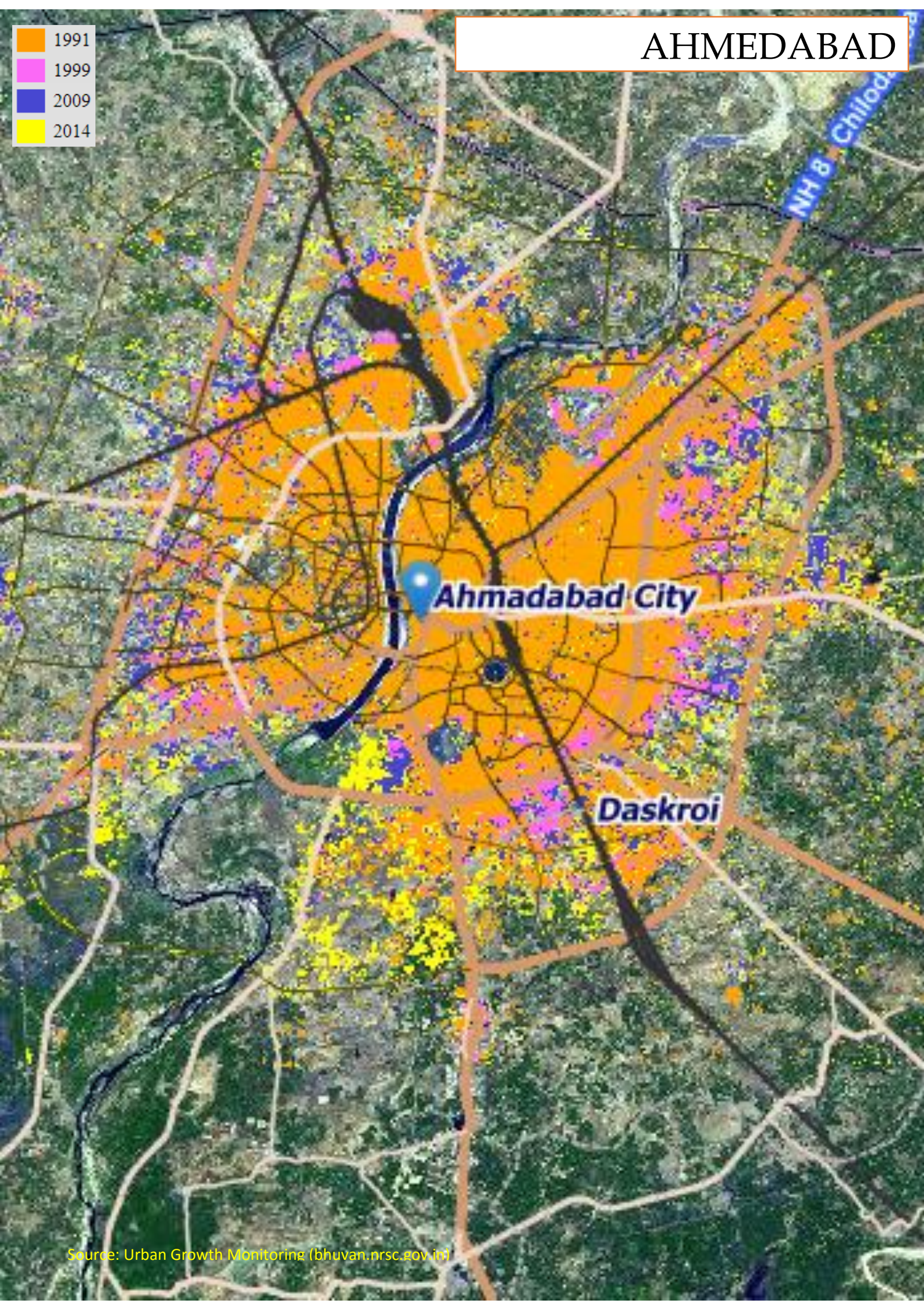

AHMEDABAD
1991
1999
2009
2014
NH 8
Ahmadabad City
Daskroi
Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)

AHMEDABAD-GANDHINAGAR

GUJARAT, INDIA

Jignesh G. Bhatt- Omkar K. Jani

TOWARDS SUSTAINABLE GROWTH BY ENERGY RELIABILITY

Introduction

Reliable electricity supply is essential and vital for development of any region or city. Therefore, smart grids – as energy backbones, are observed being essential and mandatory at the core of smart city developments globally.

(Bhatt et al. 2014) have presented detailed technical review and identified critical applications and parameters of smart grid. In (Bhatt and Jani 2015), e-governance of rooftop based solar photo voltaic rooftop system has been covered with special focus on Gandhinagar solar city project. Next, in (Bhatt and Jani 2017), smart grid pilots along with interesting applications have been discussed including various initiatives of UGVCL and GERMI.

This work presents interesting details of forthcoming initiatives of utility, government and citizens' participation with interesting facts, figures and photographic illustrations. Development of Naroda area in the smart metropolitan region of Ahmedabad-Gandhinagar twin city remains at the focus.

Study area and its regional context

Ahmedabad:

Recently, in July 2017, the Historic City of Ahmadabad or Old Ahmadabad, has been declared as India's first UNESCO World Heritage City. Earlier in 2010, Ahmedabad was ranked third in Forbes's list of fastest growing cities of the decade. In 2012, The Times of India chose Ahmedabad as India's best city to live in. Ahmedabad has been selected as one of the hundred Indian cities to be developed as a smart city under Government of India's flagship Smart Cities Mission. In 2010, Forbes magazine rated Ahmedabad as the fastest-growing city in India, and listed it as third fastest-growing in the world after the Chinese cities of Chengdu and Chongqing. In 2011, it was rated India's best megacity to live in by leading market research firm IMRB. According to the National Crime Records Bureau (NCRB) report of 2003, Ahmedabad has the lowest crime rate of the 35 Indian cities with a population of more than one million.

Ahmedabad has emerged as an important economic and industrial hub in India. It is the second largest producer of cotton in India, and its stock exchange is the country's second oldest. The effects of liberalization of the Indian economy have energized the city's economy towards tertiary sector activities such as commerce, communication, housing, construction, etc.

Ahmedabad is the fifth most populous city and seventh most populous urban agglomeration in India. According to the 2011 census, the population of Ahmedabad city was 5,577,967, while that of its urban agglomeration was 6,361,084.

Ahmedabad also known as 'Amdavad' is the largest city and former capital of Gujarat state, India. With a population of more than 6.3 million and an extended population of 7.8 million, it is the sixth largest city and seventh largest metropolitan area of India. Ahmedabad is located on the banks of the Sabarmati River, 30 km (19 mi) from the state capital Gandhinagar, which is its twin city.

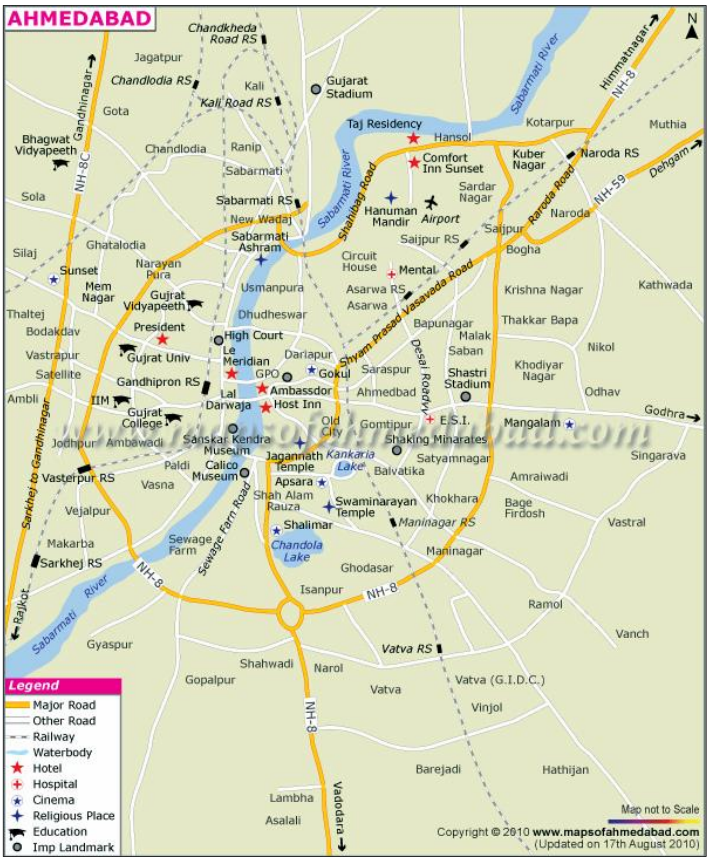
Gandhinagar:

Gandhinagar is the capital of the state of Gujarat in Western India. Gandhinagar is located approximately 23 km north of Ahmedabad, on the west central point of the Industrial corridor between Delhi, the political capital of India, and Mumbai, the financial capital of India.

Gandhinagar, Gujarat's new capital city, lies on the west bank of the Sabarmati River, about 545 km (338 miles) north of Mumbai, the financial capital of India and 901 km (560 miles) southeast of Delhi, the political capital. There is a provision of parks, extensive planting and a recreational area along the river giving the city a green garden-city atmosphere.

Naroda:

Naroda is a fast growing Area in Ahmedabad, northeast of central Ahmedabad, Gujarat, India. With the establishment of the Naroda Industrial Area in the 1980s, the town flourished; it was incorporated into Ahmedabad in 1996. Being eight km from Ahmedabad International Airport and located on the



Left: Region of interest: Naroda area in Ahmedabad-Gandhinagar Smart Twin City.
Up: Satellite map of Naroda area. (Source: Bhuvan)

SP Ring Road, Naroda is situated on the emerging Gandhinagar-Ahmedabad-Vadodara (GAV) corridor.

Naroda has over the last two years transformed from a neglected industrial area to desirable location for homes. The Naroda GIDC industrial park hosts national and multinational corporations. Several major township projects are being developed along the Ahmedabad-Vadodara expressway with Naroda being at the center of the development. In the recent Vibrant Gujarat summit, 24 projects worth more than Rs 1,000 crore were slated to be developed in this part of city and along the Ahmedabad-Vadodara expressway including hospitals, hotels and clubs, educational institutions, NRI residential colonies, business parks, etc. Fig. 1 depicts Naroda as region of our research study interest in the Ahmedabad-Gandhinagar smart twin city in geographic layout. In the satellite map of Fig. 2, Naroda's strategic presence surrounded by diversified types of locations could be referred.

Importance and role of the region

Ahmedabad-Gandhinagar twin city have been already selected as potential smart city in phase-I under PM Narendra Modi's flagship Smart Cities Mission. As the smart grid is the energy backbone of this upcoming smart city, well established and successful smart grid pilot has been conducted at Naroda area at the junction of the twin city by UGVCL. This project has been funded by Government of India funding under R-APDRP.

Rise in the new economy

The gross domestic product of Ahmedabad was estimated at US$64 billion in 2014. The RBI ranked Ahmedabad as the seventh largest deposit centre and seventh largest credit centre nationwide as of June 2012. In the 19th century, the textile and garments industry received strong capital investment.

On 30 May 1861 Ranchhodlal Chhotalal founded the first Indian textile mill, the Ahmedabad Spinning and Weaving Company Limited, followed by the establishment of a series of textile mills. The textile industry further expanded rapidly during the First World War, and benefited from the influence of Mahatma Gandhi's Swadeshi movement, which promoted the purchase of Indian-made goods. Ahmedabad was known as the "Manchester of the East" for its textile industry. The city is the largest supplier of denim and one of the largest exporters of gemstones and jewellery in India. The automobile industry is also important to the city; after Tata's Nano project, Ford and Suzuki are planning to establish plants near Ahmedabad while the groundbreaking ceremony for Peugeot has already been performed. The Ahmedabad Stock Exchange, located in the Ambavadi area of the city, is India's second oldest stock exchange. The information technology industry has developed significantly in Ahmedabad, with companies such as Tata

Consultancy Services opening offices in the city. A NASSCOM survey in 2002 on the "Super Nine Indian Destinations" for IT-enabled services ranked Ahmedabad fifth among the top nine most competitive cities in the country. The city's educational and industrial institutions have attracted students and young skilled workers from the rest of India.

The state-government-owned Gujarat State Electricity Corporation Limited (GSECL) has set up a thermal power station in Gandhinagar; at the stretch towards Pethapur. Software Technology Parks of India (STPI) was established at Infocity, Gandhinagar. Gujarat International Finance Tec-City (GIFT-City) is an under-construction central business district between Ahmedabad and Gandhinagar in the Indian state of Gujarat. It will be built on 359 hectares (886 acres) of land. Its main purpose is to provide high quality physical infrastructure (electricity, water, gas, district cooling, roads, telecoms and broadband), so that finance and tech firms can relocate their operations there from Mumbai, Bangalore, Gurgaon etc. where infrastructure is either inadequate or very expensive. It will have a special economic zone (SEZ), international education zone, integrated townships, an entertainment zone, hotels, a convention centre, an international techno park, units, shopping malls, stock exchanges and service units.

Need and scope

As the cities are becoming smart, citizen and governance support applications are rising in quantities and complexities. This has direct impact on overall electrical energy requirements. Production, transmission and distribution of electricity is getting expensive. Higher dependencies on fossil fuel based thermal power stations as well as low penetration of renewables has been resulting in rising costs. Bad habits, lack of discipline of citizens, heavy wastages, etc. are also important factors.
Therefore, it is an urgent need of today to transform all smart city homes into smart homes with smart HANs and relevant solutions, which would result into effective and optimal utilization of electricity.

Present situation

Naroda is ready with successful pilot of smart grid with smart meters already installed and NAN-WAN connectivity already tested. Meters are fetching sampled data and proper interpretation and analysis are efficiently being carried out at UGVCL head end. Citizens in the area have been found satisfactory with the setup and ready to participate at next level of development.

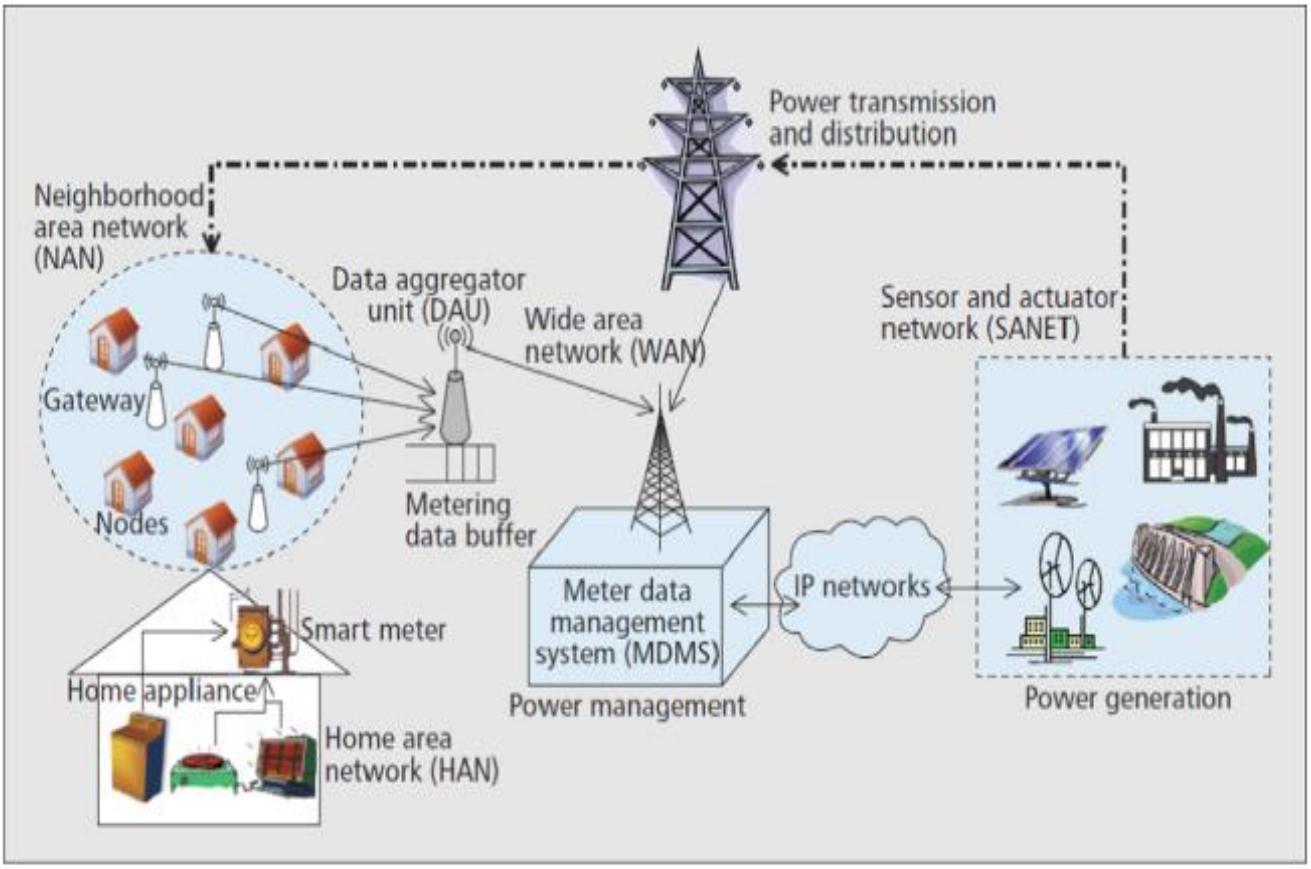


Fig.3: Automated Metering Infrastructure (AMI)

SWOC analysis

Strengths:

- Preliminary level of foundation work completed
- Pilot has been successful
- Participant citizens are cooperative

Weaknesses:

- Connectivity and ICT infrastructure

Opportunities:

- The work itself
- Motivation and support from central and state governments
- Training of citizens for upcoming changes
- Possible employments and commercial opportunities for everyone

Challenges:

- Costing and revenue sharing, subsidies, refunds, investment payback, etc.
- Security of data and access

Proposed methodology

(1) Start of work and literature review
(2) Finalization of feasible technological solution
(3) Data collection-I
(4) Preparation and proposing a model
(5) Review and modification of proposed model
(6) Implementation of model in selected location
(7) Data collection-II
(8) Validation of anticipated benefits
(9) Report submission and publications
(10) End of work

Data acquisition approach

Available data:

Consumers and their current consumption capacities, ratings of appliances, smart meter specifications, networking information

Data to be collected:

Consumption patterns, consumer habits, weather sensitive changes, application/events specific modifications, experiences and case studies

Data collection method:

Literature review, survey, questionnaire, field visits and study

Feasible e-application domains

(1) Advanced Metering Infrastructure (AMI)
(2) Monitoring and automation of substations
(3) Home Automation Network (HAN)
(4) Power network monitoring
(5) Demand Response (DR)
(6) Integration of renewables
(7) Supervisory Control And Data Acquisition (SCADA) system
(8) Plug-in Hybrid Electric Vehicles (PHEV)

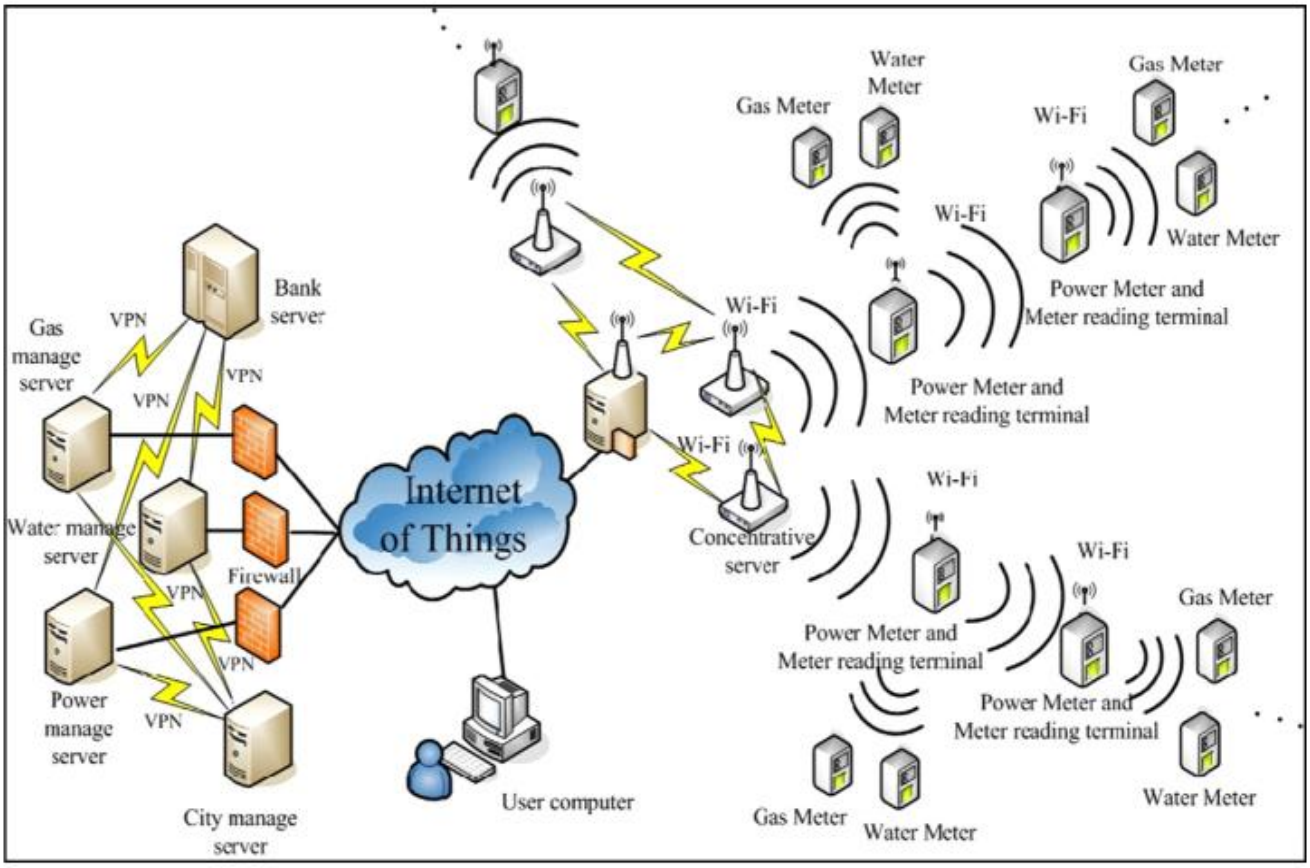


Fig.4: IoTs and AMI

Fig. 5 presents conceptual architecture of AMI containing integration of different electricity and communication networks and sub-systems. Fig. 6 provides modified version of AMI architecture of Fig. 3 after deployment of IoT components with wireless connectivity at necessary points.

Proposed workplan

- Analyze available and acquired data
- Fix up applications to be implemented
- Propose feasible options
- Finalize option(s)
- Commission pilot(s) for testing
- Feedback of participant citizens à modify
- Upscale the pilot à Feedback à modify
- Final implementation

Potential

In India, home automation sector is largely unexplored and rarely any full-scale installations could be found.

In general, popular understanding of home automation is believed as security solution with CCTV and detectors for smoke-fire-gas leak only.

Integration of technologies like IoT, HAN, BAS, Green buildings, Solar PVs and Smart Grid has strong potential to build up 'Sustainable and Energy Efficient Smart City', which result in effective and convincing justification for investment.

HAN and BAS

- Home Area Network (HAN) is the network within the premises of a home enabling devices and electrical loads to communicate with each other and dynamically respond to externally sent signals (e.g. price, etc.)
- Building Automation System (BAS) is a data acquisition and control system that incorporates various functionalities provided by central control system of a building.

Envisaged outcomes

- Useful technological framework
- Deployable, customizable and scalable working model(s)
- Simple, user-friendly interface(s)
- Remote access with useful alerts
- Effective and efficient utilization of energy
- Reduction in energy wastage
- Reduction in overall carbon footprint
- Easy integration to existing solutions
- Smart grid (Smart city) ready!!

Feasible e-applications

- *Automation*
  Internal climate control:
  Ambient temperature and humidity (HVAC) control locally as well as remotely
  Lighting control:
  This one of the major contributor to the electricity bill could be reduced significantly by controlling switching frequency and ON/OFF timings in prefixed schedule or on basis of ambient light intensity
  Water level control:
  Control of water level of underground and/or overhead tanks, which is very crucial for routine activities and to tackle abnormal occurrences like fire. Availability of sufficient water could be ensured by automatic water-level control by switching ON/OFF of pumps as necessary.
- *Security*
  Camera channels can be selected for viewing, camera control and to monitor activities
  Motion sensing feature could be configured to detect unauthorized movement and generate alerts via audio-visual annunciation
  Audio-video recording of areas under monitoring, with replay of past recordings upon demand
- *Communication*
  An intercom system allows communication via a microphone and speaker between multiple rooms.
  Remote control: using intranet/internet/PDA with wireless connectivity
  Alarm annunciation:
  Annunciation to police, doctor, person
  Inter-person communications
- *Entertainment*
  Audio entertainment:
  Audio switching and distribution on user demand, audio broadcast, also known as 'Audio on demand' or multi-zone audio
  Video entertainment:
  Video switching and distribution on user demand, video broadcast, also known as 'Audio on demand' or multi-zone audio, with integration of video door entry system

Our earlier contributions

In (Bhatt and Verma 2010; Bhatt and Verma 2015; Bhatt 2016) works could be referred for technical as well as operational details of HAN-BAS. In (Bhatt 2015), design and integration aspects of HAN-BAS in form of IoT have been included.

Summary and concluding notes

- Proposal regarding HAN-BAS development in the region presented for smart grid development
- Feasible e-applications suggested
- Earlier works cited

- Ubiquitous and effective usage of different technologies including IoT and WSN
- Significant optimization in overall energy consumption and efficient utilization
- Advancements like demand response could be made possible

References

Bhatt J (2015) Wireless Sensor Networks for Instrumentation: Recent Trends in Research and Applications Development. J Res Technol Manag 24–29.

Bhatt J, Jani O (2015) E-Governance for Photo Voltaic Powergrid: Solar City Gandhinagar, Gujarat, India. In: Kumar TMV (ed) E-Governance of Smart Cities. Springer, pp 177–230

Bhatt J, Jani O (2017) Smart Grid: Energy Backbone of Smart City and e-Democracy. In: Kumar TMV (ed) E-Democracy for Smart Cities. Springer, pp 319–366

Bhatt J, Shah V, Jani O (2014) An Instrumentation Engineer's Review on Smart Grid: Critical Applications and Parameters. Renew Sustain Energy Rev 40:1217–1239.

Bhatt J, Verma H (2015) Design and Development of Wired Building Automation Systems. Energy Build. doi: 10.1016/j.enbuild.2015.02.054

Bhatt JG (2016) Building Automation Systems: Recent Trends, Design and Development. Handb. Res. Emerg. Technol. Electr. Power Planning, Anal. Optim. pp 235–264

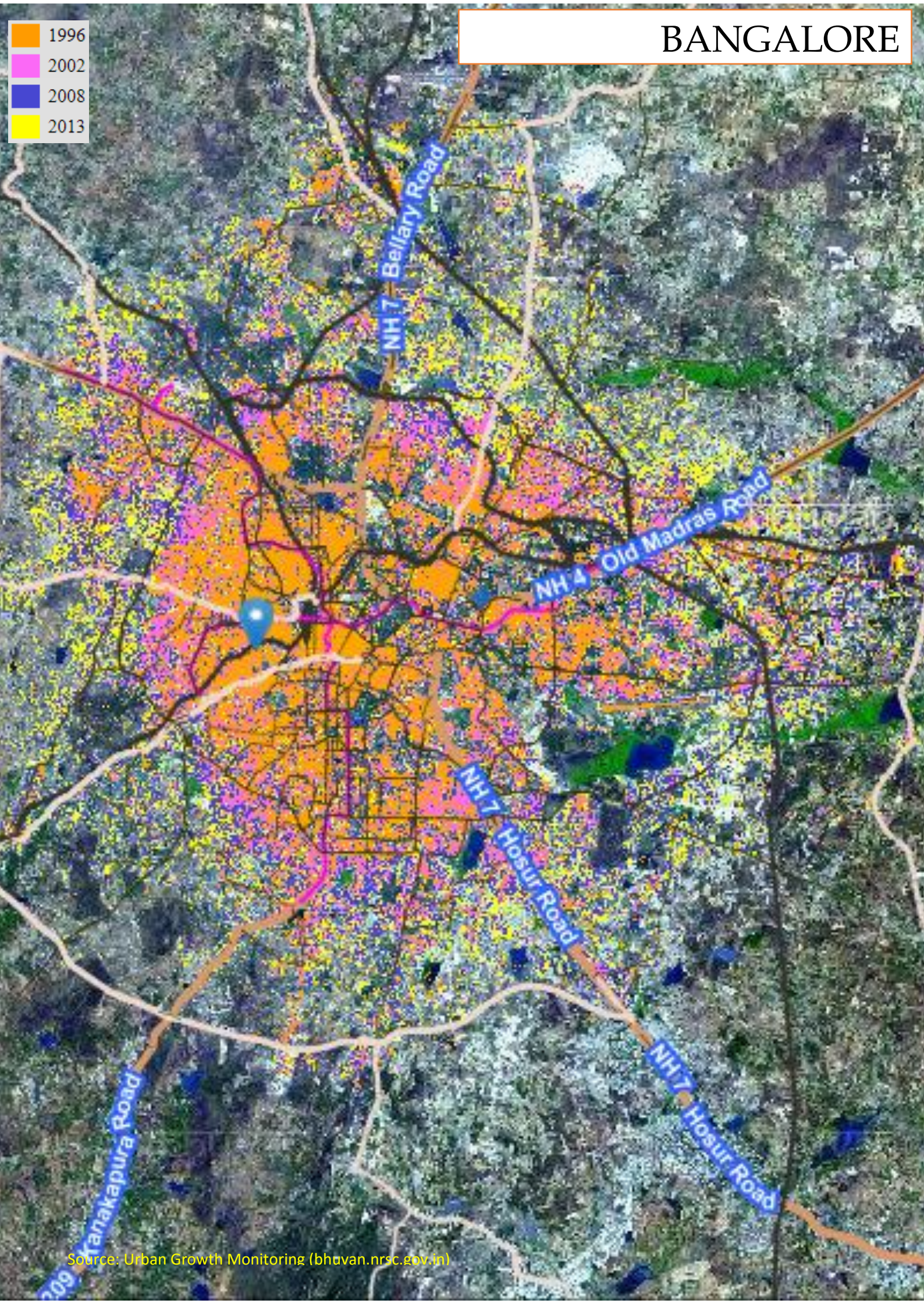
Bhatt JG, Verma H (2010) RS-485 / MODBUS based Intelligent Building Automation System using LabVIEW. 4th Int. Conf. Comput. Appl. Electr. Eng. Adv. IIT Roorkee, Roorkee, India, p 5

Additional reading

https://en.wikipedia.org/wiki/Ahmedabad
http://ahmedabadcity.gov.in/portal/index.jsp
https://en.wikipedia.org/wiki/Gandhinagar
https://en.wikipedia.org/wiki/Naroda

List of acronyms

Acronym	Full form
AMI	Advanced Metering Infrastructure
BAS	Building Automation System
CCTV	Close Circuit Tele Vision
GAV	Gandhinagar-Ahmedabad-Vadodara
GERMI	Gujarat Energy Research and Management Institute
GIDC	Gujarat Industrial Development Corporation
GIFT	Gujarat International Finance-Tec city
GSEL	Gujarat State Electricity Corporation Limited
HAN	Home Area Network
HVAC	Humidity Ventilation and Air Conditioning
ICT	Information and Communication Technology
IMRB	Indian Market Research Bureau
IoT	Internet of Things
NAN	Neighborhood Area Network
NASSCOM	National Association of Software and Services Companies
NCRB	National Crime Record Bureau
PDA	Personalized Digital Assistant
PM	Prime Minister
PV	Photo Voltaic
R-APDRP	Restructured Accelerated Power
RBI	Reserve Bank of India
SEZ	Special Economic Zone
STPI	Software Technology Parks of India
UGVCL	Uttar Gujarat Vij Company Limited
UNESCO	United Nations Educational, Scientific and Cultural Organization
WAN	Wide Area Network


1996
2002
2008
2013
BANGALORE
NH 7
Bellary Road
NH 4
Old Madras Road
NH 7
Hosur Road
NH 7
Hosur Road
Kanakapura Road
Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)

BANGALORE

KARNATAKA, INDIA

Amit Chatterjee- Binayak Choudhary- Premjeet Dasgupta- Gaurav Vaidya

TOWARDS A SMART METROPOLITAN REGION: A ROADMAP FOR TRANSFORMING BANGALORE

Introduction

Historically, all over the world, urbanization and economic growth have gone hand in hand. We are living in the century of the metropolis with more than half of the population living in the metropolitan region (Angotti, 2013). In the decade 2001-2011, the pattern of India's urbanization underwent an important shift, which was characterized by an increase in the number of metropolitan cities/Urban Agglomerations (UAs) from 35 to 52 and increase in the percentage share of population from 37.8 to 42.3 per cent. Many large Indian cities, especially the large metropolises and metropolitan regions are facing problems with respect to their growth, composition, spatial spread, congestion, environmental factors, housing, infrastructure availability as well as accessibility. Bangalore (also known as Bengaluru), the so-called 'Silicon valley of India' is no exception to these trends. In the year 2015, Government of India launched Smart City Mission and major thrust is to "develop sustainable and inclusive development and create compact and replicable model" (Ministry of Urban Development, 2015:5). The Mission will cover 100 cities over the five year time period, including Bangalore. The present study will form an analysis of the economic and spatial strategies undertaken by national and local authorities for a Smart Bangalore Metropolitan Regional Development. It will develop through two sections: Section 1 – Situational Analysis of Bangalore in Time and Space: retrospect and prospect and; Section 2– Methodology to analyze Spatial and Economic Transformations for a Smart Bangalore Metropolitan Region.

Section 1 – Situational Analysis of Bangalore in Time and Space: retrospect and prospect

Bangalore Metropolitan Region (BMR) with an area of 8005 km^2, and a population of 11.69 million is divided into 3 districts namely – Bangalore Urban, Bangalore Rural and Ramanagra (See Fig-1). The Bangalore Metropolitan Region (BMR) is a planning region recognized under the Bangalore Metropolitan Region Act, 1985. BMR has only one Corporation namely the Bruhat Bangalore Mahanagar Palika i.e. BBMP and 10 Urban Local Bodies (ULBs). Bangalore covers a space of 10% of the geographical area and has a population share of almost 72% of Bangalore Metropolitan Region (BMR). Population influx in Bangalore is an obvious result of the continuous flow of migrants to Bangalore from surrounding areas and other regions. Nearly half (45 percent) of the population had been categorized as migrants (BDA, 2015).

Demographic Change

Bangalore city population grew at a high rate, and the population of Bangalore increased from 5.7 million to 8.4 million during the decade 2001-2011. A significant rise in growth rate (4.95%)

Fig 1. Skyline of Bangalore (Source: wikipedia.org)

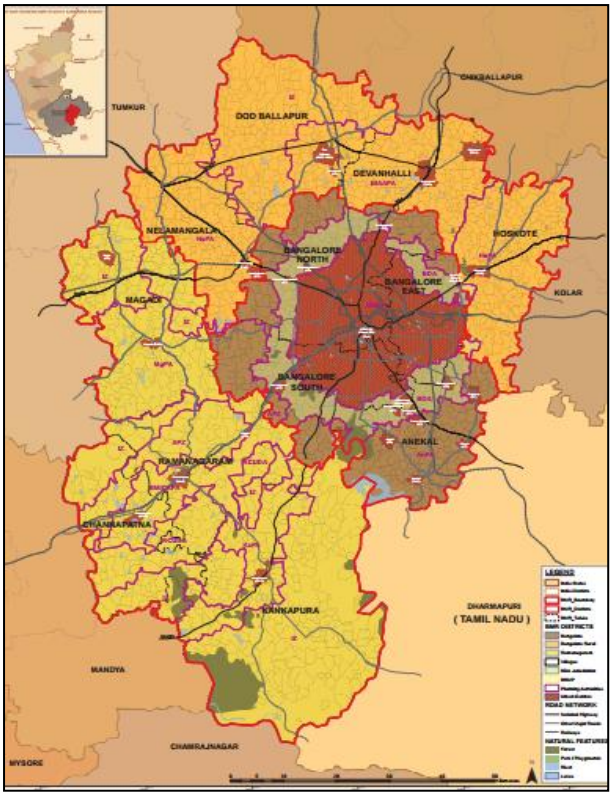


Fig 2: Bangalore Metropolitan Region

had taken place during 2001-2011 and it is also presumed that the same trend may possibly continue for the coming decades as well. The growth of Bangalore from a town to a metropolis has been a result of five growth events: i) shifting of the State Capital from Mysore after India's independence, ii) merging of the Cantonment with the city [1949], iii) setting up Public Sector Undertakings/Academic Institutions [since 1970s], iv) development of Textile Industry [1911-31], v) development of Information Technology/ITES/Biotech based industries [since 1980s]. The current regime of the urban economy is that of agglomeration of an export oriented Information Technology sector which was initiated by developments in the early 1980s. Research Institutions such as Indian Space Research Organization (ISRO), Defence Research and Development Organisation (DRDO), Indian Institute of Science (IISc) together with the Public Sector Enterprises such as Bharat Electronics Limited (BEL), Hindustan Aeronautics Limited (HAL) etc. had established a base in the city for innovation oriented high technology production mainly in the areas of Electronics, Telecommunication and Defence. The largest IT firms in India such as Infosys, Wipro, Satyam and TCS were all small start ups in the city and became large global conglomerates.

Smart Economy of Bangalore and BMR : Existing and Way forward

It is but obvious that urban economy not only dictates the urban fabric of a city, it influences the city's socio economic profile. The mistake that we often commit is to regard the growth of BMR as being endogenous when the fact remains that BMR is nothing but conurbations. BMR not only engulfs its degenerated peripheries, but also the small towns around, thereby leading to the total obliteration of the latter.

It is now being widely held that alongside superseding the national economy, globalisation has resurrected urban governments in India. Riding on this globalisation juggernaut, BMR has long entered an era of rejuvenation by inheriting its rich cultural and economic heritage with sustained innovation in its spatio – economic evolution. There is perhaps no ambiguity in terming BMR urbanisation as 'entrepreneurial urbanisation' (Datta, 2015) and in this enterprise, the smart city narratives of BMR has been synonymous with both brownfield as well as green field development with the latter having a relatively larger share.

The BMR economy although largely depends on its IT based knowledge economy, a significant share is also held by other services and manufacturing. BMR should not be carried away by its IT sector since a significant part of its economy is attributed to textile, automobile, machine tool, aviation, space, defence, and biotechnology based industries. The region is replete with huge concentration of small and medium industries (Sudhira et al, 2007). Existence of numerous high-tech education and knowledge hubs in Bangalore are itself offering an additional thrust to regional economy, evident from the establishment of premier centres like National Institute of Advanced

Studies (NIAS), Tata Institute for Fundamental Research (TIFR), Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), National Aerospace Laboratories (NAL), Indian Institute of Management (IIM), Institute for Social and Economic Change (ISEC), Indian Institute of Information Technology (IIIT) and several professional engineering and medical colleges at undergraduate and graduate levels (BMRDA, 2015). 89 percent of BMR areas falling under rural areas signify the contribution of rural economy through agro based products and handlooms. Besides all these, BMR is bustling with services ranging from education, health care, to hospitality, banking and transport logistics services.

Launching a new business can be a daunting experience in the face of uncertainty of securing funding and sufficient skills. It is here where BMR should not only secure and promote its stature as India's IT hub, it must also incubate its intellectual capital in order to sustain and upgrade its being the investment destination for entrepreneurial capital. BMR must draft its regulatory frameworks to host an ecosystem that does not blindly replicate the popular incubator and accelerator models but customises it to develop local versions. Apart from incentivising the potential investors, BMR may explore the feasibility of crowdfunding to supplement its initiatives. Urban finance shall be a formidable task for BMR administration, {both Bengaluru Municipal Corporation (BMC) and Bengaluru Metropolitan Regional Development Authority (BMRDA)} in making its economy smarter. The municipal fiscal health should be strong enough to build the credit worthiness of BMC to access international funding for effecting transformational change and towards achieving this, BMC should explore non conventional fiscal tools to replenish its coffer.

BMR appears desperate to go more digital to improve quality of life of the citizenry. While doing so, BMR banks on all the stakeholders in order to co-create tomorrow's urban services with corporate sectors and the civil society (Janagraha). Although BMR strives to steer its economy on technology-driven urbanism, it must take cognizance of the fact that today's decision-making is compounded by an information overload, BMR also must not downplay the offshoots of pollution, traffic congestion, and mushrooming of informal settlements. Let alone informal settlements, informal economic agents (hawkers, vendors, rovers etc.) should also be adequately addressed to. BMR may go more and more wired, the everything-on-demand Bangaloreans may go for higher speed connectivity, tech gizmos may satiate their appetite, but BMR must ensure that its labour markets and education systems mutually support each other to address the skill gap in order to accommodate 'youth bulge' (millennials) and prevent a 'lost generation'. With technological obsolescence exponentially picking up, BMR will find newer occupations forming a new segment of the labour market with many occupations getting disappeared. BMR must address the concern of this surplus labour force through newer skill formation and through product market and labour market scan. BMR must rope in the corporate sector in this endeavour.

The concept of 'smart economy' requires new qualitative approaches of the concept of economic growth, focused on the quality of life and on the standard of living. It is a dynamic process (PCAST, 2016) adaptable to contextual situations in which the individual and the community act in time and space for which the foundation is represented by a set of moral, cultural, traditional, political, democratic, leisure precepts (Diana Apostol et. al., 2010).

Being a global city, BMR's strategic vision must become complementary and compatible with internal realities on the one hand and the development trends of the global economy on the other. BMR must promote entrepreneurship both ways: mimetic (technology transfer through FDI and innovative (innovations suitable for local economies). Certainty is a key word, diversity is a key reality and clarity is a key prerequisite. BMR must be able to tie a knot and build a trinity. In this context, the intensity of primary energy (and not secondary energy) is of utmost importance to green the economy and for this, BMR needs collaboration between

ecologists and economists, between the development of well-informed environmental policies and economic decisions.

Keeping in view the universality of public goods such as education, culture, health and research, BMR should adopt a different approach to the concept of 'smart economy' through an indissoluble bond with the science of marketing, - cyber marketing, neuromarketing, virtual marketing. BMR must promote public private partnership: promote up-skilling and work based training, set up networked economy and ensure liaison and information sharing between business and economic development agencies.

Given the fact that we are fast moving to Industry 4 and the *third age* (retirement) industry is seen as having more development potential (BMR once being the Pensioners' Paradise), given the fact that rural BMR contributes considerably towards its economy, it is high time that BMR readies itself accordingly. BMR should also take necessary steps to multi skill the rural workforce, skilled and unskilled, to absorb the uncertain structural shocks of BMR economy.

BMR must acknowledge that everything that can be digital will be digital. The economy is shifting towards subscription based business models, product life cycles are getting shorter, users are migrating from 'possession' to 'use' and look for ultra personalization. Information is becoming more and more transparent and businesses are experiencing increasing disintermediation and automation. Processes become data centric and mobile. Businesses are preferring transition to a pull rather than a push approach. Either concentration or fragmentation is being seen to be adopted by service industries. Data monetization, especially of big data analytics and its trading is going to emerge as a big employer. BMC and BMDA should put in place the enabling platforms to smoothen these inevitable transitions. (Deloitte, 2015).

But we should never forget what urban sociologist, Robert Park, once remarks, "If the city is the world which man created, it is the world in which he is henceforth condemned to live." But unfortunately the creators and the condemned are not necessarily the same, nor do they stand on equal ground.

Existing Challenges

Bangalore is transitioning from a formerly mononucleated growth pattern to a polycentric pattern, with the fastest growth taking place around multiple peripheral areas (Taubenböck et al., 2009). This pattern of growth, with the city core becoming increasingly saturated, and new urbanization centers developing at the periphery, can be traced to multiple factors. The high land prices in the city center and the lack of large spaces that are available for further urbanization have led to the location of many public sectors, local and multinational companies, and prominent educational institutions at the city periphery (Shaw et al., 2006). As a result, in periphery areas of Bengaluru, loss of agricultural land, water body, and green spaces are faster and it is imperative that urban planning efforts concentrate of city periphery where unplanned growth is taking place at an extremely rapid rate. The partial implementation of decentralization agenda has further added to the current problem resulting in functional, political and economic gaps (BMRDA, 2015).

Section 2- Methodology to analyze Spatial and Economic Transformations for a Smart Bangalore Metropolitan Region

Smart region can be defined as 'a cluster of small urban areas which work together in order to frame a diffused smart city, sharing visions, ideas, common goals and resources'. Transition from 'the urban level of smart city to the territorial level of the smart region' is the problem that needs to be addressed. The important issue in transitioning from smart city to smart city or from a cluster of smart cities and villages to smart region is not the technology but the capability to collaborate. It is about transcending administrative boundaries in a technological sense and in other ways too. Experimentation to this effect has been carried out in Italy.

In the case of Bangalore there is a strong need to think beyond the city of Bangalore. Peeling away the layers of spatial governance jurisdiction we can see that it is the outermost layer, which is the BMR, which is of utmost importance. If the smart region vision has to be given a spatial context, then it has to be BMR. BMR is an amalgamation of the urban and rural, with the overwhelming presence of Bangalore City at its core. The jurisdictional presence of Bangalore City is reflected in the boundary of the BBMP. However, beyond it there are a large number of smaller towns which are in no way less important. Some of these towns would in fact qualify as regional cities, given the tremendous rise in their population over the last decade or so. All these towns have their own local governments (Town Municipal Councils and City Municipal Councils). If a smart region is to evolve, the need of the hour is to promote cooperation between the entities and also between them and BMC. The cooperation should be directly based on digital platform and smart networking should be explored.

The focus on smart-networking between Urban Local Bodies and Rural Local Self Governments will be incomplete if we do not consider networking with industry and businesses. Ultimately it is smart industrial innovation which is at the heart of smart region framework and will drive the smart economy. As such they will require complete policy and administrative support from the smart network of local self governments. In this way smart local government network should complement smart economy.

In this context, the role of industry assumes great importance. The legacy businesses have to transfom into digitally oriented enterprises. Bangalore is already the technology capital of India, driven largely by IT. While the IT industry in India is likely to emerge from the current downturn as much stronger riding on the back of technology transformation, it is the need of the hour to support them, and also other industries, by providing facilities for digital innovation and incubation. The role of industry bodies will be of prime importance here, but again, the need is to connect them with the smart network of local self governments, so that a synergy is achieved in terms of spatial decision-support and parameter-based prioritization without requiring complex interfacing among industry and multiple layers of government agencies. To achieve this, each of the regional cities around BMC have to be developed as smart cities first. Recently Bangalore city has broken into the smart-city club. But it needs to be emphasized that merely promoting Bangalore City as a smart city will be a self-defeating exercise as the irreversible process and the tremendous rate of urbanization means that the region itself is transforming beyond limits of imagination and has to be integrated in the context of a 'smart region'. After all, a smart Bangalore city which gets promoted in isolation will only distort the market further and lead to lopsided urbanization, costing society dear in terms of crowding, quality of public spaces, travel times, etc. If we look at the underlying concepts of smart city, we see themes like smart energy, smart health, smart living, smart mobility, and smart economy. However, if we have to graduate to smart region paradigm we need to look beyond making cities smart. Thus transformation of BMR into a smart region would mean more than location specific actions within the area. While smart energy interventions could be a thrust in the BMC area, piloting of such interventions could be easier in the smaller City Municipal Councils or Town Municipal Councils in the region. In fact, the population explosion happening in these regional centres outside BMC demands that they should also be considered for smart energy solutions. Smart health also needs to be scaled up to regional level through linkage between health institutions spread across the region, thus benefiting the rural settlements also. The first steps toward smart living at a regional scale would involve promotion of a dispersed settlement strategy dovetailed with transit oriented development and backed by incentives for affordable housing development. Smart mobility would entail smart demand-responsive integrated regional connectivity catering to diverse commuter segments. Smart mobility strategies, with fast and high-capacity regional networks supported by efficient intermodal options, would complement smart

living strategies as discussed. Finally, smart economy would be driven by industrial innovation, competitiveness, resource management, which in turn needs to be supported by the smart network of local bodies (See Fig.-3).

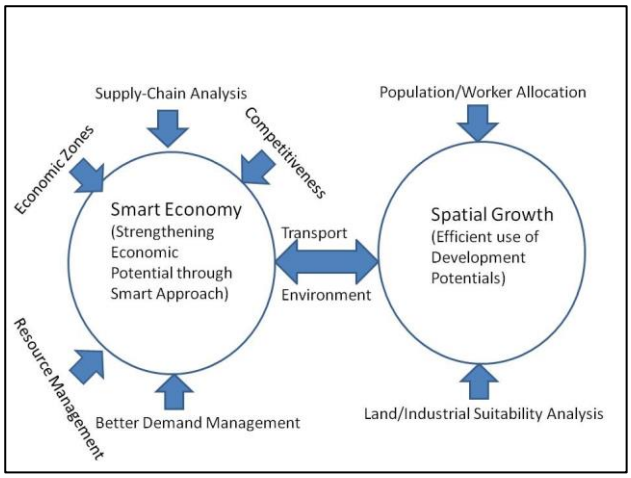


Fig 3: Smart Spatio-Economic framework for BMR

Finally, the groundwork for preparing a framework for smart region development would involve assessing and benchmarking the following:

At local level:

- Smart governance
- Smart mobility
- Compactness of urban form
- Business environment

At regional level:

- Smart networking
- Regional connectivity
- Spatial dispersal
- Diversification and synergy between businesses

References:

Angotti, T. (2013). *The New Century of the Metropolis.* Routledge: New York.

BDA (2015). *Bangalore Master Plan-2015*, Bangalore Development Authority, Government of Karnataka.

BMRDA. (2015). *Revised Structure Plan-2031 Bangalore Metropolitan Region*, Bangalore Metropolitan Regional Development Authority, Government of Karnataka.

Datta, A. (2015), New Urban Utopias of Post Colonial India: 'Entrepreneurial Urbanisation' in Dholera Smart City, Gujarat, *Dialogues in Human Geography*, 15(1), 3-22.

Deloitte (2015), *Smart Cities, Version, 1.0*, Available from:https://www2.deloitte.com/content/dam/Deloitte/tr/Documents/public-sector/deloitte-nl-ps-smart-cities-report.pdf (Accessed August 5th, 2017).

Diana A., Cristina B., Eleonora MC. (2010), Smart-Economy Concept - Facts And Perspectives, *Journal of Economic Literature,* Vol. 48, No. 1, 264-277.

Ministry of Urban Development (2015). *Smart City Mission Statement and Guidelines*, Ministry of Urban Development, Government of India, New Delhi.

Park, R. (1967) *The City as Social Laboratory, in On Social Control and Collective Behavior*, Chicago University Press: Chicago.

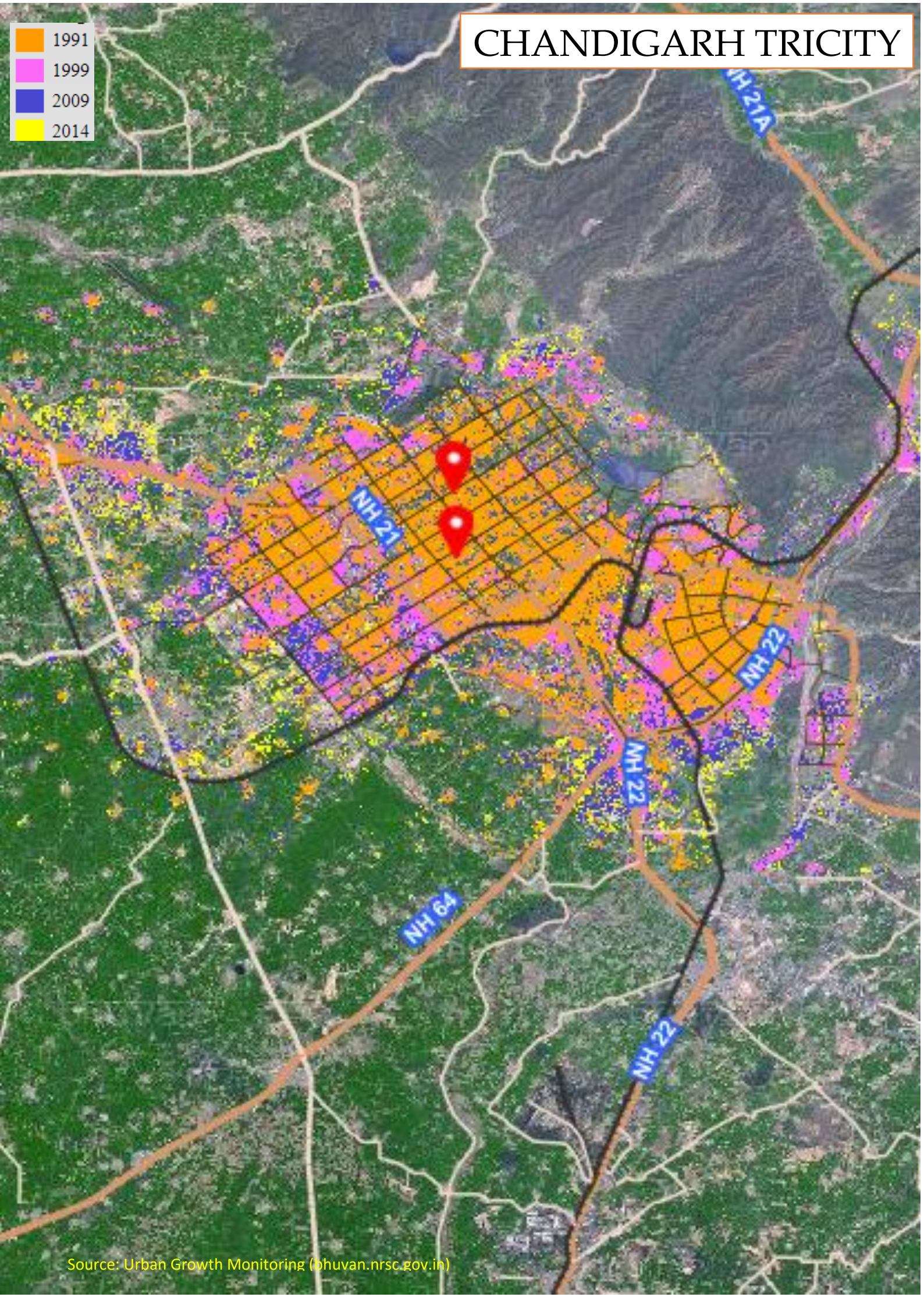
President's Council of Advisors on Science and Technology (PCAST). (2016), *Technology and the Future of Cities* Available from: https://www.whitehouse.gov/sites/default/files/microsites/ostp/PCAST/pcast_cities_report_final_3_2016.pdf (Accessed August 9th, 2017).

Shaw, A., Satish, M. K. (2006). Metropolitan restructuring in post Liberalized India: Separating the global and the local. *Cities* 24(2), 148-163.

Sudhira H. S., Ramachandra T. V. & Bala Subrahmanya M. H. (2007). *City Profile: Bangalore*, Available from: http://wgbis.ces.iisc.ernet.in/energy/water/paper/bangalore/TVR24_p11_Bangalore.pdf, (Accessed 5th July, 2017).

Taubenbock, H., Wegmann, M., Roth, A., Mehl , H., Dech, S. (2009). Urbanization in India - Spatio temporal analysis using remote sensing data. *Computers, Environment and Urban System* 3(33), 179-188, Available from: https://doi.org/10.1016/j.compenvurbsys.2008.09.003 (Accessed August 4th, 2017)

CHANDIGARH TRICITY



Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)

CHANDIGARH

INDIA

Asfa Siddiqui- Pramod Kumar

CHANDIGARH: A REGIONAL PERSPECTIVE

Introduction

The 'City Beautiful', Chandigarh was planned under the able vision of Jawahar lal Nehru. With an area of 114 sq. km (including adjoining 26 villages), the Master Plan of the city was designed by well-known Architect Le Corbusier and his team Pierre Jeanneret, Jane B Drew and Maxwell Fry along with young budding Indian architects and planners. Le Corbusier designed the iconic city with a vision of 'modernism' and translated his geometric and modular thought into reality which is still considered a great piece of work shaped through deep thinking demonstrating sense of freedom, wisdom and perseverance. Chandigarh serves as a Capital of two states Punjab and Haryana by gaining the status of Union territory in the year 1966. The city is a life example of symbiotic relationship between nature and the built.

Chandigarh is the hub of political and bureaucratic activities of adjoining states. Its existence as a planned capital designed with a view of urban containment theory as a result of Garden city concept, makes it a design to cherish and look forward to for future design strategies as an example. However conceived to have a regulated planned growth, in the recent years the peripheral growth suggests that the vision of the designers are compromised. Some defend sprawl as an inescapable phenomenon while others advocate its essentiality in preserving the character of the city core, the reality can be understood as the details of the Chandigarh and its environs are studied in detail. The need of understanding the intra-city growth and the inter-city growth in the outskirts called the Periphery like Mohali in Punjab and Panchkula in Haryana regarded as satellite towns becomes inevitable in order to understand the regional dynamics of the area. There may be certain drivers of growth that also need to be studied. It is inadvertent to mention that Chandigarh faces a legal framework restricting a regional plan that can be adhered to while designing the city. It shall be explored in the study. The study shall direct to understanding the sprawl in time line from 1990 onwards with the help of remote sensing, GIS and online web information portals and end in providing recommendations and strategies shaping Smart Growth directing towards a Smart Metropolitan Development.

Section 1: The shaping of the City and the Legal framework

The Inception: Thought Provoking vision

In light of understanding the significance of self-contained neighborhoods and essence of green spaces in an urban setting, Chandigarh was planned with focus on preservation of the unbuilt, urban design principles and aesthetic

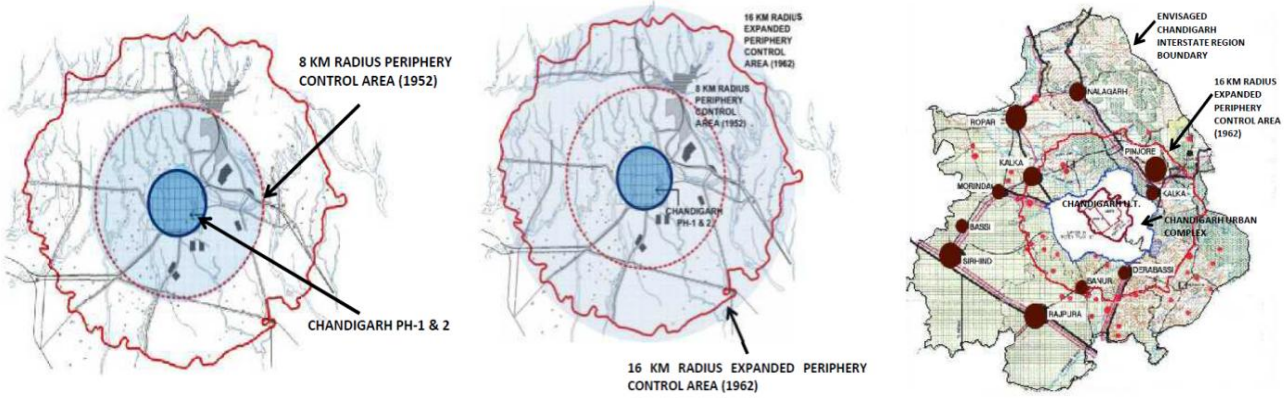


Fig 1: (a) 8 km Periphery area, (b) 16 km expanded Periphery Control Area and (c) Chandigarh Interstate Metropolitan Region Plan. Source: Chandigarh Master Plan, 2031

appeal. While 'urban containment' theory was inherent in Garden City concept proposed by Ebenezer Howard, it was adopted in India by the first ever planner duo Albert Mayer and Mathew Nowicki. But due to administrative hitches and other unforeseen circumstances, the big project fell into the laps of the lead Le Corbusier (Chalana, 2014).

The design of Chandigarh was more inspired from the original design proposed by Mayer. The improvisations in the plan restricting a grid-iron movement approach and phasing of city functionalities resembling intrinsic body parts into work, living and leisure, were worth admiring. The city was decided to be built in two phases consisting of Sectors 1 to 30 in phase 1 efficient to accommodate 1.5 lakh people and a rather dense development accommodating 3.5 lakh people in sectors 31 to 47 making it a total of 5 lakh people.

It was a vision of Le-Corbusier where his emphasis not only dwelled on the urban core development but also on the rural-urban transitional zones in the fringes. His work clearly depicts his passion for preserving agricultural activities and open spaces for a serene site like Chandigarh amidst Shivaliks. The perfect Assimilation of town and country was addressed through the design keeping in view the problems faced by an urban setting due to urban sprawl. This decentralized solution was also helpful in driving planned growth and at the same time posed limitations on the adhoc growth pattern resulting due to poor management of land resources and Indian way of organic city development.

Going back to history and remembering notes on the effectiveness of having a green belt around the main city core, a peripheral area termed as 'Periphery' was introduced. This philosophy was adopted in various states in the United States and the United Kingdom. Same philosophy reflects in the designing of Letchworth and Welwyn. The Periphery Zone consorted to having a large chunk of agrarian land, 8 kms around the urban core. The greenbelt was legally restricted to have any developments under the Punjab New Capital (Periphery) Control Act of 1952 (Chandigarh master Plan, 2031).

The essence of 8 km buffer space can only be realized if we understand the basics of regional planning. According to Howard, green and open spaces around the cities paves way for a rationalistic self-contained developments scenario where the satellite towns shall grow and help cores to grow economically and socially subsequently. But as is said, land is a resource and it is scarce, greenbelts sooner starting engulfing to the needs of the urbanization dearth.

Demography Profile

Chandigarh's development scenario is a realization of accommodation that has seen a rise from designed limit of 5 lakhs to over 10 lakhs as per Census 2011(Census of India, 2011). It is needless to mention that migration phenomenon cannot be avoided in any settlement especially in a city like Chandigarh offering good quality of life, green spaces, regularized legal framework and density control with a beautiful Shivalik backdrop and Sukhna Lake. It is regarded as one of the cleanest and greenest cites in India. However, statistics pertaining to demographics reveal that the city is unsafe from the effect of population explosion unless roads are paved for accommodating the additional need. This is the sole reason where public and private developments have started eating up the peripheral lands in the form of unplanned settlements. This is the rising demand that is forcing to act against le-Corbusier's vision of development scenario aimed for the City Beautiful (Weber, 2014).

The Metropolitan region: Chandigarh Periphery Act and others

While we turn the leaves of historical documents, the growth pace of the urban areas was negligible enough to have foreseen the scenario where Le-Corbusier's spirit of a greenbelt can be defeated. The Punjab New capital (Periphery) Control Act of 1952 was revised in 1962 suggesting a 16 km buffer as a result of establishment of Army Cantonment, Air Force and new township. However, in 1966 when Punjab was reorganized as Punjab and Haryana State, out of the total peripheral area called Periphery control Area 1315 sq. km, 1021 sq. km went to Punjab and 295 sq. km went to Haryana and 114 sq. km was reserved for capital city Union Territory Zone. Basic analysis reveals that this area also consist of certain area under Himachal Pradesh not mentioned in any legal document.

Need was felt to develop the land under the periphery to avoid unregulated growth. Subsequently, Mohali in Punjab and Panchkula in Haryana were planned to counterface the pressures of development. It was only in 1966 that the Periphery no longer remained virgin, mere 16 years later from the conception of a greenbelt buffer thought. Later in 1975 need was felt to retain the originality of the idea giving life to Chandigarh's existence. In 1977 an immediate region called Chandigarh Urban Complex (CUC) covering 330 sq. km (including Chandigarh UT, Mohali and adjoining 27 villages along with Panchkula and 23 villages) was declared. A 'No Development' Zone North of the City was identified in the original 8 km periphery control area (Refer Fig 1)(Shaw, 2009).

As time progressed, each decade saw need to revise the plan to have an Interstate Plan incorporating the regional perspective. In 1984 an interstate Regional Plan called Structure Plan was formulated with a vision of 2001 claiming to accommodate a population of 25 lakhs. In 1999, a Chandigarh Interstate Metropolitan Regional Plan (CISMeR) was made having a new Periphery Control Area of 50 km including Himachal Pradesh, Punjab, Haryana and Chandigarh UT. Towns like Mullanpur, Kharar, Dera Bassi and many others emerged as satellite towns for relieving Chandigarh from the pressure of development. Unfortunately, the Regional Plans failed to be implemented due to lack of legal status and statutory powers and hence remained ineffective since inception.

Section 2: Facets of Smart Metropolitan Planning and Role of Remote Sensing and GIS in shaping the Region

The Need for a Region

Economically, Chandigarh retained a sound base an edge over other cities being a Union Territory. It was bestowed with Central funds to cater to meet the infrastructure upgradation and maintenance. Le-Corbusier never dreamt of having an industrial setup within the city. However some light industries were planted in Chandigarh. Hence, it can be said the area never developed like an Industrial Area. But unfortunately, the planner lacked the understanding of the essence of such drivers that contribute to all class of people and ultimately help in boosting the economy.

Another major fallback was that the city had an intrinsic individual character which when seen through the eyes of a visitor is pleasing, but when looked upon in a broader perspective, lacks connectivity. With 65% of the total area dedicated to residential and commercial land-use, it is a paradise for people to live but not to flourish. Also, with limited carrying capacity (as per bye-laws) and regulated development thought, the idea of expansion was not envisaged. The city collapses when trying to accommodate the in-migrants. The whole philosophy revolves around the dynamics of the city.

The city lacks economic vibrance, it has no scope of further development after land allocated under Chandigarh Master Plan 2031 is utilized,

the connectivity threads are ineffective and has no place for in-migrants. It was never ready to accommodate informal settlements and slums. It was never ready for settlements like Manimajra due to the growth pressure. It is evident that Indian cities have seen organic growth pattern. Laws like Periphery Control Act, 1952 paved ways for no-development zone that later amends the same for development needs. Transformations of the cityscape following construction activities addressing 10 lakh people (double the population Chandigarh was designed for).

Any change to the original character of the city defeats the visions of the designer, while no change makes it difficult for uphold its positions with grace any further. The development of Panchkula and Mohali in terms of architectural impetus, were effective in easing out the migration pressure but their effectiveness is questionable in terms of architectural ambience, green buffers, character and quality of life.

It is time to understand the need for a holistic development as advocated by Lewis Mumford and Ebenezer Howard. Their philosophy was simple, to have a balance between built and unbuilt unlike school of thoughts promoting urban sprawl. Such kind of efficient utilization of land resources coupled with thoughtful thinking can be regarded as 'Smart Growth'.

Smart Metropolitan Regional Development

The development of a region focuses on understanding the fragments of a region and then realizing the region as a whole. Regional Development promotes the thinking of a bottom-up and top-down approach both. From a city perspective it shall focus on building up a Smart Growth, Smart Environment, Smart Infrastructure, Smart Energy and Smart People. From a Regional Perspective it shall focus on Building Smart Connectivity and Smart Governance.

Role of Remote Sensing and GIS in enabling Smart Development

In the last three decades, the population of Mohali, Panchkula and other satellite areas in the periphery has increased manifolds. As per the Census of India, 2011, the population density of Chandigarh UT has risen to 9252 persons per sq. km., second highest after Delhi. The regional landlocked setting of Chandigarh and with barely 114 sq. km of area and low rise development, the city is under immense pressure to cater to the rising demands. Expansion in Phase 3 by adding sectors 48 to 56, granting urban status to a village called Manimajra, acquisition of land near Sukhna Lake for development of IT Park and further densification of southern sectors were some of the methods to adhere to the growing demands.

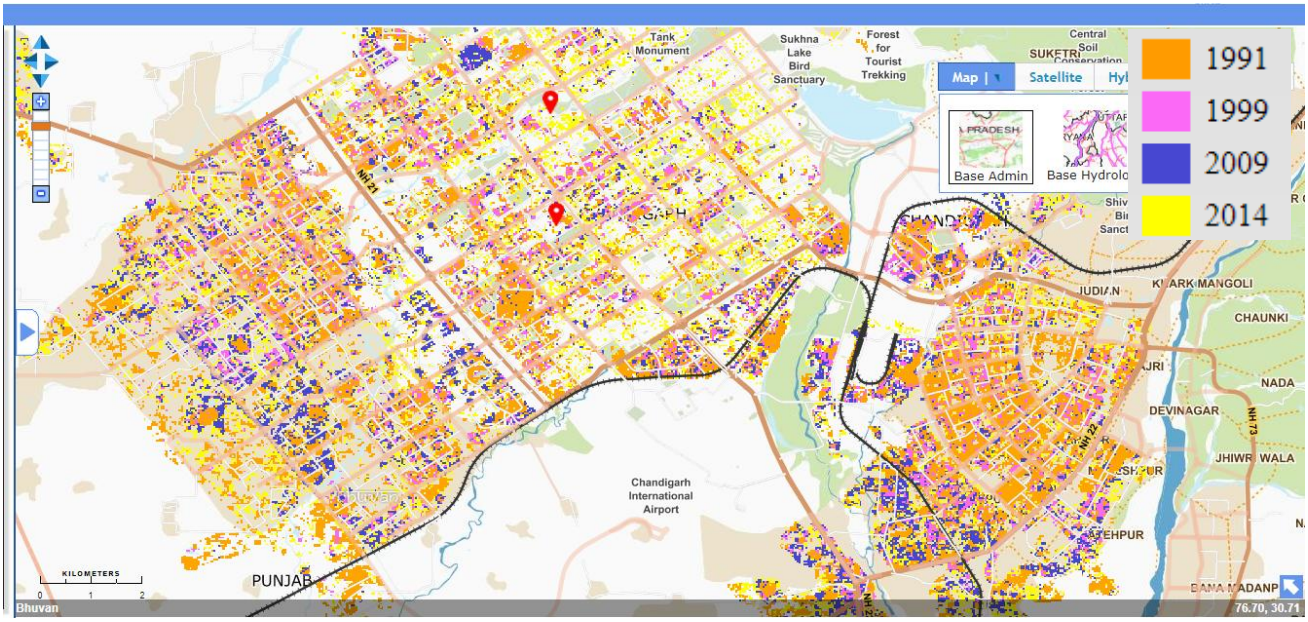


Fig 2: Chandigarh Tricity:Urban Growth Scenario from 1991, 1999, 2009 and 2014.
Source: http://bhuvan.nrsc.gov.in

The Chandigarh master Plan 2031 projects a population of 16 lakhs accommodated in the sectoral grids 48 to 56 and parts of Sectors 61 and 63 (Fig 2).

While the Tricity (Chandigarh, Mohali and Panchkula) had seen their share of planned development but the process shows signs of uncoordinated adhoc development scenario in th region. Hence, it is essential to understand the growth scenario of the region after 1990 till date. For the purpose of the study a 16 km peripheral area is taken. The study of sprawl shall be conducted for their time periods to analyze the status of growth pace and direction.

Section 4: Recommendations and Discussion

This section deals with providing recommendations on strategies that can be adopted for translating an urban setup like Chandigarh into a Smart Metropolitan Regional Plan. The drivers of growth shall help us in understanding the growth phenomenon supported by online web information systems like Bhuvan-NUIS Thematic Mapping. Chandigarh requires a Regional Plan extending to the three states keeping in view to restore the visions of the designers.

Chandigarh has a complex design strategy that requires a stringent policy making for incorporating a regional perspective to the city. The entire region is required to develop in holistic manner contributing to the region's grwth without tampering the character of the city: Chandigarh.

References

Chalana, Manish "Chandigarh: City and Periphery, *Journal of Planning History, , 2014, Page 62-84*

Chandigarh Administration, ''Chandigarh Master Plan 2031,'' accessed August 9, 2017, http://chandigarh.gov.in/cmp_2031.htm, 2017

Census of India, Administrative Atlas of India (New Delhi, India: Office of the Registrar General & Census Commissioner, India, 2011)

Government of Punjab, Greater Mohali Area Development Authority "Regional Plan 2008-2058." Plan.

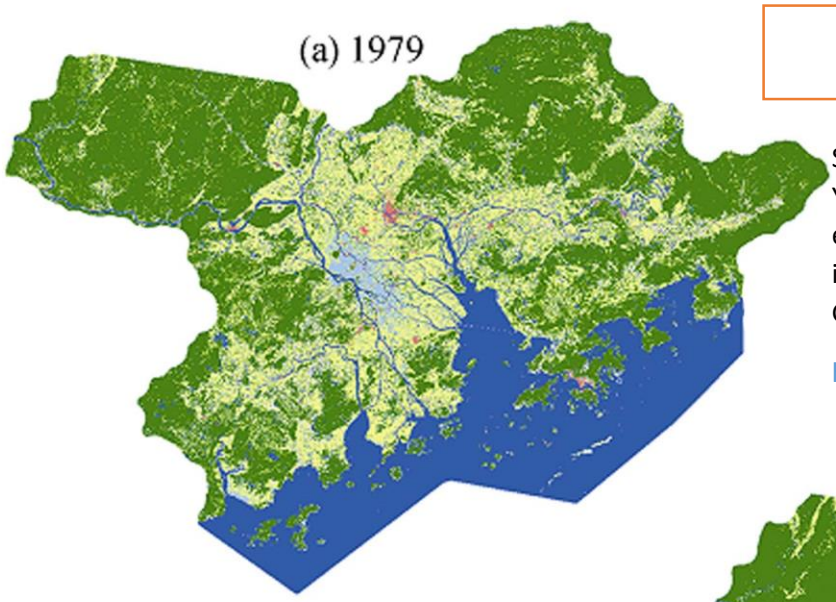
Shaw, Annapurna, "Town Planning in Post-Colonial India, 1947-1965: Chandigarh Re-examined", *Urban geography*, 2009, pg. 857-878

Town and Country Planning Organization, ''Concept Note on Chandigarh and its Region. Ministry of Urban Development, India,'' accessed August 1, 2017, http://tcpomud.gov.in/Divisions/MUTP/Concept_Note_Chandigarh.pdf.

Town and Country Planning Organization, ''Report on Formulating a Master Plan for Chandigarh,'' Indian Ministry of Urban Development, 2009, accessed August 1, 2017, http://tcpomud.gov.in/Divisions/MUTP/Master_Plan_for_Chandigarh.pdf

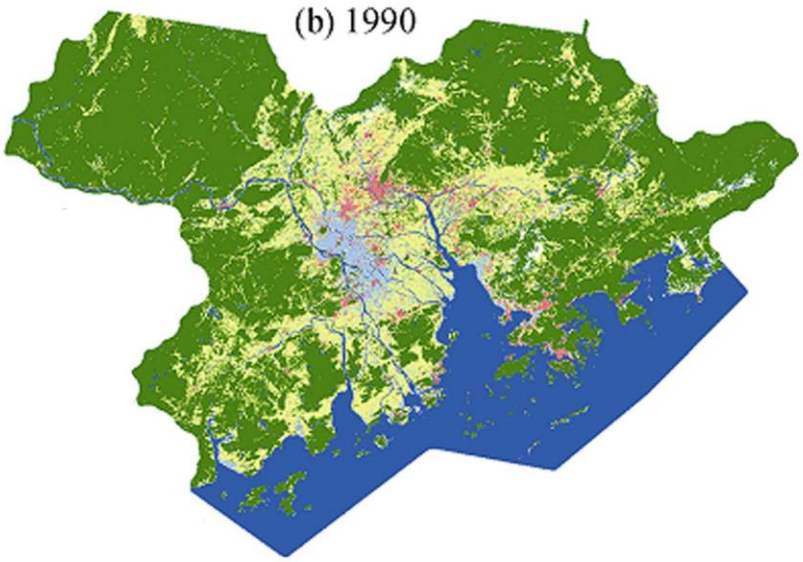
Weber, Abigail "Within the Edge: A revised approach to urban containment within the Chandigarh periphery", Thesis, Department of Urban Planning, University of Washington, 2014

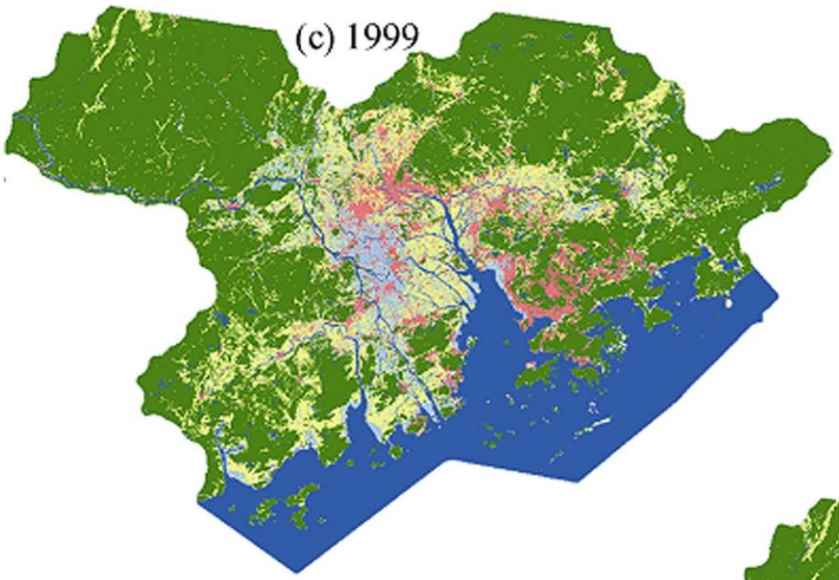
HONG KONG

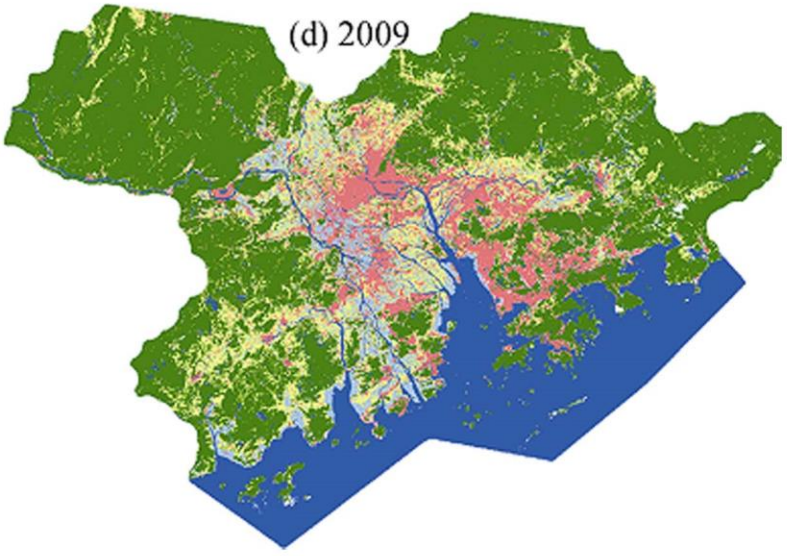


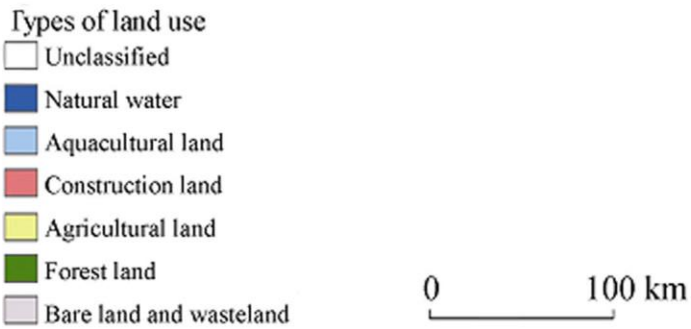
Source: LIU Zhijia, *HUANG Heqing, Saskia E. WERNERS, YAN Dan. Construction area expansion in relation to economic-demographic development and land resource in the Pearl River Delta of China[J]. Journal of Geographical Sciences, 26 (2): 188- 202.

http://www.geogsci.com/article/2016/1009-637X/38479









HONG KONG

CHINA

Sujata Govada- Timothy Rodgers

HONG KONG AND THE GREATER PEARL RIVER DELTA REGION

Introduction

The Greater Pearl River Delta (GPRD) region is a 55,000 km² area in Southern China comprised of the '9+2' cities from three jurisdictions[1]. The first jurisdiction is the Pearl River Delta (PRD) region of Guangdong Province in Mainland China, which includes the nine major cities of Dongguan, Foshan, Guangzhou, Huizhou, Jiangmen, Shenzhen, Zhaoqing, Zhongshan, and Zhuhai. The second and third jurisdictions comprise the two Special Administrative Regions, Hong Kong (HKSAR) and Macau (MSAR). Their location surrounding the Pearl River estuary on the coast of the South China Sea has benefitted this region with a strategic geographic advantage by positioning itself as a gateway into Mainland China and hub for manufacturing and trade within South East Asia and the world.

Figure 1: Map of the GPRD '9+2'and its location in Southern China. (Source: https://blooloop.com/features/eca-attraction-market-profile-overview-of-pearl-river-delta-prd-extended-theme-park-hub-cluster/)

In 2015, the nine cities in the PRD region had a total population of around 58 million people [2], Hong Kong's population was at around 7.3 million people [3], and Macau had a population of about 646,000 people [3]. Therefore, the total population of the GPRD was around 66 million people at the end of 2015, which classifies the

GPRD metropolitan region as a 'Meta City' which are "conurbations of more than 20 million people"[4]. In 2015, the World Bank stated that the PRD had become the largest urban area in the world in both size and population [5].

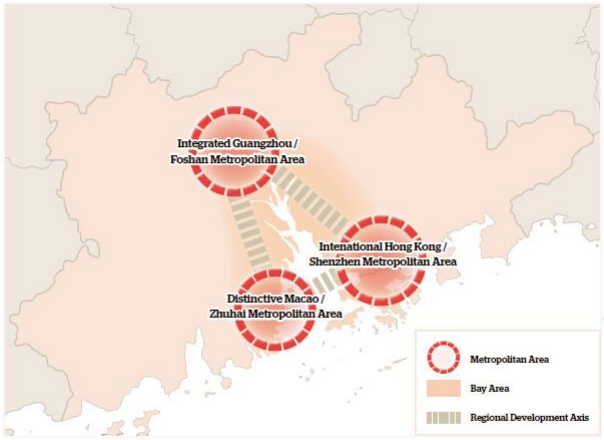
Table 1: Population and Land Area of major cities in the GPRD region

Cities	Land Area (Sq km)	Population (Millions)
Guangzhou	7,434.0	13.50
Shenzhen	1,953.0	11.38
Zhuhai	1,688.0	1.63
Foshan	3,848.0	7.43
Huizhou	11,158.0	4.76
Dongguan	2,465.0	8.25
Zhongshan	1,800.0	3.21
Jiangmen	9,541.0	4.52
Zhaoqing	14,856.0	4.06
Hong Kong SAR	1,105.0	7.30
Macau SAR	30.5	0.60
GPRD Total	**55,878.5**	**66.64**

(Sources: Guangdong Statistical Yearbook 2016; Hong Kong Census and Statistics Department 2016; Macau Census and Statistics Service 2016)

Although the GPRD encompasses an expansive land area and numerous cities,

over the years it has developed into a polycentric metropolis with three key population centers, namely the Hong Kong and Shenzhen Metropolitan Area, the Guangzhou and Foshan Metropolitan Area, and the Macau and Zhuhai Metropolitan Area. The Hong Kong and Shenzhen, and Guangzhou and Foshan Metropolitan Areas make up the majority of the population in the GPRD, with populations of 18.68 million and 20.93 million people respectively. These three population centres are where the majority of the economic growth and population migration have taken place, and now comprise the main nodes of development within the GPRD.



Source: Based on Construction Department of Guangdong Provincial Government, Development Bureau of the Hong Kong SAR Government, Secretariat for Transport and Public Works of the Macao SAR Government, Planning Study on the Coordinated Development of the Greater Pearl River Delta Townships, 2009, p.45.

Figure 2: Map of the 3 major metropolitan clusters within the GPRD (Source: Invest Hong Kong 2014)

Historical Regional Economic Growth and Industry Transformation

The GPRD was not always as demographically large and economically significant as it is today. Over 40 years ago, cities and districts in the PRD were primarily agricultural based economies with 25.8% of the PRD's regional GDP derived from primary activities in 1978, compared with only 1.8% in 2015 [7]. At the time, Guangzhou and Hong Kong were the notable exceptions, considered the prime cities in the region that specialized in manufacturing and service activities, with Guangzhou serving the Mainland China market and Hong Kong the international market.

From 1978 onwards, things began to change dramatically with the opening up of China's economy to the global international marketplace as part of China's Open Door Policy initiated in 1979. As part of China's strategy to encourage investment and businesses, Special Economic Zones (SEZs) began to be developed, which were characterized by "special policies and flexible measures" that were less economically restrictive and enjoyed special financial, investment and trade privileges compared with the rest of the country, which attracted increased foreign investment into the region. Shenzhen and Zhuhai were pioneered as two of the first Special Economic Zones (SEZs) in China and chosen for their geographic proximity to Hong Kong and Macau, as at the time Hong Kong and Macau were still under Colonial rule by the British and Portuguese respectively and thus had existing free-market economic trade connections to the rest of the world.

The success of these first SEZs led to their areas of influence being expanded within the PRD, as well as further SEZs developed in the GPRD and other parts of China. Combined with the opening up of the Chinese economy, the SEZs propelled foreign direct investment (FDI) into the region and rapidly transformed the PRD into a highly populated, highly urbanized, export oriented integrated manufacturing and logistics economy through the end of the 20th century, and then into a technology based industrial and service economy throughout the beginning of the 21st century. This transformation is clearly reflected in the drastic change in the PRD's GDP composition, from secondary and

tertiary industries making up 45.3% and 28.9% in 1980 to 43.6% and 54.6% in 2015 [8].

Figure 3: Shenzhen, Lo Wu border crossing 1964 vs. 2011(Source:https://hikespot.wordpress.com/2011/04/13/aftermath-border-walk-ping-yeung-to-tai-shek-mo/)

The Need for a Smarter and More Integrated GPRD

As cities such as Shenzhen and Guangzhou in the PRD continue to grow in population and size, advance industrial high-technology innovation, and continue the transition towards more service based economies with enhanced international and global economic, logistic and trade connections, some may see Hong Kong as less significant than it once was essential to the success of the GPRD. Therefore, there is a pressing need to discuss how Hong Kong can reposition itself within the GPRD in the next 30 years, in addition to assessing how the vast and increasingly complex GPRD metropolitan region can enhance and transform itself into a more cohesive, integrated and efficient regional economy through Smart interventions in urban planning, economic, social, political and spatial strategies.

Approach & Methodology

By utilizing the Smart City Framework developed in the Hong Kong Smart Economy in Smart Cities chapter published in 2016 [9], this chapter will assess the current state of development of the GPRD with respect to hard connections (i.e. infrastructure, environmental etc.) and soft connections (i.e. demographic, economic, social, governance etc.), and their respective associations with the three core values (Smart People, Smart Place, and Smart Planet), and six elements (Smart Economy, Smart Mobility, Smart Living, Smart Environment, Smart Governance, and Smart Infrastructure) of Smart City development indicated in the framework.

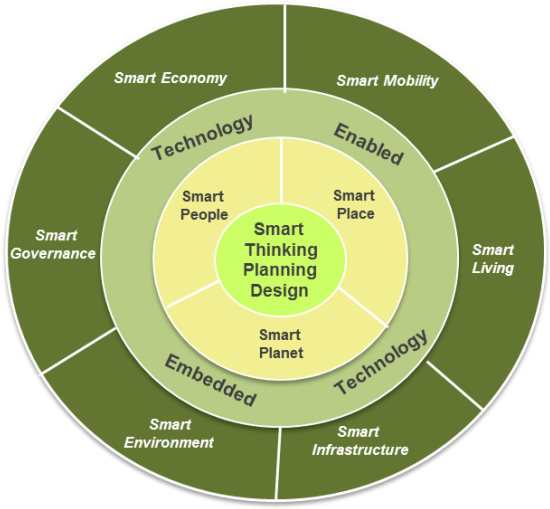


Figure 4: Smart City Framework with People, Place and Planet as core values. (Source: ISU/UDP International 2016)

This bottom up approach to the planning and development of the Smart Metropolitan region with a renewed focus on Smart Thinking, Planning and Design, Smart People, Place and Planet, would effectively help to mitigate potential future urban issues or crises arising from the lack of a forward looking coordinated and cooperative development strategy for the

GPRD going forward. In this regional metropolitan context, 'Smart' does not necessarily solely mean ICT connectivity and implementation, but rather that technology can facilitate better integration, and promote greater efficiency and enhanced functioning, resulting in smart and sustainable development of the cities within the GPRD.

Key aspects of smart regional development such as transport and utilities infrastructure, economic and political cooperation, social cohesion and demographic transitions will be focused on, with the aim to better understand the existing regional context.

To some extent, there already exists significant integration and cooperation between the PRD, Hong Kong and Macau. There are existing road, rail and ferry links between the cities, cooperation regarding the provision of utilities such as water, electricity and waste, and substantial economic ebbs and flows involving a "dense web of policies, institutions, business relationships, and personal networks that tie Hong Kong and the PRD together in the areas of science, technology, and innovation" [10].

Transportation and Infrastructure

Plans to improve accessibility and mobility links throughout the GPRD are already underway. Construction of the Hong Kong-Zhuhai-Macau Bridge is almost complete, which will reduce road travel times between Hong Kong, and Zhuhai and Macau in the Western region of the GPRD from about 4 hours to under 1 hour [11]. The High-Speed Rail Express Rail Link between Hong Kong, Shenzhen and Guangzhou is currently under construction which will connect Hong Kong to the Mainland's advanced High Speed Rail Network, and improve efficiency of border crossing controls through a joint customs checkpoint in the urban area of Hong Kong.

Moreover, technological improvements to infrastructure are also underway with the aim to enhance the smart capabilities of the GPRD region.

Figure 5: Construction of the Hong Kong-Zhuhai-Macau Bridge in 2016. (Source: The Standard http://www.thestandard.com.hk/section-news.php?id=173208)

Managing Development, Growth and Environmental Sustainability

As economic and demographic growth continues in the GPRD, future development and environmental sustainability must be managed and balanced appropriately. For example, past disproportionate growth favouring coastal cities has encouraged the Chinese Government to consider rebalancing growth between inland and coastal cities in future development [12]. Furthermore, sustainable growth and development will be a high priority, with a focus on promoting environmentally friendly green industries and use of renewable energies to improve the air and water quality in the Pearl River Estuary and more cooperation within the GPRD.

Economic and Social Integration

Economic integration and cooperation between businesses in the PRD, Hong Kong and Macau have been occurring for many years, however only in more recent years have these relationships become more

formalized and visible to small businesses and citizens. An example being agreements such as the Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA) signed in 2003 was the first free trade agreement between Mainland China and Hong Kong, and greatly expanded the markets for trade in goods and services, investment and technical cooperation [13].

Figure 6: Mainland and Hong Kong Closer Economic Partnership Arrangement Signing Ceremony in 2003.(Source:http://sp.wenweipo.com/hk15contest/?action-viewnews-itemid-134)

Cooperation in the Science and Technology fields has also expanded, with academic institutions, non-profit organisations, start-ups and established businesses increasingly working together in Research & Development, technological innovation, and financing and management to capitalize on the competitive advantages and specializations that characterize the different clusters in the GPRD [14].

Figure 7: The Hong Kong Science and Technology Park in Pak Shek Kok. (Source: http://photos.prnewswire.com/prnfull/20150722/240693)

One key action in recent years is the government's aim, as part of its Hong Kong 2030+ strategy, to consolidate and foster a knowledge and technology corridor on the eastern part of Hong Kong stretching from the existing Hong Kong Science and Technology Park (HKSTP) in Ma Liu Shui up to the Lok Ma Chau Loop, a strategic location adjacent in proximity to the boundary between Hong Kong and Shenzhen [15]. The Lok Ma Chau Loop is to be jointly developed by Hong Kong and Shenzhen into an Innovation and Technology Park with a long term vision to create a cluster of talent, research institutions and technological companies from all around the world. The rationale behind the development and its location is to enjoy the lower manufacturing costs in Shenzhen while retaining Hong Kong's legal and business framework and internet freedom [16][17].

Figure 8: Aerial view of the Lok Ma Chau Loop site. (Source: Hong Kong Planning Department)

This collaboration and cooperation in the high-tech and service tertiary industries is reinforced by the increasing migration flows within the GPRD and across the Hong Kong border. Greater numbers of Chinese firms are establishing office spaces in Hong Kong, and organisations and academic

institutions are seeing influxes of Mainland Chinese into Hong Kong for better economic opportunities and international exposure. Conversely, a migration of Hong Kong citizens to Mainland China has also been underway due to the increasing cost of living in Hong Kong and those who long for a return to their cultural roots. There exists a phenomenon of 'dependent urbanization' where migration on both sides of the border are the result of differing advantages offered by the PRD and Hong Kong, and people are able to capitalize on them by moving across the border, contributing to a sense of social and cultural sustainability in the region [18].

Concluding Remarks

This Chapter will critically review the literature on the current discussions and analyses surrounding the current and future growth, development and integration of the GPRD and its economic, spatial and social strategies. By addressing each Smart City element with respect to existing situations and real-world examples, we will then suggest recommendations for the way forward on how smarter integrated regional development can take place within the GPRD, with an emphasis on identifying and highlighting how Hong Kong can reposition itself within the PRD in the future.

References

[1] Invest Hong Kong. (2014). *The Greater Pearl River Delta.* A report commissioned by Invest Hong Kong, 7th Edition. The Government of Hong Kong Special Administrative Region.

[2] HKTDC Research. (2016). *PRD Economic Profile*. Available from: http://china-trade-research.hktdc.com/business-news/article/Facts-and-Figures/PRD-Economic-Profile/ff/en/1/1X000000/1X06BW84.htm [Accessed 28 Jul. 2017].

[3] Census and Statistics Department HKSAR (2017). *Hong Kong Annual Digest of Statistics 2016*. Available from: http://www.statistics.gov.hk/pub/B10100032016AN16B0100.pdf [Accessed 28 Jul. 2017].

[4] Statistics and Census Service Government of Macao Special Administrative R**eg**ion .(2017). *Yearbook of Statistics*. [online] Available from: http://www.dsec.gov.mo/Statistic.aspx?lang=en-US&NodeGuid=d45bf8ce-2b35-45d9-ab3a-ed645e8af4bb [Accessed 28 Jul. 2017].

[5] UN-HABITAT. (2006). Urbanization: Mega & Meta Cities, *New City States? State of the World's Cities 2006/7.* [online] Available at http://mirror.unhabitat.org/documents/media_centre/sowcr2006/SOWCR%202.pdf [Accessed 28 Jul 2017]

[6] The World Bank. (2017). *World Bank Report Provides New Data to Help Ensure Urban Growth Benefits the Poor*. [online] Available at: http://www.worldbank.org/en/news/press-release/2015/01/26/world-bank-report-provides-new-data-to-help-ensure-urban-growth-benefits-the-poor [Accessed 28 Jul. 2017].

[7] Composition of Gross Domestic Product, Guangdong Statistical Yearbook 2016, National Bureau of Statistics

[8] Composition of Gross Domestic Product, Guangdong Statistical Yearbook 2016, National Bureau of Statistics

[9] Govada, S. S., Spruijt, W., & Rodgers, T. (2017). Smart City Concept and Framework. In Smart Economy in Smart Cities (pp. 187-198). Springer Singapore.

[10] Segal, A. (2014). Hong Kong and the Pearl River Delta: Science and Technology Cooperation. Hong Kong Innovation Project Report No. 6, Council on Foreign Relations. Available from: http://demo.savantas.org/wp-content/uploads/2014/06/6_Segal.pdf

[11]Highways Department HKSAR. (2017). *HongKong-Zhuhai-Macao Bridge (HZMB) : Transportation*. [online] Hzmb.hk. Available from: http://www.hzmb.hk/eng/benefits_transportation.html [Accessed 28 Jul. 2017].

[12] Asia Business Council. (2011). *Economic Transformation of the Greater Pearl River Delta: Moving Up the Value Chai*n. Available from: http://www.asiabusinesscouncil.org/docs/PRDBriefing.pdf.

[13] Trade and Industry Department. (2017) CEPA https://www.tid.gov.hk/english/cepa/cepa_overview.html

[14] Segal, A. (2010). Hong Kong and the Pearl River Delta: Science and Technology Cooperation. In *Innovation Policy and the Limits of Laissez-faire* (pp. 181-197). Palgrave Macmillan UK.

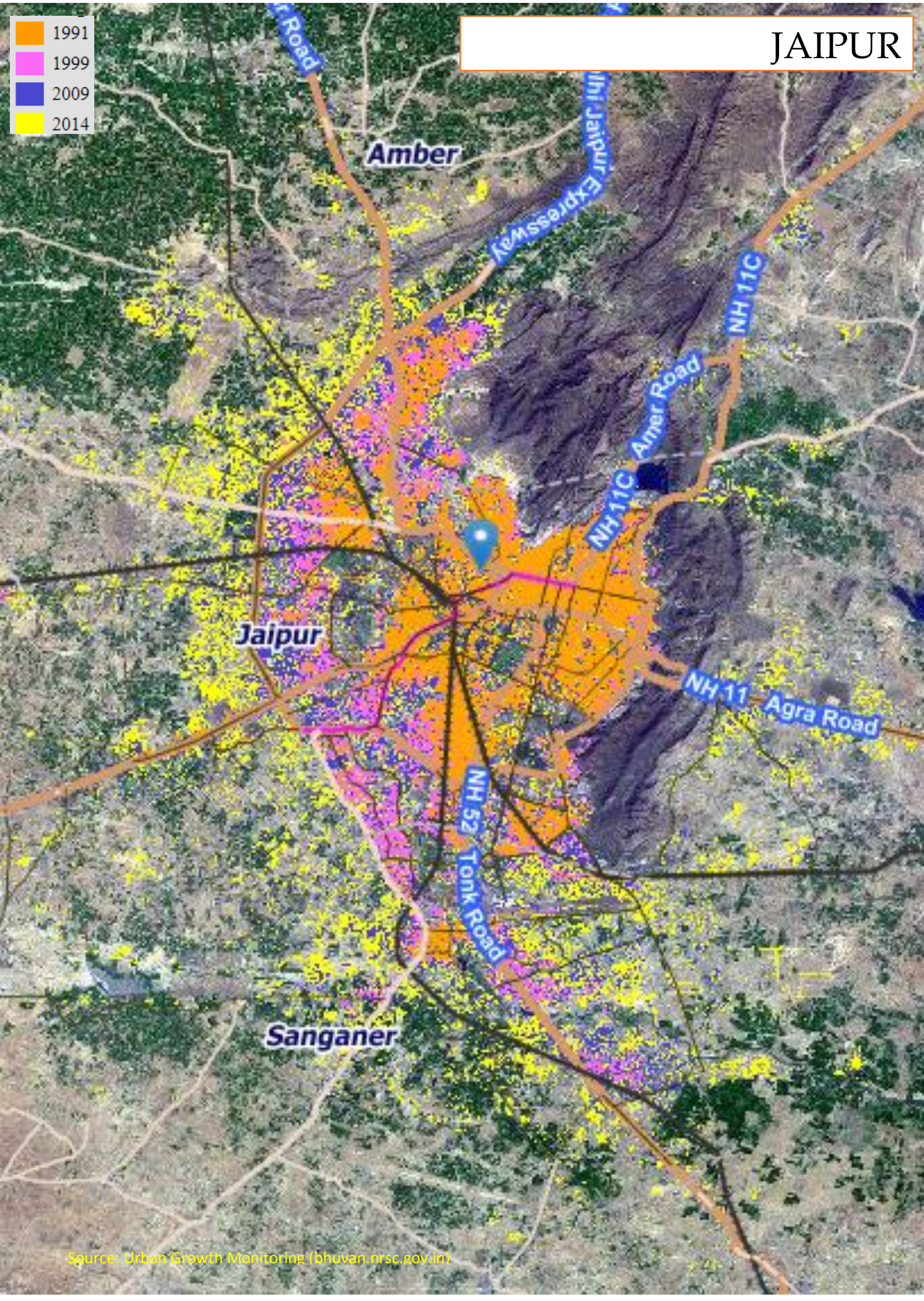
[15]Development Bureau and Planning Department, HKSAR. *Hong Kong 2030+ Towards a Planning Vision and Strategy Transcending 2030*.

[16]HKSTP. (2017). *HKSTP welcomes the development of the Lok Ma Chau Loop into a "Hong Kong/Shenzhen Innovation and Technology Park*. Available from: https://www.hkstp.org/hkstp_web/en/corporate-news-science-park-company-news/latest-news?Alias=hkstp-welcomes-the-development-of-the-lok-ma-chau-loop-into-a-hong-kongshenzhen-innovation-and-technology-park [Accessed 1 Aug. 2017]

[17] ChinaDaily.(2017). *Hong Kong cozies up to Shenzhen to create tech giants*. Available from: http://www.chinadailyasia.com/articles/4/0/244/1497264457951.html [Accessed 1 Aug. 2017]

[18] Ashraful, A. & Khalil, M. B. (2012). Migration and Inter-Dependence, Sustainable Urbanism in the Pearl River Delta Region, South China. *Journal of Social and Development Sciences*. Vol. 3, No. 3, pp. 99-107.

JAIPUR



Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)

JAIPUR

RAJASTHAN, INDIA

H. B. Singh- Prabh Bedi- Neha Goel Tripathi

SMART DEVELOPMENT STRATEGIES FOR JAIPUR METROPOLITAN REGION: SUSTAINABLE SOCIO-ECONOMIC AND SPATIAL INTER LINKAGES

Introduction

A phenomenon primarily of the post-independence India, the Census of India defines metropolitan as an urban agglomeration / city having a population of one million and above. Also called million plus cities, these serve their influence region as the dominating centers of economic, socio-cultural, administrative and political activity. It may comprise of one or more districts and consist of two or more municipalities or *panchayats*[1] or contiguous area specified by the Governor through public notification (Census of India, 2001 and Kulshrestha, 2006). At the turn of the 21st century, number of million-plus cities were 35 accounting for 38% of urban population (Census of India, 2001). Million-plus cities were 5 in 1951 when the first census was conducted after Independence which are now 53 (Census of India, 2011). The percentage of population living in metropolitan cities to the total urban population in the country has increased by 68 percent. (refer *Table 1, Metropolitan Cities in India 1951- 2011)*. The pace of metropolitisation has been largely dependent upon the migration of people from rural areas to urban centers due to the pull factors turning large urban centers over a period of time into metropolitan cities.

Table 1 Metropolitan Cities in India 1951- 2011

Year	Number of Metropolitan Cities	Percentage of Population of Metropolitan Cities to the Total Urban Population
2011	53	42.6
2001	35	37.8
1991	23	32.5
1981	12	26.4
1971	9	25.5
1961	7	22.9
1951	5	18.8

Source: Compiled from Census of India

View from North of Nahargarh Fort, Jaipur

Increasing population in metropolitan cities has been exerting pressure on the services

Census of India recorded a million-plus population in Jaipur in 1981. Jaipur city, capital of State of Rajasthan lies 250 KMs south west of New Delhi, the national capital. It has been the administrative headquarters since it was first developed by Maharaja Jai Singh II in 1727 as first planned city of medieval period based on grid pattern. On three sides, the city is enclosed by the Aravali hills which has safeguarded the city from rough desert. Over the centuries it has developed into a socio-cultural and economic hub of the region with tourism being one of its key functions.

In this chapter, the authors aim to bring about the challenges, failures and success of planning efforts in Jaipur region and further look in the regional economic strategies that may turn the region in a smart entity. Smart City is now an immensely popular concept in urban planning world over. The Government of India perceives Smart City as a city that is able to provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of Smart Solutions. Jaipur is among the hundred identified Smart Cities in India, having a vision, as articulated by the Chief Minister of the State, Ms. Vasundhra Raje, of creating a balance of heritage with modernism such that the citizens can be smart while keeping their heritage protected.

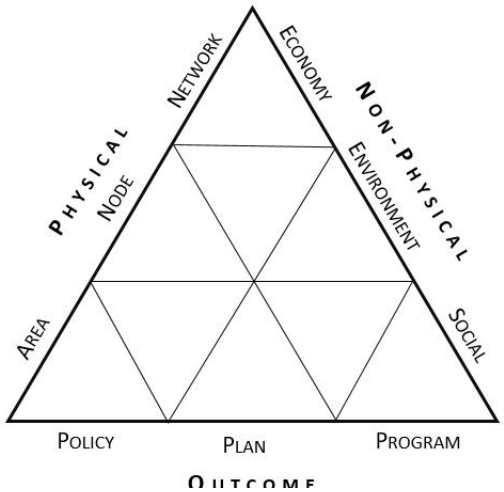


Fig 1: Urban planning paradigm

The authors shall broadly analyse the extent to which Jaipur's development is in sync with the principles of Smart City as laid down by the government, which is a work-in-progress as well as within the framework of the concept of Smart City consisting of six pillars of smart people, smart economy, smart mobility, smart environment, smart living and smart governance (United Nations 2015). Detailed study would focus of economy, environment and social aspects within the framework of the standard outcomes of urban planning paradigm as depicted in Figure 1.

Study Area

Jaipur has a hot semi-arid climate receiving over 650 millimeters (26 inches) of rainfall annually, most of it occurring in the monsoon months between June and September. Temperature remains relatively high throughout the year, with the summer month of April to early July having average daily temperatures of around 30 °C (86 °F). The major rivers passing through the Jaipur district are Banas and Banganga, which are a source of water supply to the city as well. The City with a population of approximately 3.07 million in 2011 (Census of India, 2011) has experienced above 30 percent growth rate in the last decade.

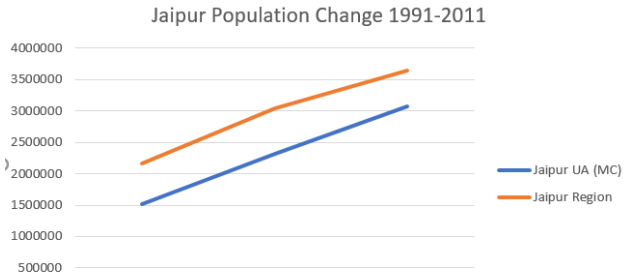


Figure 1 Jaipur Population Change 1991-2011

Source: Census of India 2011, 2001&199 1

In the western part of India, Jaipur is the most important city. It is an important node on the Dedicated Freight Corridor (DFC), which is a rail link connecting Jawahalal Nehru Port near Mumbai to Dadri, an industrial area near Delhi. It is a node on the Golden Quadrilateral, a network of highways connecting India's four top metropolitan cities, namely Delhi, Mumbai,

Chennai and Kolkata. At the state level too, the city is on important tourist circuits.

The study area for this research is the region with Jaipur as its primate city. Jaipur Region has been delineated in the Master Development Plan- 2025. However, for the purpose of this research, the authors will be delineating a region around Jaipur based on the principles of regional planning. The existing metropolitan region is wholly a part of Jaipur District and comprises of 9 *tehsils* in part or whole, with Jaipur municipal area at the core and 15 satellite towns and 725 revenue villages spread across the region. The region comprises of an area of 2940 Sq. KMs. The regions being under multiple authorities experience difficulties in policy and plan implementation. The current Master Plan envisions Jaipur to be a global metropolis and a world class city (Master Development Plan – 2025).

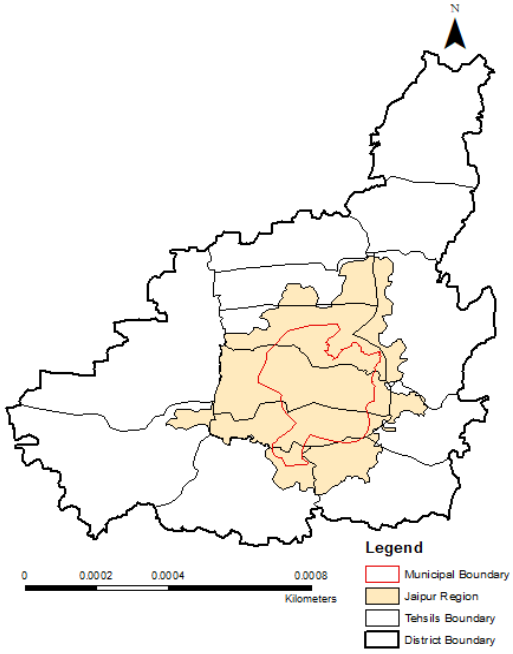


Fig 2. Jaipur Region
Compiled from Master DevelopmentPlan2025

The first Master Development Plan was made in 1976 for 1991 and was extended to 1998 under the Urban Improvement Trust Act. In 1982 Jaipur Development Authority (JDA) was constituted after the city's population crossed a million inhabitants. In 1998, JDA prepared and approved the Master Development Plan for 2011 and in 2009, the third plan was prepared that came into enforcement in 2011 after due approval. The development in Jaipur has been overshooting the guidelines and policies of the master plans. The First Plan envisaged development of 156 Sq. KMs, but actual development was nearly 22 percent more than the designated area. During the second plan too, the deviations stood at 84 percent. The preliminary analysis indicates a lack and integration of functional and zonal plans clubbed with weak regulations and implementation to be the cause.

Existing Challenges

Challenges identified based on preliminary analysis of the region are -

- decades of rapid population growth and unplanned development have led to numerous infrastructure challenges
- There is a gradual loss of traditional income base which is slowly loosening the socio-cultural fabric
- Paucity of resources particularly depletion of groundwater as 97% of the population of the region depends on it.
- The area faces an elevated risk of infectious disease due to high population density and inadequate sanitation systems

The satellite towns identified as per the Master Development Plan of the region are already overburdened due to lack of infrastructure. These are small towns of category III and IV, governed by a municipality. In addition, the numerous villages too soak in migrant population despite having poor infrastructure. There is a need to develop the region such that these small towns and villages do not become congested centers of population with the intervening area (presently agricultural) between the towns and villages as highly developed stretches, making the villages and towns as sores in the region.

Work in Progress

Other than providing for the physical infrastructure in a planned manner, it is essential to enhance the economic and social fabric keeping in mind the culture and heritage of the region. The region is known for its rich

heritage which is reflected in its customs and traditions, art and architecture and even its cuisine.

The focus of the authors shall be on integrating the aspects of heritage and culture into the economic strategies so as to carry forward the region's environmental vibrance and make it smart and sustainable. We shall be discussing the challenges in terms of institutional framework and policies for the region. We welcome any comments and suggestions from our colleagues.

References

Census of India, (2011): Population Totals: Urban Agglomerations/Cities having Population above 1 Lakh, at http://censusindia.gov.in/2011-prov-results/paper2/data_files/India2/Table_3_PR_UA_Citiees_1Lakh_and_Above.pdf accessed on 08 August 2017.

Firodia and Pavnaskar (2015), Smart City: A Blueprint for a Zero Pollution, Sustainable, Smart Industrial City, Vishwakarma Publications

Jaipur Development Authority (1998), Master Development Plan – 2011 Jaipur Region Part 1.

Jaipur Development Authority (2011), Master Development Plan – 2025 Jaipur Region.

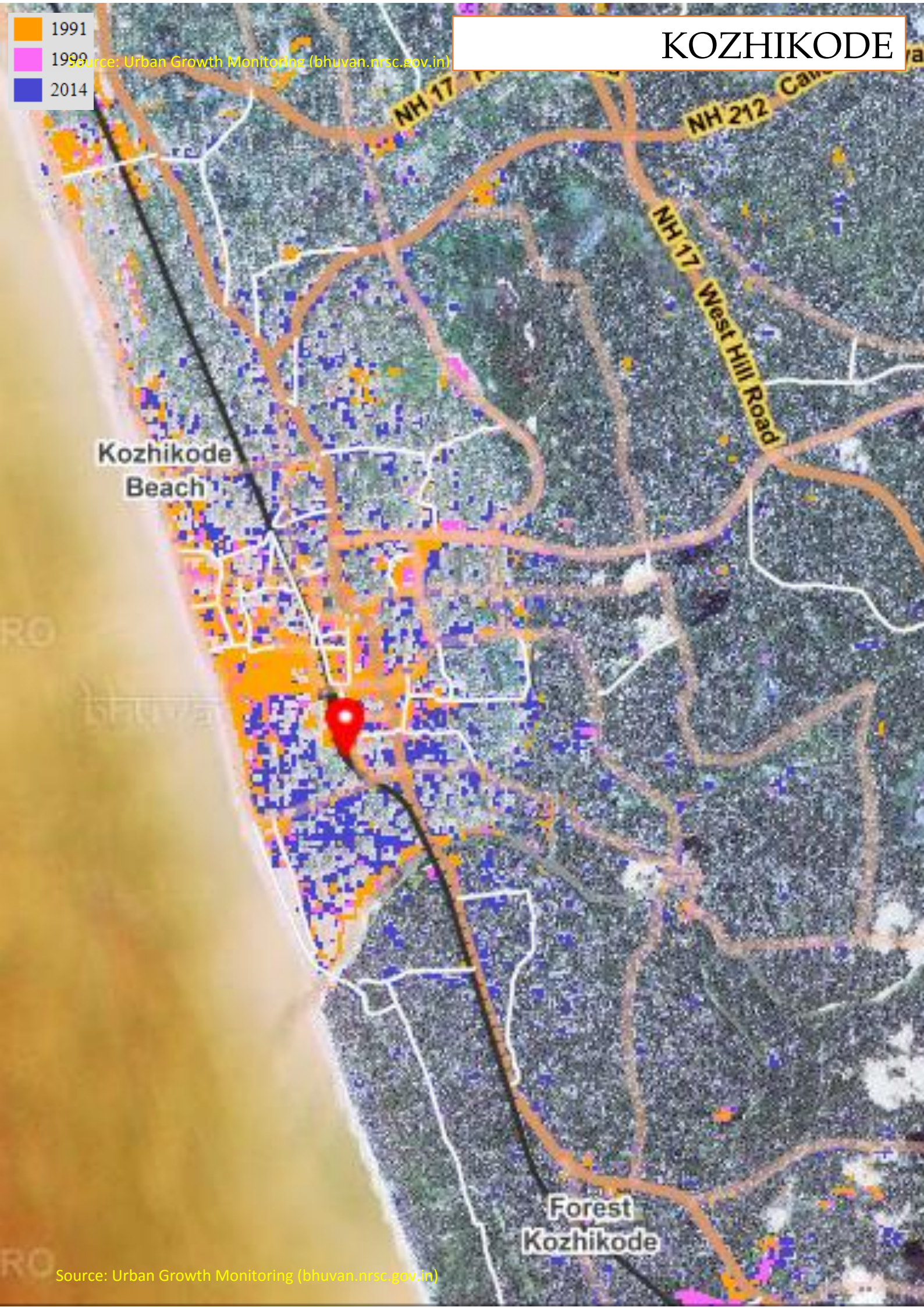
Kulshtreshtra S. K. (2006), Dictionary of Urban and Regional Planning, Kalpaz Publications.

Saini, N. S. (1989), "Issues in Metropolitan Planning in India: Case Study of Ahmedabad". SPACE, 4(3).

United Nationa (2015), Smart Cities: Regional Perspective, The Government Summit Thought Leadership Series, accessed on 23 August, 2017 at https://worldgovernmentsummit.org/api/publications/document/d1d75ec4-e97c-6578-b2f8-ff0000a7ddb6

Vinod Kumar, T. M. (ed.) (2017), E-Democracy for Smart Cities, Springer.

KOZHIKODE


1991
1999
2014
Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)
NH 17
NH 212
NH 17 West Hill Road
Kozhikode Beach
Forest Kozhikode
Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)

KOZHIKODE

KERALA, INDIA

T M Vinod Kumar- Mohd. Firoz C.- Namratha Radhakrishnan

TOWARDS SMART KOZHIKODE METROPOLIS: ECONOMIC AND SPATIAL DESIGN STRATEGIES FOR KOZHIKODE METROPOLITAN

Introduction

The peculiar settlement pattern of Kerala has been subject of much discussion among economists and policy makers. High rate of urbanization in the state has led to the emergence urban agglomerations and Census towns forming an urban corridor along the coast of the state.

The major contributor to this increase is the change in the workforce pattern from agriculture to other non-agriculture sectors (Firoz, 2006). This rural – urban continuum has been responsible for the outreach of social infrastructure and services to almost all parts of the state resulting in high literacy, life expectancy, favourable sex ratio, better human resources, political awareness, public participation etc. Due to all these factors the state has Human Development Indices comparable to that of the developed countries.

In sharp contrast to this, the cities of Kerala have witnessed rapid decline in industrial activity thus resulting in loss of employment opportunities and subsequent high migration rates. The industrial decline is attributed particularly to backwardness in industrial technology along with high wage rates and labour militancy[1]. It has now become pertinent for cities in Kerala to adopt new economic strategies that will help build competitiveness for the 21st century.

Kozhikode district is located along the south west coast of India in the Malabar region of Kerala. It is bound by the Arabian Sea on the west and the districts of Kannur, Wayanad and Malappuram to the north, east and south respectively. The district is located approximately 420 kms north of the state capital Thiruvananthauram and 250 kms from the commercial capital namely, Ernakulam. Chennai and Bangalore, the two other major cities of south India are located within 650 kms from Kozhikode.

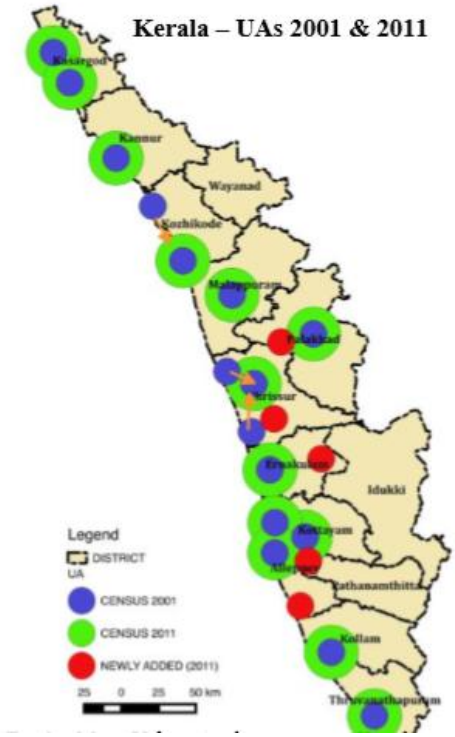


Figure 1: Settlement pattern of Kerala. Source: 2015, Masterplan for Kozhikode Urban Area 2035.

Location and regional connectivity

The district – which is well connected via air, rail and road – acts as the regional transit hub for the Malabar. The closest airport, located in Karipur, is approximately 30 kms from the city. While the Trivandrum – Mangalore – Mumbai railway line connects the district to the major coastal

[1] http://www.thehindubusinessline.com/2004/01/17/stories/2004011701360400.htm

towns of the state and to other major cities of the country, road connectivity to all coastal cities is ensured by the National Highway (NH) 47. The two major ports Kochi and Mangalore lie within 250 kms and an intermediate port namely, Beypore is located in close proximity to Kozhikode – hence increasing trade prospects for the district.

Figure 2: Connectivity of Kozhikode district to regional urban centers

Source: 2015, Masterplan for Kozhikode Urban Area 2035, Kozhikode Corporation.

Existing economic base of the city

Kozhikode, was once a vibrant global trading hub with an established trade route connecting Europe and South Asia. Historically, Calicut was a port city and an important center of trade and commerce especially for spices trading for several centuries which thus earned its name as 'City of Spices' (Firoz, Kumar VTM, 2017).

The political and social fabric prevalent during the post-independence period in the city did not support any major industrial developments. The industrial activity is presently limited to few medium scale industries related to steel processing and small scale industries manufacturing rubber products, food and dairy, textile, handloom, timber etc. The industries are neither a major source of revenue nor does it generate any employment opportunities

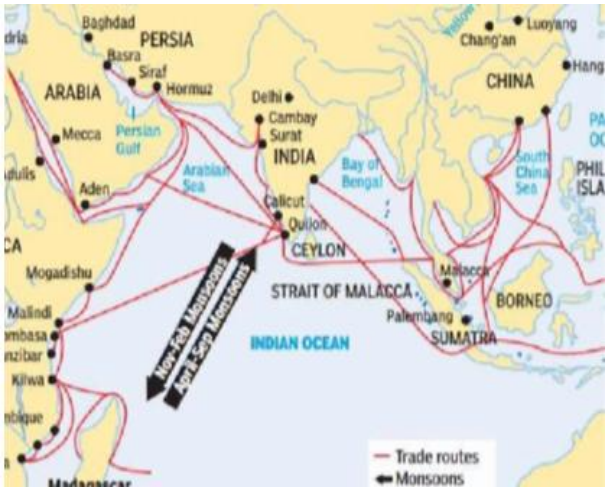


Figure 3: Trade links between Calicut and rest of the world until 16th century. Source: Firoz & Kumar, V. T.M. (2017)

Statistics from the Economic Review of 2016 prepared by the State Planning Board indicate that the economy of the district, in 2016, was primarily driven by the tertiary sector - 61% of district GSVA – followed by the secondary sector - 31% of district GSVA (Figure 4). The primary sector only contributed to 8% of the district economy wherein majority of the activities included agriculture cultivation of paddy, coconut, banana, tubers, spices and other tree crops along with fishing and its allied activities.

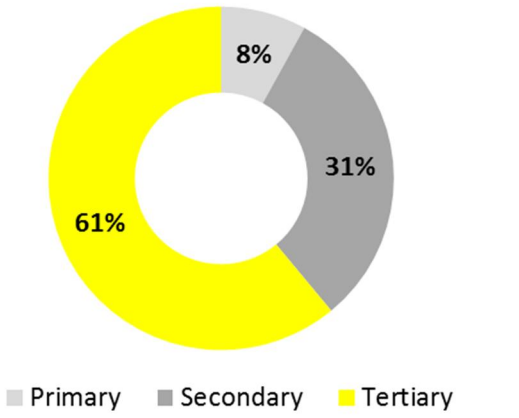


Figure 4: Sectoral share of district GSVA (2015 – 2016)

Source: Economic Review 2015 - 2016, State Planning Board

While secondary sector activities included medium scale industries with manufacturing activities primarily focused on F&B, timber processing and tile manufacturing among others, the tertiary sector activities included tourism and retail establishments. Additionally, a large number of cyber parks have also been proposed for the district that is in various stages of development. With Kozhikode being positioned as the next IT destination of the state after Kochi, a potential shift in the economic base of the city is envisaged.

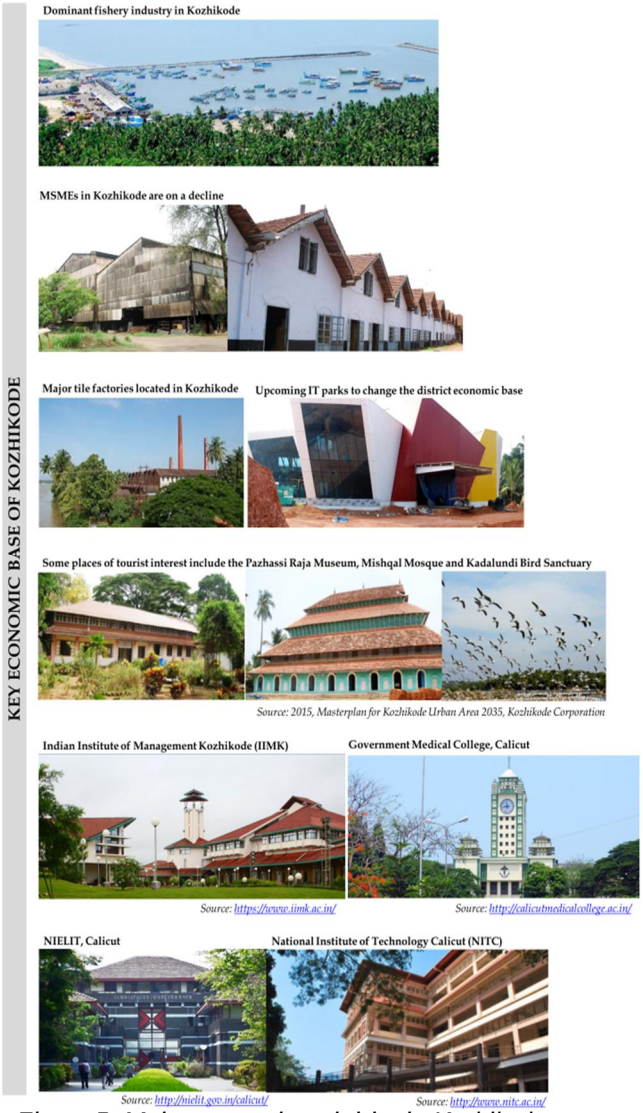


Figure 5: Major economic activities in Kozhikode. Source: Studio work.

Economic decline, unemployment growth and high migration have made it important to reconsider economic strategies and transform Kozhikode. Low profitability of other erstwhile industry and trade activities has resulted in a structural shift in the economy from manufacturing to tertiary sector activities such as tourism, education, healthcare and IT/ITeS. Lonely Planet has ranked North Kerala as the third must-visit destination among ten other places in Asia for 2017. This will help Kozhikode strengthen its' position on the international tourist map. The district is also home to some of the best education institutes in the country and the presence of well-developed medical facilities makes it the go-to place for health care in the region. Upcoming investments in the IT/ITeS sector include the development of a 50 acre cyber park. These developments are expected to position Kozhikode as the third IT hub in the state.

Metropolitan region in Kozhikode

The 73rd and 74th Constitutional Amendment Acts envisages democratic decentralization of administration and planning. The Act mandates the constitution of the District Planning Committees (DPC) and Metropolitan Planning Committees (MPC) for the planning and development of Districts and Metropolitan areas respectively. Though, Kerala has already constituted DPCs, there are no MPCs in the State. However, the Kerala Town and Country Planning Act, 2016, recently enacted envisage plans for State, metropolitan areas, districts, local areas and micro level areas (Easow, 2016).

As per the results of the Census of 2011, urbanization in the district indicates that approximately 67% of the total population is defined 'urban' and the number of census areas has increased by 173% from 2001 to 2011. As indicated in Figure 6, it can be seen that the Kozhikode urban agglomeration has become a continuous, vast stretch along the coast, against the three standalone urban agglomerations – similar to the urbanization pattern observed in the state. This poses a great potential for and integrated metropolitan regional level

Previous planning efforts indicated in the masterplan prepared by the Kozhikode Corporation include the Interim Development Plan (1967 – 1981), Development Plan for Calicut Urban Area (1981 – 2001), Perspective Plan of 2003, City Development Plan (2006) and

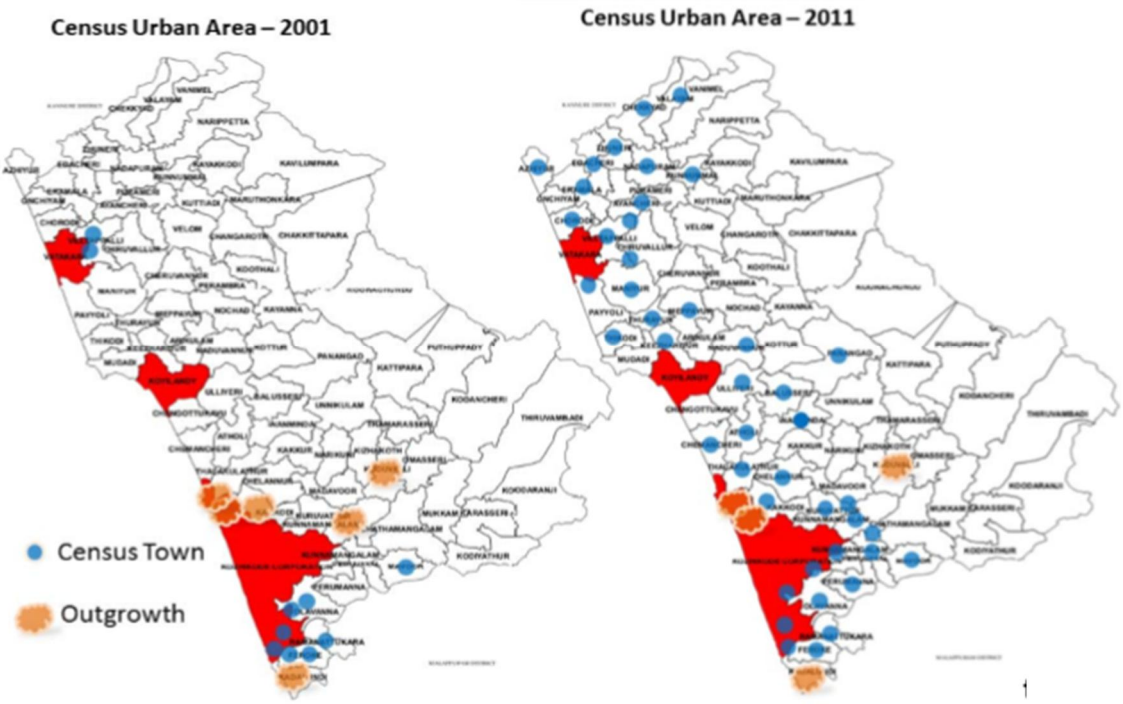


Figure 6: Urbanization pattern in Kozhikode district. Source: 2015, Masterplan for Kozhikode Urban Area 2035.

various town planning schemes. The various proposals in these plans range from overall district level interventions to small scale schemes, all limited to the Kozhikode Corporation area.

In this chapter we aim to study the existing economic and spatial structure of the place and propose economic and spatial strategies that can be adapted to revive the economy for a delineated metropolitan region within the district.

Study area

The planning area for the Kozhikode Metropolitan Region has been delineated for this research and this includes the boundaries of census defined urban areas and urban agglomerations that fall within the Kozhikode district boundary. The region comprises of 75 Local Self Governing Bodies (LSGBs) and the Kozhikode Corporation – located to the south of the planning area – is the administrative center of the district and will also play the same role for the region. The region, with an area of approximately 1,720 sq kms, accounts for 73% of total district area. The planning area has a population of approximately 2.9 million and an average density of 1734 persons per sq kms.

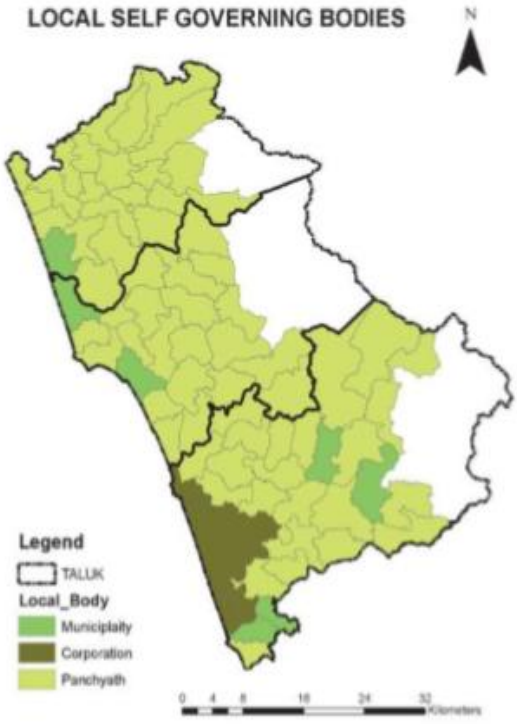


Figure 7: Kozhikode Metropolitan Region delineated within Kozhikode districts. Source: Studio work.

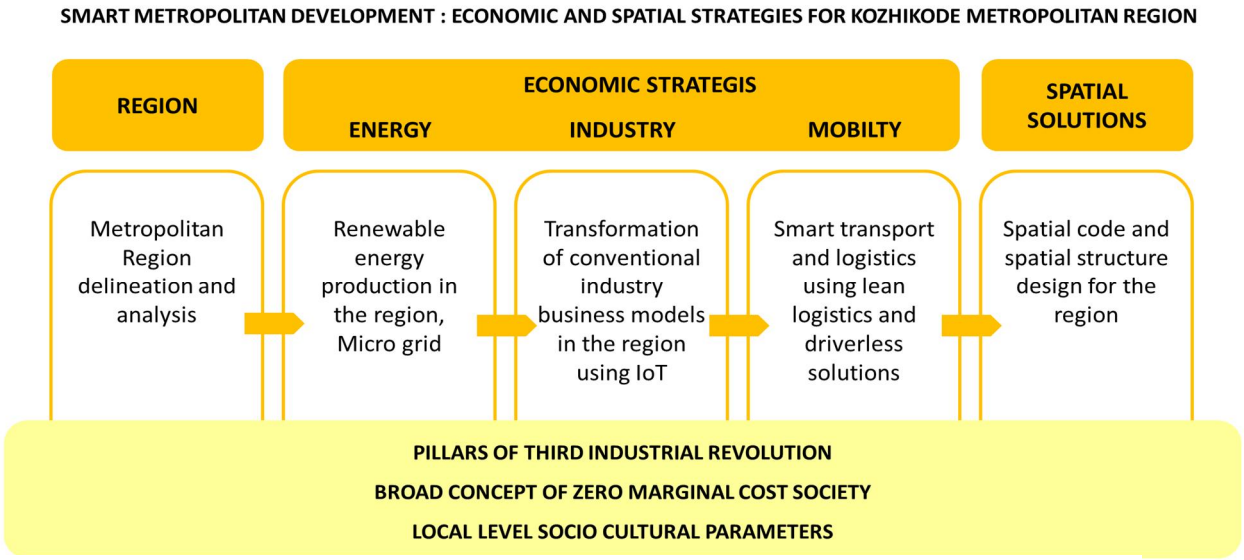


Figure 8: Study approach. Source: Studio work.

Approach

The principles of the Third Industrial Revolution and Zero Marginal Cost Society - proposed by Jeremy Rifkin – have been used as the basis to develop the economic and spatial strategies for the metropolitan region.

According to Rifkin, history has been witness to at least seven major economic paradigm shifts and they share a common denominator – three defining technologies emerge and then converge to create infrastructure that change power management methods and movement of economic activities across the value chains. These defining technologies are a) new communication technology to manage economic activities; b) new energy sources to enhance the economic activities and c) new transportation and logistics facilities for movement of these economic activities

Zero marginal cost works on the principle of efficient technologies that will accelerate productivity such that the marginal cost of production would be zero – making goods and services essentially free[2].

Kozhikode is famously called the 'City of Truth' owing to the amicble, forthcoming and trustworthy nature of the people (Narayanan, 2006). Along with this, specific religious and cultural unique practices of Kozhikode are also prevalent in the region. These factors have been also been integrated as part of ensuring community involvement in the process.

Methodology

The three key steps in while proposing the economic and spatial strategies for the Kozhikode Metropolitan Region include,

a) Renewable energy generation and deployment

All of the energy used in industries, homes and vehicles still use conventional sources that entail very high environmental impacts. In lieu of climate change and strategies adopted to reduce the carbon foot print, it becomes pertinent to carry out new models of energy production. This energy can be generated by harnessing renewable sources at nearly zero marginal cost (TIR Consulting Group 2016). Kerala has been one of the first few states to focus on renewable energy generation for large scale businesses andhouseholds. This step took further strides as the Cochin International Airport became the first high demand infrastructure project to be completely operational using solar power[3]. It

[2] https://www.theguardian.com/commentisfree/2014/mar/31/capitalism-age-of-free-internet-of-things-economic-shift

[3] http://blog.ksidc.org/the-rise-of-renewable-energy-in-kerala/

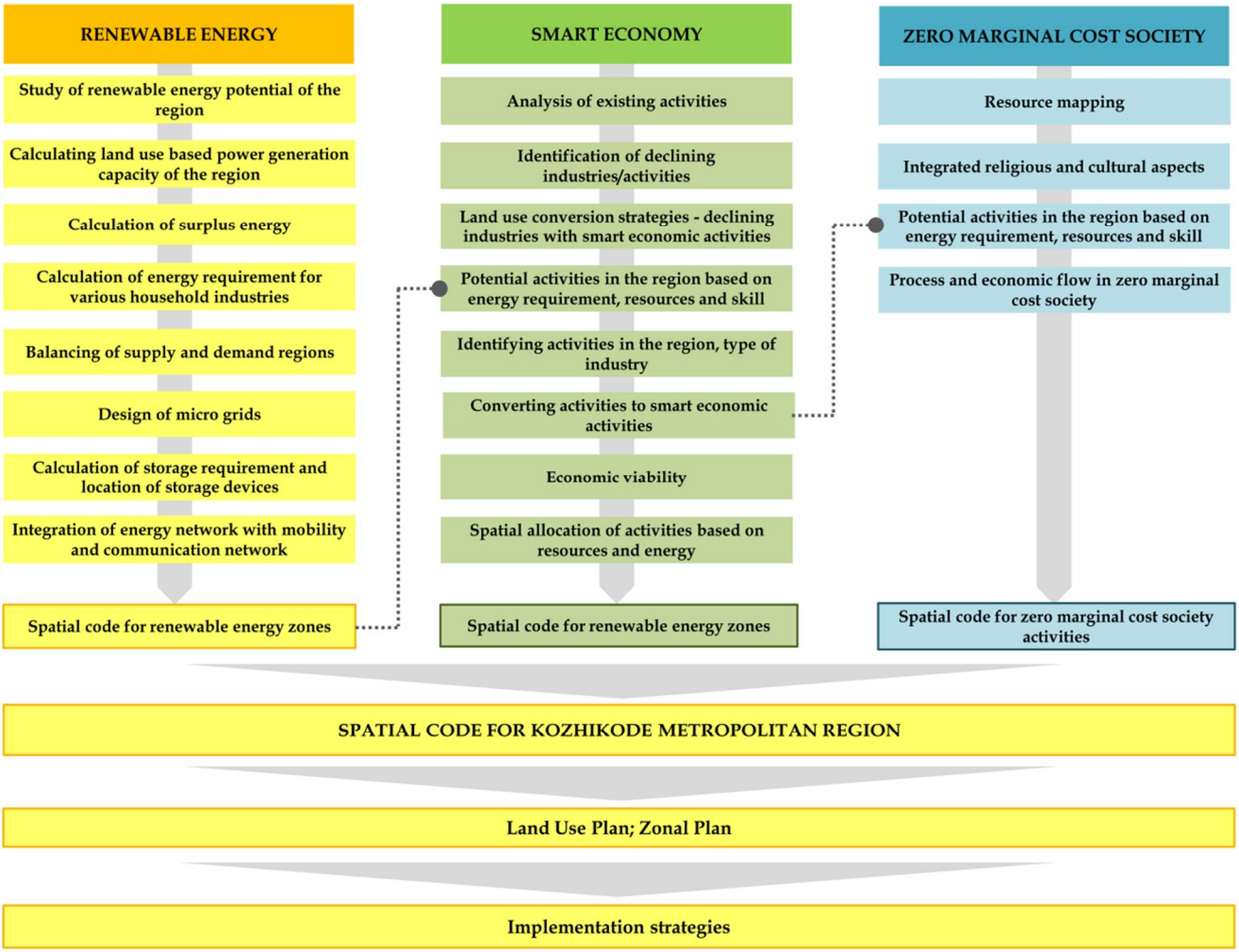


Figure 9: Study Methodology

will be easier to deploy this due to plugging costs of overall renewable energy generation[4]. Energy surplus and deficit are calculated for regions which are used for energy balancing. This renewable energy will be generated on site at zero marginal cost by transforming businesses and homes into micro power plants. Based on this, the renewable energy potential of the region has been studied first by identifying various methods of generating energy through renewable resources suitable to the region and to select the most suitable method. The energy generation capacity of the region was calculated. Then energy requirement for residential, commercial, institutional, public and semi – public land use activities has been calculated. The surplus energy has been derived based on the energy generated (supply) and the energy required (demand). The energy demand for various household industries has been estimated next followed by balancing the supply and demand regions. The micro-grids have been identified based on the balanced regions. Calculation of storage requirement and allocation of location of storage devices have been done, resulting in the spatial codes for renewable energy. The energy network has been integrated with the communication network necessary for making a 'smart' regional economy.

b) Transformation to smart industrial economy

Smart Economy involves the creation 'Prosumers,' i.e., a person would be a consumer and producer in a smart economic environment. This would involve conversion of major

[4] Mass production of solar power components has brought down the unit price. Cost of power from solar declines at seven per cent annum. But the cost of grid energy rises at three per cent per annum. http://www.thehindubusinessline.com/news/national/kerala-has-potential-for-10000-mw-in-solar-rooftop-energy-expert/article4606754.ece

economic activities to Smart economic activities based on energy and resources in a region. Rather than following a conventional system of large and medium scale industries, every individual household shall be a Prosumer and would be considered as an industry.

To create a 'Smart Economy' for the region, the existing economic activities of the region have been studied and declining activities/ industries are identified. In order to replace declining activities with smart economic activities land use conversion strategies have been formulated. Identification of the potential activities in the region has been done based on energy requirement, resources, skills etc. and on the spatial codes for renewable energy. The existing activities have been converted to smart

economic activities and the economic viability is assessed. The activities based on resources and energy has been spatially allocated and spatial codes for smart economy is derived. The strategies to convert smart economic activities to Zero Marginal Cost have been formulated.

c) *Cascading society based on Zero marginal cost*

It is based on the idea that if the marginal cost of producing each additional item falls to essentially nothing, then everything becomes free. To create a Zero Marginal Cost Society framework for the region, the resources in the region have been mapped out. Then religious and cultural aspects are integrated and potential activities based on energy requirement, resources and skill are identified. The process and economic flow in zero marginal cost society has been worked out and spatial codes for a zero marginal cost society were prepared.

Finally, to arrive at spatial code for the metropolitan region, each spatial code for renewable energy, Smart Economy and Zero Marginal Cost Society has been consolidated followed by preparation of Land use plan and Zonal plan along with strategies for implementation.

Credits

This chapter is based on an academic project conducted with 9 students of third semester Master in Planning in the Department of Architecture and Planning, National Institute of Technology Calicut. They were divided into three groups based on the three major steps in the methodology. We thank the students of all three groups for each of them have contributed to developing our understanding of the topic.

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References

Industrial backwardness in Kerala, Available from: http://www.thehindubusinessline.com/2004/01/17/stories/2004011701360400.htm (Accessed on 30 July 2017)

Renewable Energy in Kerala, Available from: http://blog.ksidc.org/the-rise-of-renewable-energy-in-kerala/ (Accessed on 29 July 2017)

Solar energy in Kerala, Available from: http://www.thehindubusinessline.com/news/national/kerala-has-potential-for-10000-mw-in-solar-rooftop-energy-expert/article4606754.ece (Accessed on 29 July 2017)

Firoz, M (2006), Spatial planning in the rural urban interface in Kerala, Journal of Institute of Town Planners India, New Delhi

Firoz, M & Kumar, V.T.M. (2017), Transforming Economy of Calicut to Smart Economy, Chapter 16 in Kumar, V.T.M. (Ed.), Smart Economy in Smart Cities, Singapore: Springer

Master Plan for Kozhikode Urban Area (2035), 2015, Kozhikode Corporation

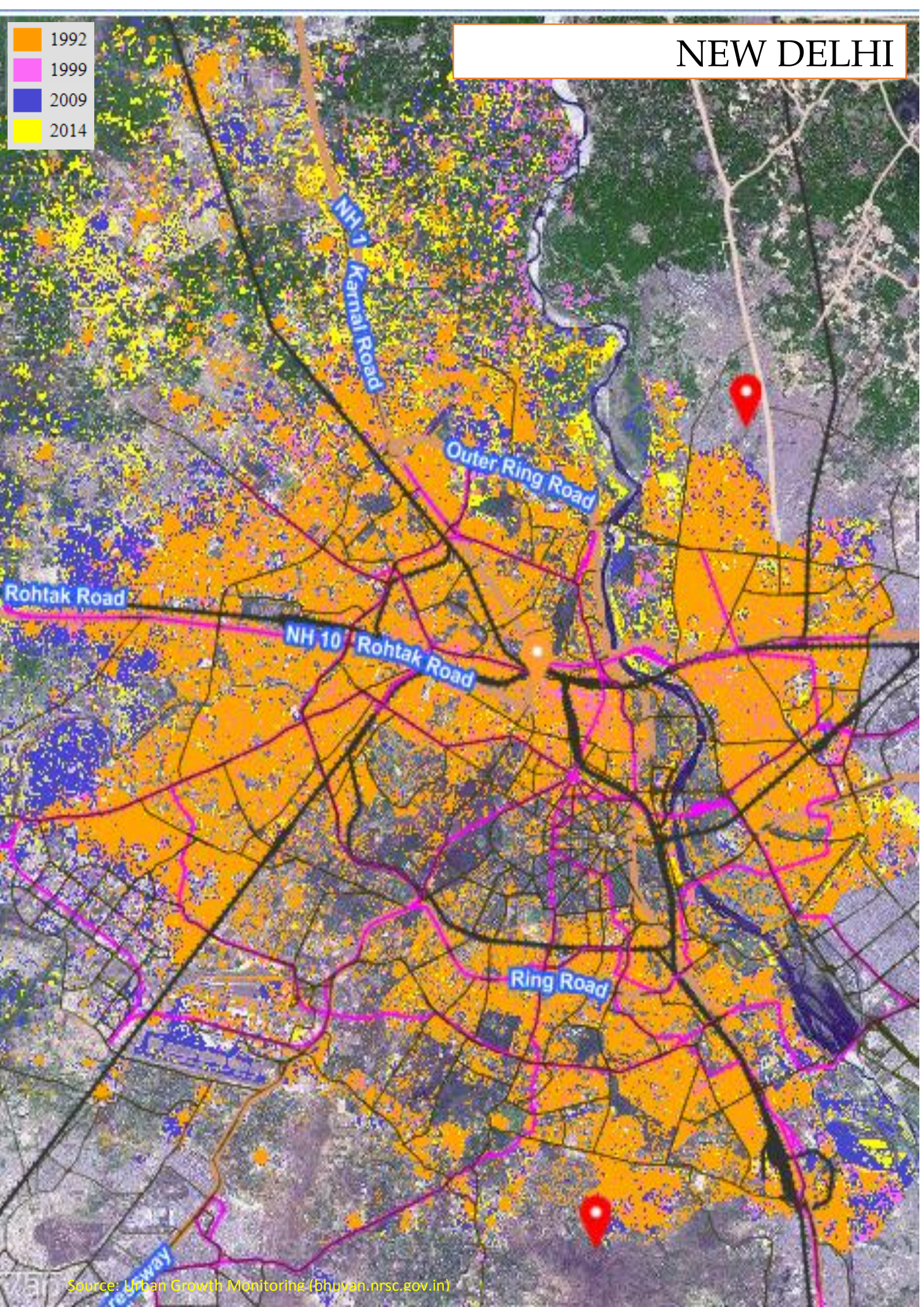
Easow, J (2016), Kerala Town and Country Planning Act : A Democratic Spatial Planning Law for States in India, Spatio Economic Development Record

Economic Review, 2016, Kerala State Planning Board

The Third Industrial Revolution Strategy Study (2016), TIR Consulting Group, Grand Duchy of Luxemburg

Census (2011), Census of India, Ministry of Home Affairs

M. Narayanan (2006), Calicut: The City of Truth Revisited. University of Calicut


1992
1999
2009
2014
NEW DELHI
NH 1
Karnal Road
Outer Ring Road
Rohtak Road
NH 10
Rohtak Road
Ring Road
Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)

NEW DELHI

INDIA

Ashok Kumar

NATIONAL CAPITAL REGION

Introduction

Regional planning is not new to the National Capital Region of India. Even if we take stock of regional planning attempts made after independence, a number of regional planning studies were carried out by the Town and Country Planning Organization, Government of India. These include Growth Pattern of Public Sector Offices in the NCR (1969); Cropping Pattern for the National Capital Region (1973); NCR Plan Implementation: A Programme for Action (1977); Industrial Profile of Rajasthan Sub-Region of NCR (1985); Industrial Profile of Uttar Pradesh Sub-Region of NCR (1985); and Industrial Profile of Haryana Sub-Region of NCR of 1986 (TCPO, 2001: 12-49). Above inventory of research reports shows that before formal commencement of regional planning in the National Capital Region under an Act of Indian Parliament, not only there was awareness and dialogue about regional planning among planners, number significant studies were carried out by the TCPO on behalf of Government of India. As Tridib Banerjee also underscores: "Although talks about preparing a plan for the National Capital Region began as early as the late fifties, serious efforts were under way only in the late sixties, when the Town and Country Planning Organization of the Ministry of Works, Housing and Urban Development began its preliminary research and studies" (Banerjee, 1996: 223).

Although, it took nearly 40 years after independence to set up the Planning Board under the National Capital Region Planning Board Act, 1985, the first draft regional plan for the NCR was published in 1971. The Planning Board was made responsible "for the preparation of a plan for the development of the National Capital Region and for coordinating and monitoring the implementation of such plan and for evolving harmonized policies for the control of land-uses and development of infrastructure in the National Capital Region so as to avoid any haphazard development of that region (Government of India 1985: 3). The NCRPB prepared and enforced the National Capital Region Plan, 2001 in January 1989. The National Capital Region Plan, 2021 was notified on 17 September 2005. The NCRPB took nearly four year to prepare each of the two regional plans, which is not a long time to prepare and get approved plan for a large and complex region. Since the current regional plan of the NCR will come to an end in 2021, preparations are being made to prepare and enforce the third regional plan for the NCR.

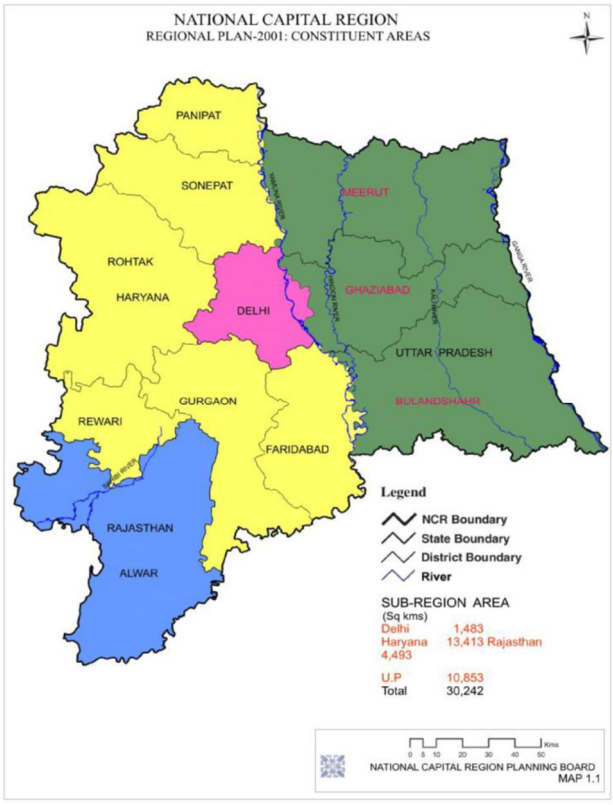


Figure 1: National Capital Region of India
Source: National Capital region Planning Board (2005:5)

This brief overview about the NCR of India focuses on three elements of the smart regional planning and development. These are smart regional economy, smart regional accessibility, and smart regional settlement pattern, which is also largely in line with the objectives of the Regional Plan 2021 (see NCRPB, 2005: 18). But before I do this, a brief discussion about the planning history of the NCR is imperative. The rapid urbanization and growth of the National Capital of Delhi was a cause of concern for the State and Central Government. During the formulation of the first master plan of Delhi, in 1959, the need of a regional plan was recognized to regulate the growth of Delhi in a planned manner. The first Master Plan for Delhi in 1962 made a recommendation for the formation of a National Capital Regional Planning Board to strategize the growth of Delhi and the National Capital Region.

The National Capital Region Planning Board was formed under the National Capital Region Planning Board Act, 1985. The metropolitan region is the largest metropolitan region in India and the third largest metropolitan region in the world covering approximately 33,600 sq km.

The constituents of National Capital Region are the National Capital Territory of Delhi spanning over 1,483 sq km; Haryana Sub-region comprising of Faridabad, Gurgaon, Rohtak, and Sonepat districts in addition to Rewari, Bawal, and Panipat tehsils covering an area of 13,413 sq km; Rajasthan Sub-region constituting of Alwar, Ramgarh, Behror, Mandawar, Kishangarh and Tijara tehsils with a total area of 4,493 sq km; and Uttar Pradesh Sub-region constituting Meerut, Ghaziabad and Bulandshahr districts with an area of 10,853 sq km.

The National Capital Region is also the largest populated metropolitan region in the world with a population of approximately 46.07 million (Census of India; for comparison see Demographia, 2017: 18; also see Fig. 1). Present total area of the NCR is 45,888 sq km after the Ministry of Urban Development vide gazette notification of 1 October 2013 included Bhiwani and Mahendragarh districts of Haryana state, and Bharatpur district of Rajasthan state in the NCR.

Planning process of the National Capital Regional Plan involves public participation, publishing the approved draft regional plan to invite comments, objections and suggestions from the public, individuals, central

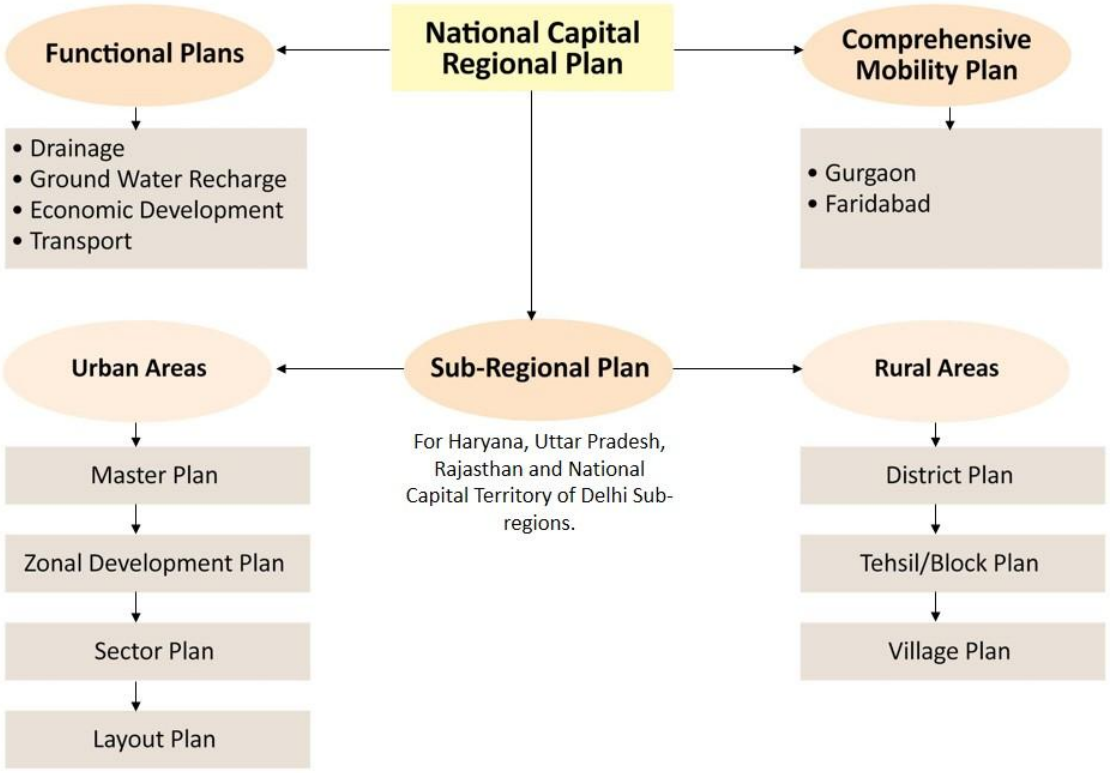


Figure 2: hierarchy of Plans in the NCR of India

government, state governments, local bodies and agencies. This process of public participation is mandated under section 10 of the National Capital Region Planning Board Act, 1985. The hierarchy of plans for National Capital Region is given in Fig. 2).

Two regional plans have been formulated till date for the National Capital Region with perspective years of 2001 and 2011. Regional plan for the National Capital Region is followed by Sub-regional Plans for the sub-regions of Uttar Pradesh, Haryana, Rajasthan and Delhi. However, from the start sub-regional plan for Delhi was never prepared, arguing that the area of Master Plan for Delhi and proposed Sub-regional Plan for Delhi is coterminous. This argument is flawed because even if area is coterminous, a sub-regional plan would throw up different planning issues than the Master Plan for Delhi. To implement the regional and sub-regional plans and elaborate a particular element of the regional plan, functional plans are prepared for drainage in the region, ground water recharge, economic development of the region as whole and seamless transport connectivity. Finally, for the urban areas of Faridabad and Gurgaon, comprehensive mobility plans have been also prepared to ease traffic problems in both these areas.

Apart from the regional plan and sub-regional plans, the urban areas in the metropolitan region formulate their own master plans (example Master Plan of Delhi, 2021). Rural areas in the region make their own plans at three levels including district plans, block plans, and village plans, mandated under local government acts of the relevant states since 1992 when 73rd and 74th constitutional amendments were made.

Smart regional Settlement Pattern

A region where all rural and urban settlements are planned and developed on the basis of the principle of 'balanced growth' would be able to obtain smart regional settlement pattern. In such regions, all settlements would be allowed to develop according to their different potentials in terms of natural and human resources. Regional planning will not make deliberate attempts to seek to equally develop all parts of a region. Regional inequalities, particularly, economic inequalities, would be thwarted as far as potential of an area could manage; no deliberate economic transformation is emphasised. Certain parts of a region will grow faster than others; equality being addressed through free movement of people and goods, and also through welfare policies of government. However, deliberate attempts (read planning) will be made to create decent access to housing and basic services to all people of a region.

Regional Plan 2021 proposes six-tier hierarchy of settlements including Metro Centre (population 10 lakhs and above), Regional Centre (3-10 lakh), Sub-regional Centre (0.5 to 3 lakh), Service Centre (10,000-50,000), Central Village (5,000-10,000), and Basic Village (below 5,000). A robust system of mass public transport is proposed to be developed to make these settlements accessible for movement of people and goods (NCRPB, 2005: 29). This excludes Central National Capital Region or CNCR. Regional Plan 2021 continues to maintain the primacy of Delhi, which is further reinforced by the development of proposed seven Metro Centres with combined population of 127.69 lakhs excluding the population of Delhi. Metro Centres are expected to "act as powerful growth nodes to attract capital functions and activities and help in population dispersal from the national Capital. Because of their special functional status and size, a very high level of physical, social and economic infrastructure better than that in the Capital is required to be developed within these towns/complexes. This would include efficient intra-urban mass transportation system as well as strong transport and communication linkages with Delhi, other Metro Centres and NCR towns" (NCRPB, 2005: 30; also see Table 2).

Proposed settlement pattern partially continues to perpetuate the existing settlement pattern dictated by the existing road and rail networks. Accessibility continues to play crucial role in developing regional settlement pattern for 2021. However, with proposals like RRTS, circular

movement of people and goods is expected to increase manifold in future.

Table 2: Proposed Metro Centres, 2021

S. No.	City/Complex	Proposed Population (in Lakhs)	
		2011	2021
1	2	3	4
1.	Faridabad-Ballabgarh	16.00	25.00
2.	Gurgaon-Manesar	4.50	16.50
3.	Ghaziabad-Loni	19.00	30.19
4.	NOIDA	6.00	12.00
5.	Sonepat-Kundli	3.50	10.00
6.	Greater NOIDA	7.00	12.00
7.	Meerut	15.00	22.00
	Total	**71.00**	**127.69**

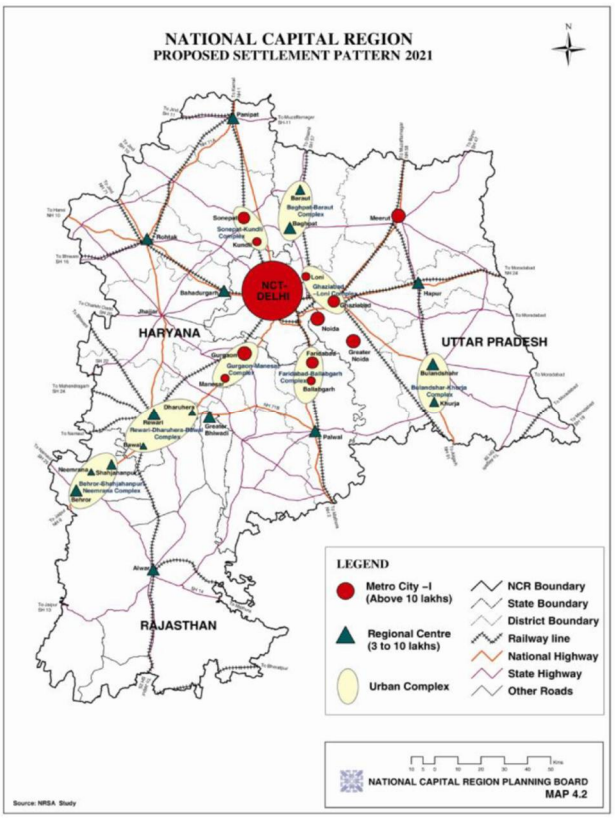


Figure 3: Proposed Settlement pattern, 2021
Source: NCRPB (2005:33)

Smart Regional Economy

Smart regional economy refers to sustainable economic growth that simultaneously protects physical environment and enhances general quality of life. National Capital Region of India is a buoyant region, its economy being one of the fastest growing regional economies. Economic growth is sustained over the last two and half decades, fulfilling the first condition of smart regional economy. But it is evident that the NCR planning policies and the kind of development it gives rise to lag much behind on protection of physical environment. A degraded environment such as Delhi Ridge in the southern parts of Delhi is just one notable example. Rampant mining activity continues unabated in spite of regular interventions by various courts.

Economy of the National Capital Region is surging ahead in the wake of sustained growth of the service sector and the real estate sector. Measured in terms of per capita income, the NCR stands among the top five regions of India. Over 71 percent of the total workers would be engaged in trade, commerce and services by 2021. This is an increase from nearly 64 percent in 1991. Overall participation rate has been consistently increasing and is expected to touch 40 percent by 2021 (NCRPB, 2005: 40).

Environment of the region however remains a major concern. The ridge, wetlands and sanctuaries need to be protected, particularly from the process of unplanned and unauthorized urbanization. Another important aspect is that productive agriculture land should also be protected from industrialization and urbanization. Government is steadfast in dealing with these issues as it has already published regulations for setting up SEZ in areas, which are not agriculturally productive. The Regional Plan 2021 intends to enforce Environment Protection Act, 1986.

Smart Regional Accessibility

Smart regional accessibility is crucial to the realization of regional planning and development. Without smart regional accessibility - fast, safe and affordable regional commuting, and economically viable movement of freight - regional planning and development would remain a pipedream. Movement for work, leisure, trade, education and other purposes remains at the heart of regional development. Moreover, accessibility is pivotal to real estate development. National Capital Region Planning Board clearly recognised regional accessibility as central to the development of the NCR, and proposed

Regional Rapid Transit System (RRTS) in the National Capital Region Plan 2021 notified on 17 September 2005. Functional Plan on Transport for National Capital Region, 2032 was prepared by a private consulting firm under the close supervision of the NCRPB in order to detail out for implementation the transport policies entailed in the National Capital Region Plan, 2021. The Functional Plan for Transportation in NCR, 2032 was approved by the NCRPB on 11 November 2009. Even before the proposed RRTS is implemented, other major transport projects that would considerably enhance accessibility are at various stages of implementation. Notable among them include (NCRPB, 2009: 84-88; also see Fig. 4):

- Upgradation of national highway within NCR
- Peripheral Expressways around Delhi
- Upgradation of roads through NCR financed projects
- Delhi-Meerut Expressway
- New rail links on Rewari-Jhajjar-Rohtak, Sonepat-Gohana-Jind, Tuglakabad-Palwal Fourth Line and Sahibabad-Anand Vihar third and fourth line
- Extension of Delhi Metro to NCR Towns
- Dedicated Freight Corridors (DFCs)
  - Western DFC: Mumbai-Delhi (Dadri)–1,515 km
  - Eastern DFC: Ludhiana–Dadri–Son Nagar–1,278 km
- Delhi – Mumbai Industrial Corridor
- Yamuna (Taj) Expressway
- Ganga Expressway

Nonetheless, the Functional Plan for Transportation in NCR, 2032 makes some radical transport planning proposals. Extensive network of 1,107 km long regional expressways has been proposed connecting major urban nodes in the region with lane length of 9,398 km. to be developed through public private partnership mode, the regional expressways would be developed with the right of way of 100 m and design speed of 120 kilometres (NCRPB, 2009: 93-94). Following are expressway links:

- Delhi – Sonipat – Panipat
- Delhi – Bahadurgarh – Sampla - Rohtak
- Delhi – Gurgaon – Manesar – Rewari
- Gurgaon - Faridabad
- Delhi – Faridabad – Ballabgarh – Palwal
- Delhi – Ghaziabad – Hapur
- Dadri – Ghaziabad – Meerut
- Loni – Baghpat (with potential to extend to Baraut and beyond)
- Sonipat – Baghpat – Meerut
- The entire outer grid from Panipat – Gohana – Rohtak – Jhajjar – Rewari – Palwal – Jewar – Bulandshahr – Hapur – Meerut

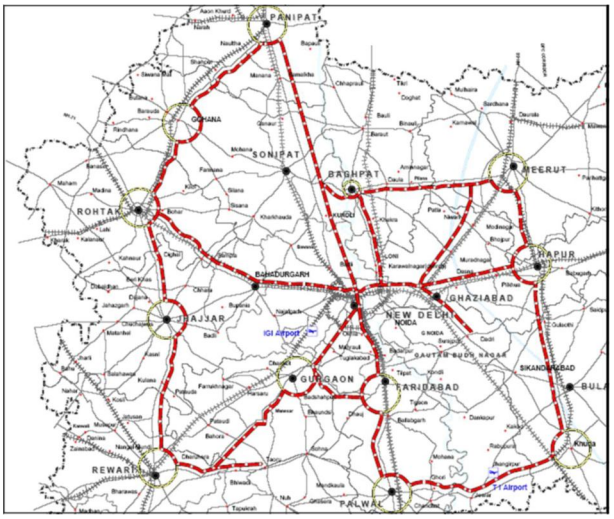


Figure 4: Network of Regional Expressways in the NCR

Marked as high speed, high capacity, safe and affordable mode of public transport, the Regional Rapid Transit System is expected to connect major regional nodes in the region with Delhi and with Sub-regional Centres; orbital rail and Mass Rapid Transit System (MRTS) for Delhi and CNCR towns. RRTS is proposed to run at an average speed three times that of the Delhi Metro with higher acceleration and deceleration. Average speed of Delhi Metro ranges from 30 to 40 km per hour. In order to cover the NCR, the RRTS stations would be placed at an average distance of 5 to 10 km. Website of the National Capital Region Transport Corporation (NCRTC) shows that it is a Joint Sector company of Government of India and States of Delhi, Haryana, Rajasthan and U.P. and is mandated for implementing the Regional Rapid Transport System (RRTS)

project across the National Capital Region, ensuring a balanced and sustainable urban development through better connectivity and access (also see Fig. 5).

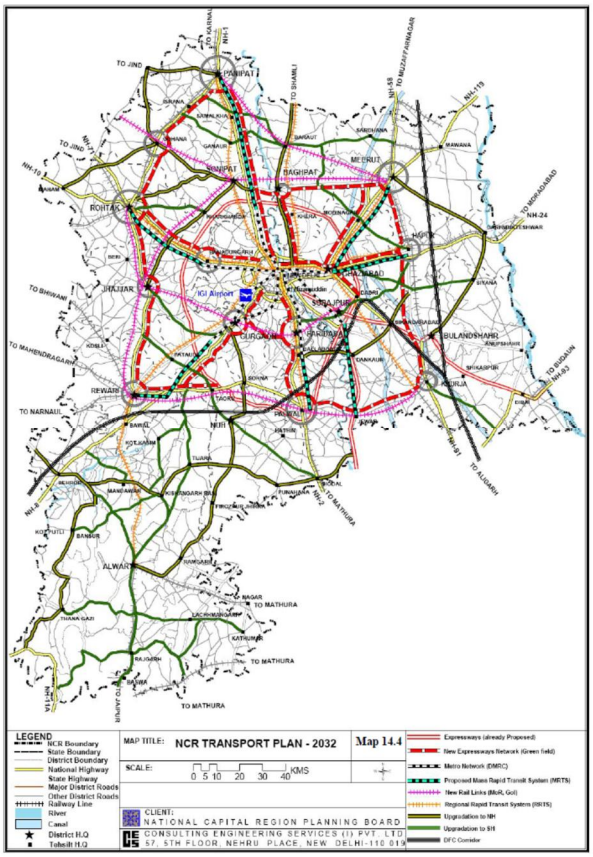


Figure 5: NCR Transport Plan, 2032

Conclusion

This contribution advances the smart region approach, which seeks to address environmental and social justice simultaneously. While economic growth is necessary for providing jobs and creating wealth for everyone living in the NCR of India, it is equally crucial to protect the environment for current and future generations. A preliminary sketch is presented here by constructing three dimensions of a smart region – smart regional economy, smart regional accessibility, and a smart regional settlement pattern. Smart regional settlement pattern could not be planned and developed without smart regional economy, and smart regional accessibility. Major objectives of the Regional Plan 2021 appear to remain same as that of the Draft Regional Plan of 1971 – contain population growth of the central core of the region, and direct population and economic growth to the secondary cities of the region.

References

Banerjee, T. (1996) Role of Indicators in Monitoring Growing Urban Regions- The Case of Planning in India's National Capital Region, *Journal of the American Planning Association*, Vol. 62, No. 2, pp. 222-235.

Census of India (2011) *Population of India*, Registrar General of India, New Delhi.

Demographia (2017) *Demographia World Urban Areas,* Retrieved November 5 August 2017. demographia.com / db-worldua-index.htm

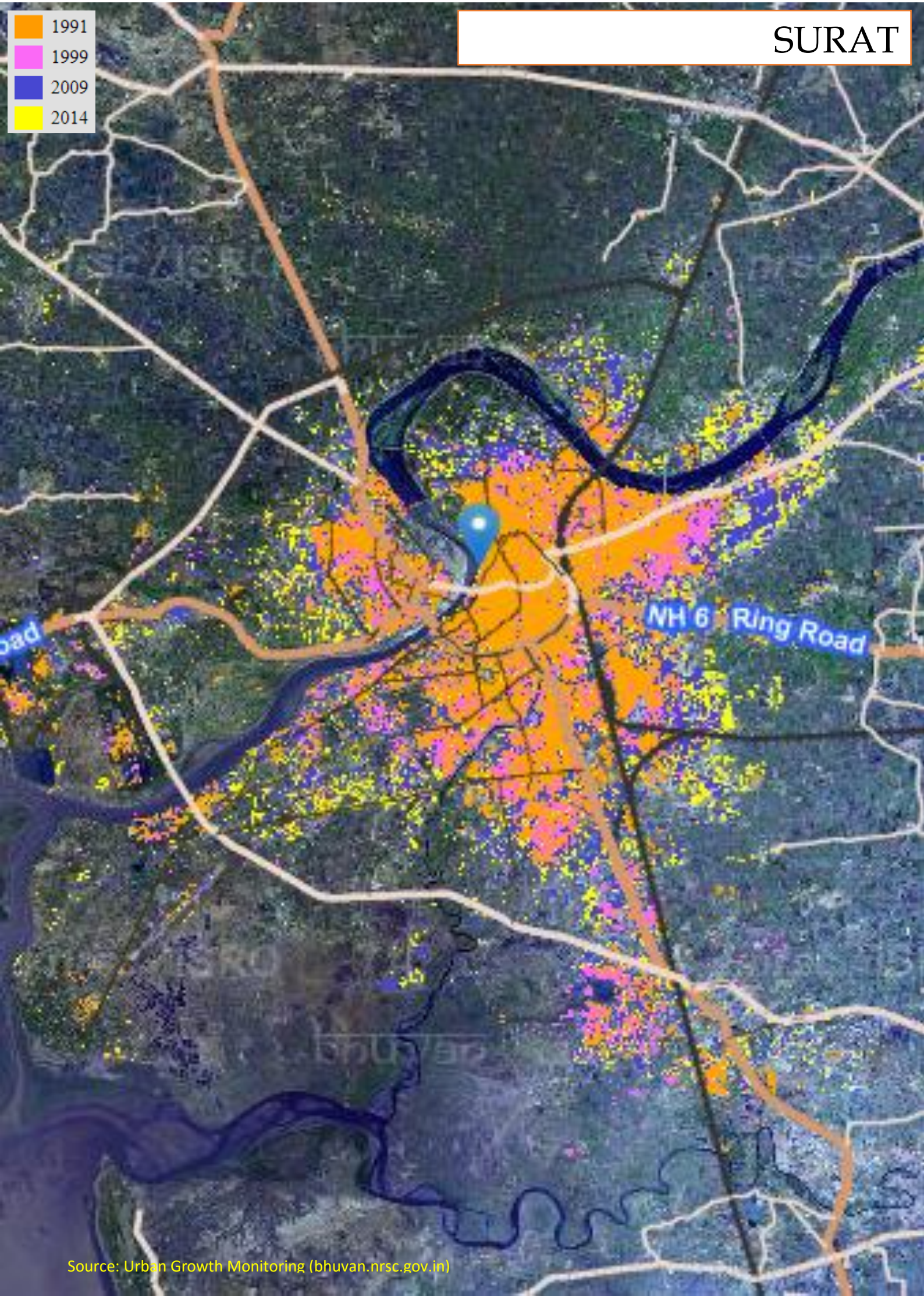
Government of India (1985) *The National Capital Region Planning Board Act, 1985*, Ministry of Urban Development, Government of India, New Delhi.

NCRPB (2005) *Regional Plan-2021, National Capital Region*, NCRPB, Ministry of Urban Development, Government of India, New Delhi.

NCRPB (2009) *Functional Plan on Transport for National Capital Region-2032*, NCRPB, Ministry of Urban Development, Government of India, New Delhi.

TCPO (2001) *Retrospect and Prospect*, TCPO, Ministry of Urban Development, Government of India, New Delhi.

SURAT



Source: Urban Growth Monitoring (bhuvan.nrsc.gov.in)

SURAT

GUJARAT, INDIA

Krupesh A. Chauhan –Leena Garg- Bhasker Vijaykumar Bhatt

SMART SURAT METROPOLITAN REGION

Introduction

The history of Surat dates to 300 BC as per available and documented records [1] however, it has its roots of origin beyond the era. It settled as a hamlet by then and today it is housing more than 5.5 million citizens [2] in its urban area. Originally, it emerged as a settlement on the meandering bank of Tapi river flowing towards the West into the Arabian Sea in the Southern part of Gujarat State. Over a period, the alluvial soils spread by frequent floods in Tapi river made the region fertile for agricultural activities and promoted for larger settlement. However, the history marks the city as a Port town since the Mughal empire and it is claimed that the port had offices of about 74 countries (Surat Municipal Corporation, 2012). Since then, the trading activities predominated and attracted migration of people from different parts of India. Since past half-century, the port activities were diminished and trading as well as industrial sectors picked up as economic activity choice by the citizens. Today, the textile industries, diamond cutting-polishing, jewelry manufacturing and real estate sectors are predominating with ancillary service providers. The lands have emerged a unique identity by typical and unique culture of 'Suratis' (the Citizens of Surat), well known for a variety of delicacies, their friendly and welcoming behavior showing acceptance to all who wish to contribute in the wealth of all. Surat is ranked Fourth among the fastest growing global cities [4]. The city has emerged as economic capital of the Gujarat State however, by spatial extent and population, it is ranking second in the State following Ahmedabad.

As per the records of Census of India, 2011, the Urban population of Surat city was earmarked as 4.4 million with an administrative area of the ULB (Surat Municipality, established in 1852 AD and working as a Corporation in 1966 AD) as 326 Sq. Km. However, the urban region of Surat, the study area as metropolitan region, has an extent of about 721 Sq. Km. housing a population of about 5.5 million [5]. We shall be analyzing the area delineated administratively by the Government of Gujarat as Surat Urban Development Authority (SUDA) and surrounding spaces thereof that has inward impact. The region is located equidistant to Mumbai and Ahmedabad.

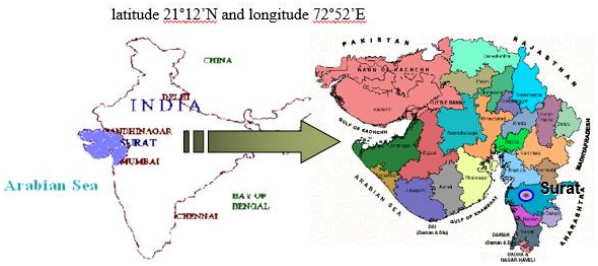


Fig 1: Location of Surat

Administrative decentralization of Surat city is split in eight zones (Central, North, South, East, West, South-East, South-West and New North Zone) [6]. In addition to these zones, our study area of metropolitan region covers the inner and outer fringes of the city forming a larger entity. Surat Metropolitan Region is becoming a major commercial hub of South Gujarat. Surat city is home to the highest percentage of migrant population in India, and thus a vibrant melting pot of varied cultures. As per UNESCO's report

Banks of River Tapi. Source: Surat Municipal Corporation.

on ‘Social Inclusion of Illegal Migrants in India’ around 60% population of this city has its background in different states of India. Besides the region has been bestowed with rich natural resource of a major perennial river Tapi, that drains off in the Arabian sea, a long coastline having biodiversity of flora fauna both marine, as well as terrestrial. The dang forests of this region are home to variety of tree species, chiefly the species of Bamboo. This region is also home to various tribes having indigenous cultural traditions that add richness to local arts and crafts giving the region a unique identity of its own. Since past three decades, the pace of development in terms of diverse establishments and residential settlements is booming, at the same time certain industries are suffering due to lack of visionary and creative approach. A timely intervention with proactive and creative measures can save entire region from the decay that is observed in various spheres. The concerns must focus on smarter regional development that promotes the vibrancy of varied social cultures, a healthy sustainable economy and most importantly preserving environmental resources at large leading to long term sustainability of all the human settlements big and small within the region.

Our stydy is aiming to address the development of intervention and scope for proactive planning measures by identifying existing geospatial conditions of various settlements of this region, along with the industrial and commercial activity, and propose strategies for smart development that integrates the smart city initiatives with the regional development.

At present, growth of local establishment is observed, that needs to be integrated with the overall vision for smart development. As the country is poised to take advantage of revolutionary economic policies of present government, the region also awaits a total transformation in the way businesses are carried out, bringing more equity, more transparency and holistic development aided with smart technologies.

The current study is aiming at addressing not limited to but the following major points of concern:

1. To explore the development potential of sub-regions within the Surat metro region on smart and sustainable paradigms;
2. Identification of growth extent and latent expansion possibilities as a multi-nuclei entity;
3. Identification of development goals and activities in accordance ‘smart development’ notion; and;
4. Forecast based guidance for the anticipated impacts of development in the entire of the metropolitan region.

Surat region in time and space

The common story stretching the origin of the name of Suryapur refers to the time in 1500-1520 A.D. when Surat was already a city of great trade. This seems to be possible that modern city of Surat was built on the site of old Hindu town of Suryapur. In the course of time significant Muslim domination changed its Hindu name “Suryapur” to “Suryt” and ultimately reached “Surat” [7]. Surat became the most important trade link between India and many other countries and was at the height of prosperity till the rise of Bombay port in the 17th and 18th centuries. Surat was also a flourishing centre for ship building activities. After the rise of the port at Bombay, Surat faced a severe blow and its ship building industry also declined. During the post-independence period, Surat has experienced considerable growth in industrial activities (especially textiles) along with trading activities. Concentration of these activities combined with residential developments has resulted in considerable expansion of the city limits [5].

Originally established on the banks of river Tapi with a fort on eastern bank and a Custom house on the northern side of the port the city growth in the initial years was concentrated in the inner walled city area only. The wall was constructed in 1664 A.D. and the area within the walled city measured 440 acres. The entrances to the walled

city were through 12 gates. The outer wall was constructed in 1707 enclosing an area of 1818 acres. The economic and infrastructural development since the 60's, seen in the city and the region, have resulted in a spurt in urban population in the city.

The evolution of the power loom and hand-loom sectors and diamond cutting and polishing industries in 1950's changed the city outlook. Parallel to the industrial expansion, Surat emerged as a major center for trade and commerce in the region and a silent evolution has been that of the informal sector. The turnaround of the city of Surat happened after the plague in 1994. Within two years, Surat had been transformed from the one of the filthiest cities to the second cleanest city in the country. In the center of all this transformation process is the Surat Municipal Corporation (SMC). A systematic process to upgrade infrastructure, both quantitatively and qualitatively, has been made by the local government. Surat continues to present a 6% plus annual population growth since 60's, placing Surat 8th in terms of population size countrywide (2011) with population of about 4.46 million within local governing limits of 326.5 Sq. Km. and district population of around 6.08 million (2011 census), a change of about 42.24% over the district population of 2001. Notable is also the fact that out of this about 80% population lives in urban area, and only 20% population resides in rural areas, which is far higher than the nation average of 32% (urban population) and 68% (rural population). While the city has successfully filled the large infrastructural gap accumulated over the decades within a short span of a decade, consistently high rate of growth in population has posed new demands. From time to time jurisdictional limits of SMC (Surat Municipal Corporation) the local governing body have also been extended to include the outgrowth.

Economic profiling through major industries

Entire region is by now having established and upcomig a variety of industrial units. Most of male workers are engaged in these economic activities and the extent of these establishments is spreading in all directions. The region has

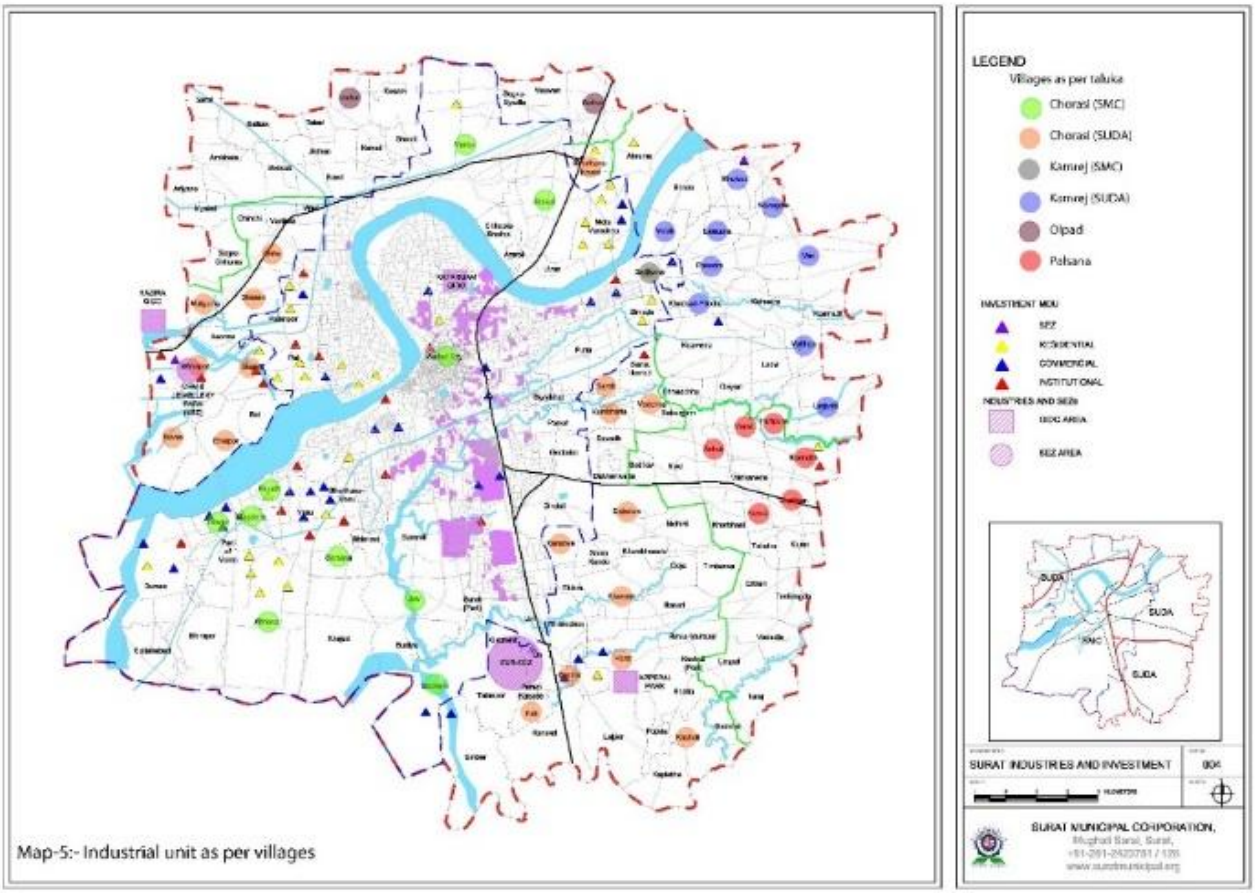


Fig 2: Industrial Units Source: Derived from SMC map and information made available by DIC-Surat and GIDC, 2016

about four SEZ in operation, many industrial estates and special industrial area earmarked for heavy industries – Hazira on the West. Map below show the spatial extent of spread of these activities.

Textile Industry

The evolution of the power loom and handloom sectors led to gradual growth of textile industries in Surat City. Today Surat is known for its textile manufacturing especially synthetic Sarees (almost 70% of Nation's synthetic Sarees are manufactured in Surat), and intricate zari works (fine brocade work). These textiles based units are located mostly in the Central Zone and adjoining Northern, Eastern, and South-Eastern Zones of the city.

Diamond Industry

Another important addition since the 1950's is the diamond cutting and polishing industry. In the last few decades, especially during the eighties large-scale industries have come up in Surat and its peripheries, especially in the Eastern Zone of Surat City which saw tremendous increase in population owing to diamond-cutting and Polishing Industry increase (Decadal growth of 670% for 1991-2001) in the Fringe areas of this Zone. Today Surat city accounts for 75% of nation's total rough diamonds cutting and polishing. This increased the importance of Surat in the regional context. The southern part of the city houses the industrial complexes of Gujarat Industrial Development Corporation at Sachin and Diamond Nagar.

Heavy Industries

The West and South-West part of the city is characterised by historic Magdalla Port and location of chemical industries and the gas based industries at Hazira established by leading nationally significant industry houses such as ONGC, Reliance, ESSAR, Shell, KRIBHCO and GAIL.

Small Scale Industries

The industrial base is labour intensive. Of the total 2,78,656 small scale units registered (2003) in the state, Ahmedabad and Surat districts leads the list with high number of small scale industrial units at 61,185 and 41,509 units respectively constituting 21.96% and 14.9% of total SSI units in the State. The share of Surat has increased from 12.6% in 1980 to 15.1% in 2005. In terms of factory sector also the share of Surat is significant. In 2001, Surat district accounted for 1900 units employing about a lakh and thirty- five thousand workers. [8]

Approach to smart development strategies

Recently, the city is selected under 'smart cities Mission' for 'smart development' by the Central Government of India, Ministry of Housing and Urban Affairs. It has opened a path for futuristic and visionary development which can cater for inclusive as well as sustainable development.

Present work is an extension of the goals that have been identified for smart city development, at a larger context of entire region to which this city caters. The smart city goals can only be met, when a clear understanding of the regional activities is developed which has a bearing upon the city growth with its regional network. Following are the geospatial expanse and the brief regarding the hierarchy of various settlements of this region that demonstrate for SMC and SUDA region.

For the administrative zoning purpose, the city is already divided into zones based on cardinal directions. The same zoning convention will need to be extended for the regional studies as well. For the study purpose, the Surat metropolitan region will be broadly divided into four quadrants, and the corresponding quadrant will be studied in detail regarding the opportunities offered versus the limitations.

Surat, being a coastal city offers very distinctive features along its fringes. The northern and north-eastern fringe is the one with maximum potential for further expansion and growth as it connects the city with other cities through national highway road infrastructure. Mumbai-Ahmedabad highway connects the city with these two giants of the eastern India along this quadrant. No wonder that, most of the outgrowth is happening along this quadrant and eastern side of the city. The south of the city is again having extension possibility; however,

Table 1: Population growth in Surat (1981 to 2011)

Year	SMC area			SUDA area (Except SMC)			SUDA area		
	Population	Density per sq.km	Growth Rate	Population	Density per sq.km	Growth Rate	Population	Density per sq.km	Growth Rate
1981	9,99,373	3,066	--	1,20,993	306	--	11,20,366	1,552	
1991	16,24,135	4,982	62.52%	1,55,501	393	28.52%	17,79,636	2,465	58.84%
2001	28,68,603	8,799	76.62%	2,36,521	597	52.10%	31,05,124	4,301	74.48%
2011	44,73,143	13,721	55.93%	3,31,739	838	40.26%	48,04,882	6,655	54.74%

Source: SUDA, derived from Census of India, 2011 and earlier

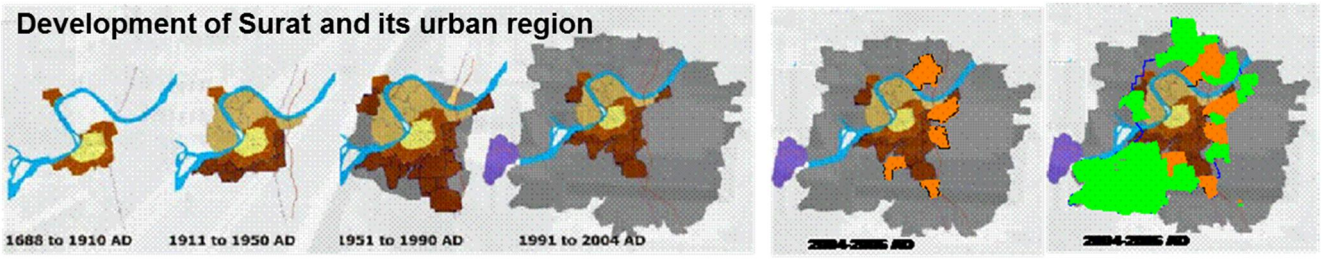


Fig 3: Development of Surat and its urban region. (Derived from various images of Surat Municipal Corporation)

this zone has become saturated with small scale industrial growth and substandard housing catering to such industries. A creek carrying most of the industrial waste water flows in this quadrant, which needs cleaning and rejuvenation efforts. The south-western quadrant and the north-western quadrant have adjoining Arabian sea; thus, these directions have their limitation so far, the city expansion is concerned, however this area has great potential to be developed as eco- sensitive zones partly serving recreational purposes. Also, the western side of the city houses all mega industries of national importance, as well as the regional air terminal, thus in future these two quadrants having western fringe boundary can be developed for low-rise low-density development. Also, the proposals for coastal highway, Mumbai-Vadodara Expressway, Damanganga-Narmada Interlinking Canal, Dedicated freight corridor, Delhi-Mumbai Industrial Corridor, Kalpsar project, declaration of development authorities in surrounding and such mega initiatives will have their unique impacts over the region.

We will attempt to analyze in the context of degrees of successes, failures and opportunities in the Surat metropolitan region considering restructuring the theme of smart city systems.

We will also explore various policies affecting smarter region development intersecting smart city development strategies based on the relevance. Spatial understanding and effects thereof with potential smarter options will be explored for the aspects discussed earlier. Major focus will be around the legal, policy framework and physical planning interventions. We will be welcoming all sort of comments and suggestions from our reviewers and learned colleagues for improving our attempt for visualizing smarter and sustainable metropolitan region of Surat.

References

[1] Surat Municipal Corporation, "History of Surat," 2012. [Online]. Available: https://www.suratmunicipal.gov.in/content/city/history.shtml. [Accessed: 22-Feb-2017].

[2] SMC, "Housing information for various zones of Surat," Surat, 2014.

[3] Surat Municipal Corporation, "Surat Castle : Surat Municipal Corporation," 2012. [Online]. Available: https://www.suratmunicipal.gov.in/TheCity/SuratCastle#intro. [Accessed: 28-May-2017].

[4] Times of India; Himansshu Bhatt, "Surat fourth fastest growing city in world - Times of India," *Times of India*, 2011. [Online]. Available:

http://timesofindia.indiatimes.com/city/surat/Surat-fourth-fastest-growing-city-in-world/articleshow/9328885.cms. [Accessed: 23-Feb-2017].

[5] SUDA, "SUDA Revised Development Plan.Pdf," Surat, 2014.

[6] Surat Municipal Corporation, "Zones:Surat Municipal Corporation," 2016. [Online]. Available: https://www.suratmunicipal.gov.in/Zones/Functions. [Accessed: 23-Feb-2017].

[7] R. C. D. Plan, "Revised City Development Plan (2008-2013)," Surat, 2013.

[8] GIDC, "GIDC," *GIDC, Government of Gujarat*, 2016. [Online]. Available: http://117.239.80.70/gis/public.html. [Accessed: 02-Aug-2017].

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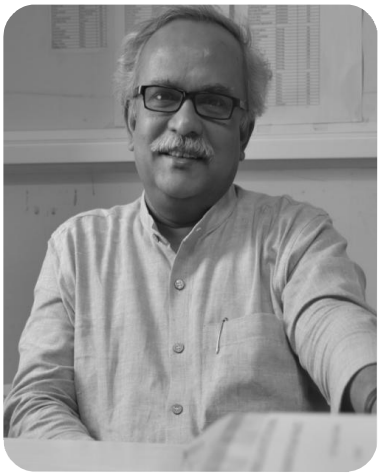

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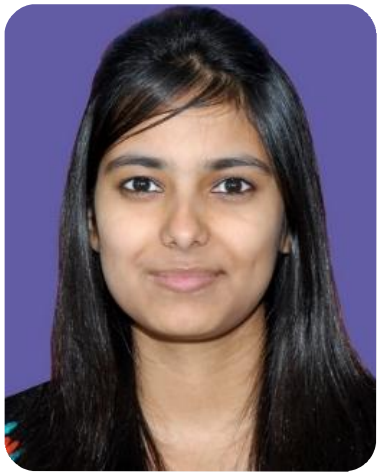

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