



**INTEGRATING SMART CITY CONCEPT IN PLANNING AND
MANAGEMENT OF A HERITAGE CITY FOR DISASTER RISK
MANAGEMENT: A CASE STUDY OF VARANASI, INDIA**

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ABSTRACT

The concept of smart city is now gaining momentum as a tool to improve the quality of life and living condition in urban areas. Varanasi located in Uttar Pradesh, India is all set to be developed as a smart city being the ambitious projects of the Ministry of Urban Development, Government of India. The city integrates a rich cultural heritage and past glorious history. However, the city has been suffering from a series of problems originating from unplanned and haphazard urbanization with inadequate infrastructure supports to the developing cities, polluted environment, inefficient waste disposal, and poor living conditions, which in turn the natural disaster events in absence of adequate safeguards may pose a serious threat to urban risk management under climate change scenario. Contrastingly, the city of ten thousand shrines, Kyoto successfully balanced age-old infrastructure, culture and heritage with all its modern amenities and technologies. There are ample opportunities to integrate the concept and practices of Kyoto to be inherited within Varanasi without compromising its heritage and legacy. Present study attempted to highlight several inherent problems associated with the aged old city Varanasi and what remedial measures can be taken as the prospective solutions for the sustainability of the smart city. We infer that socio-cultural cohesion and economic infrastructural supports are needed for long-term sustainability of the smart city by providing

robust transport and urban mobility; land use planning; environmental planning; governance and public participation in day-to-day life of citizens with proper augmentation of these factors with the geo-scientific findings of the area under settlement, which can work effectively for making the city urban-induced risk resilient.

Key words: Smart city; Urban-induced risk resilient; Land use, Infrastructure, Development, Environment Planning

1. Introduction

The trend of global population rise is dramatic. From 1950s, population growth has been tremendously increased with reduced rate of mortality associated with proper nutrition and increase in food security. However, most of this increased rate of growth has been witnessed in the cities where presently an about half of entire world's population reside. The proportion is the highest in mankind's history, and it is growing extremely fast as by 2030, approximately 60% of world's population will be city dwellers. Therefore, the way the city cope up with rapid infrastructural growth are of huge significance and is a matter of great concern to researchers, scientists and policy makers.

The concept of Smart City is simply based on to enhance the living quality of citizen possibly through intelligent urban development by means of Information and Communication Technologies (ICT) to achieve sustainable socio-economic growth. The concept arise mostly during 1990s when a series of socio-economical, organizational and institutional problems reduce the quality of cities life and therefore, asks for implementing more technology based approach for managing cities resources and infrastructure. Samuel Palmisano, Ex-CEO of IBM, first put the concept of smart city forward by emphasizing next generation information technology to be integrated in all forms of the life and supporting services which could be integrated through super computers and cloud computing¹. However, mere presence of sophisticated technologies does not automatically represent a city as smart while there implementation for betterment of quality life is essentially an important parameter to be considered. Smart city is also defined as - "The use of Smart Computing technologies to make the critical infrastructure components and services of a city-which include city administration, education, healthcare, public safety, real estate, transportation and utilities- more intelligent, interconnected, and efficient", exemplifying London, Stockholm, Amsterdam, Vienna,

Luxembourg, Turkey, Eindhoven, and Montpellier^{2,3}. However due to lack of consensus on the definition of smart cities the key features of a Smart City lies in establishing a balance between competitiveness, capital and sustainability^{4,5}.

MotherEarth is expected to double its population size by 2050 and most of this population is expected to increase in the existing cities^{6,7}. With such an increase city residents are expected to face challenges in the growth, performance, competitiveness, and livelihoods^{7,8}. Therefore, existing cities needs to transform into smart one to cope up with the emerging challenges. The renovation of cities into smart cities may face challenges in terms of availability of funds and will demand a cut in allocation for meeting the basic amenities such as providing the services of education, health and housing infrastructure etc. It needs investment from the government as well as the private one, which would have to play a bigger role to run such mega projects. The economic infrastructure to propel and maintain such investment from private partnership from the outside would require friendly and progressive relations.

As per Census 2011, India's urban population (377 million, 31% of total population) contributing more than 60% of India's GDP. Further, it is projected that the Indian cities will contribute nearly 75% of the national GDP over 2030¹⁰. It shows the importance of the cities as 'engines of economic growth' in future. Rural migration into cities, population explosion and the unplanned urbanization have stressed and forced the government to look for new plans to combat these challenges. The Ministry of Urban Development (MoUD) visualizes the smart city concept as to provide basic infrastructure facilities and decent quality of life to its people through comprehensive development of institutional, physical, social and economic infrastructures (**Fig. 1**). The MoUD has emphasized to replicate the smart city model conceptualized for 98 cities for the duration of five years and thereafter, the mission may be continued in light of evaluation by ministry itself. Smart cities are proposed to raise the quality of urban life by providing a clean and livable environment, along with 24x7 h power and water supply. Sanitation and solid waste management, efficient urban mobility and public transportation, affordable housing for poor and robust IT connectivity among others are essential features of the project. It is important to explore this in a more efficient manner so that a partnership with private sector may be developed for proper channelization, coordination and maximum utilization of existing resources.

Concept of smart city in India has got recognition after the announcement of India's Prime Minister Mr. Narendra Modi's dream project of 100 smart cities within a duration of five

financial years (FY2015-16 to FY2019-20)⁹. In first phase, with due consideration of household income, expenditure and variables related to standard of living initially 20 cities are selected. In September 2014, Prime Minister of India visited Japan and MoU was signed between the two countries to transform some Indian cities based on some Japanese city. Scheme named Heritage City Development & Augmentation Yojna (HRIDAY) will focus on development of twelve heritage cities namely; Ajmer, Amravati, Amritsar, Badami, Dwarka, Gaya, Kanchipuram, Mathura, Puri, Varanasi, Velankanni, and Warangal. Additional cities may be explored after consultations¹¹. These are highly ambitious projects take in tremendous investments for acquiring land, building infrastructure and erecting large scale settlements. From ancient period, Varanasi has been a center of attraction for its rich cultural heritage which in due course of time lost his charm mostly due to unsustainable planning and development. Present submission deals with the present scenario of Varanasi city, problems it would be facing while its transformation into smart city and the possible solutions that would be required to deal with the emerging challenges.

2. Varanasi: A Heritage City

Varanasi, or Kashi, Kasi, Benares and Banaras is one of the oldest living cities in the world. Varanasi, situated on bank of river Ganges is famous for its rich history, culture, archeological sites, educational institutes, music and rituals (Fig. 2). The legacy and sanctity of Benaras may well be visualized by Mark Twain, English author, as he explained “Benaras is older than history, older than tradition, older even than legend and looks twice as old as all of them put together”¹². With a population of 0.2 million (in 1931), the city is expected to reach a population of 2.5 million by 2021 while with considering current population growth may well exceed 3.1 million by 2031¹³. The overall population density is 14,605 persons/ km² while in older parts it ranges from 30,000-48,000 / km² (14). The entire city is divided into five administrative zones which were further divided into 90 electoral wards. Increasing population is continuously putting pressure on existing resources and services to manage and cater the increasing needs and sustaining these resources for future. The current modernization plan is set to transform Varanasi based on smart city model of Kyoto, Japan without jeopardizing its rich cultural essence. Selecting Kyoto model for selective transformation of Varanasi is entirely based on existing similarities between these two culturally famous cities with rich in tradition. Varanasi is one of the oldest continuously inhabited cities in the world while Kyoto was the capital of Japan for over 1,000 years. Both the cities hold a rich tradition of having numerous memorials for religious and

cultural activities. While Kyoto and Varanasi share many historical similarities, the present situation largely distinguishes both the cities by means of quality of life and economic, social and environmental sustainability. Kyoto is modernized and planned contemporarily while keeping its ancient history, temples and monuments alive, while Varanasi has languished in its past glory and observed to be unplanned and mismanagement of resources and services.

3.0. Incorporating concept of Kyoto based smart city: problems and prospective

The city of Varanasi is located in Indo-Gangetic alluvial plains which is one of well recognized global hotspot in terms of crop production and diversity which essentially boosts a massive population to live with it (**Fig. 1**). With increase in population due to massive migration from nearby rural and suburban areas because of reasons like employment, business or education put pressure on available basic urban amenities. In addition to that the emerging challenge of planning, managing and sustaining the limited resources for future including basic civic amenities have increased manifold. Increase in a gigantic number of registered vehicles (522,000 in 2009; Road Transport Yearbook-2011, Govt. of India) and small sized mass transportation has resulted in massive traffic congestion with increasing air and noise pollution within the city. Narrow roads, poor maintenance, crowded roads and shortages of parking facilities and encroachment have made the traffic situation further worse. Thus, public and social infrastructures like water crisis, electricity cut, traffic problems, illegal encroachment on land and water bodies, development of slums and poor housing and their illegal extensions, old sewage systems, lack of public amenities are the most prominent challenges. People living in low lying areas near Ganges may face higher risks from floods and lack the necessary capacity to recuperate from disaster-related events. The fall out of violation of the National Building Code (NBC) and lack of fire safety measures were evident during recent earthquakes in April and May 2015 in residential apartments and high-rise buildings. In view of these shortcomings, city essentially need a comprehensive planning to accomplish the Kyoto type smart city under following areas to be considered:

3.1. Heritage conservation and tourism management

Varanasi is blessed with a rich cultural heritage percolated from one generation to next that provides a rich prospect for economic development by encouraging the tourism industry. Further, the city has its own advantages of having multiple institutional collaboration, strength in

social capital and educational system. In a way of getting smarter it should not lose its glorious history. In September 2014, agreement on Sister City Cooperation was signed between India and Japan to make the city smart without compromising with its cultural heritage and continuum in which the tradition have been assimilating the changes and flowing with the passage of time. Popularizing and promotion of the heritage and historical sites of the city can help in increasing the tourism and restoring heritage which will help in elevating the socio-economic condition of the city.

3.2. Urban mobility and infrastructure planning

Infrastructure is the backbone of any city to make it operational. Institutional, physical, social and economic infrastructure makes the strength of any city¹⁵. Institutional infrastructure includes governance, planning and management of cities for its citizens. Infrastructures like amusement parks, sports ground and hotel, club, restaurants, and necessary facilities like school, colleges and hospitals are fundamentals to strengthen city's social infrastructure. To create the employment opportunities and upgrade the economic condition of its citizen, the city must attract investors and promote the local small-scale industries. That must include financial banks, IT parks and industrial parks, trade center and tourist destination. In the city of Varanasi, most of the land is not accessible through paved road while mere 20 - 30% of its land has defined road network. Further, during natural flood, most of the road network remain inaccessible which readily decrease the urban mobility. Further, minimum traffic awareness among people, decade old car, non-registered public transport system, non-functional traffic signal additionally burden the entire urban mobility of the city.

3.3. Land use planning and built environment

Land use planning of any city identifies the preferred areas that will support local development goals by zoning of land for specific uses; it is a holistic approach that includes designing and shaping cities, towns and villages with the goal of making functional, attractive and sustainable urban areas. Land availability for development, guidelines for private land holdings, open space development along historic sites and river banks, cultural and religious activities, footpath or pedestrian street, large green spaces, Industrial belt, trade centre, IT parks, educational institute are some of the areas that require proper land allocation on upmost priority. The entire city consist of buildings mostly of permanent structure without having adherence of specific building code and therefore, are subject to degrade in case of natural hazards like

earthquake or flood. Further, some local habitations have been promoted to be build up in close proximity to waste disposal sites, river basin or drainage site, which ultimately induce specific health hazards to local population.

3.4. Economic development

Economic development is the sustained, concerted actions of policy makers and communities that promote the standard of living and economic health of an area by providing employment opportunities and assuring social wellbeing of people. It is a proven fact that once the development of the city would be as per the guidelines then it retards the disaster risk vulnerability of the area, whilst the haphazard and development plan induces the disaster risk vulnerability of the area to be developed as the command area of the smart city. The economic dimension of peoples of Varanasi is predominately low to moderate mainly in terms of income, potential of expenditure, employment and assets. Considerable proportion of inhabitants exists within poverty line with their existence mostly depend on daily wages. Further, individual household is mostly dependent on single source of income which additionally increases their vulnerabilities. The areas that can be taken under consideration may include - promotion of famous *Banarasee- saree* industry, pan, wooden toy, local handicraft, and tourism. These industries generate informal jobs with no guaranteed source of income and employment therefore the steps for economic development should include job security.

3.5. Environmental planning

Environmental planning is the process of facilitating decision making to carry out development with due consideration given to the natural environment in social, political, economic and governance factors to form a holistic framework to achieve sustainable outcomes. For Varanasi, waste management, water pollution, flood plain management, Ganga action plan, Varuna and Assi river revitalization, development of cremation ground and Ganges riverfront, control and monitoring of industrial effluent, air pollution monitoring and control, sand mining prohibition and urban greenery should be taken under consideration (Fig. 3). Further, the disaster resilience of the Varanasi is extremely low with no specific plan of rehabilitation has been properly implemented. With reducing trend of urban green cover coupled with poor air-noise pollution mitigation plan, the city is itself suffer with pollution induced health hazards. Further, the city is prone to several climate related health hazards specifically flood, water stress and draught which essentially reflect the poor natural resilience of Varanasi.

3.6. Public participation

The citizens play a very important role in the development process of a city. Every city needs an innovative tool and techniques and new ideas and advices that can help in reducing the local problem. People's participation is important in decision making in each step. Public participation may be ensured with regular public interaction through print and mass media on various issues that government want to undertake by decentralizing the decision making process. The community based participation in disaster risk management to deal with city floods, environmental pollution, and application of building design codes besides retrofitting of the old buildings of the city can be initiated for the risk resilient structures and sustainable development of the smart city

3.7. Role of Science and Technology vis-à-vis Geosciences

Science and technology dominate in their role to make smart cities. It integrates the real time communication and information technology in the strategy for urban planning to bring innovation and sustainable development¹⁶. Exemplifying the waste disposal system, the city may found mobile-based waste bin clearance monitoring system handy to monitor its daily clearance of garbage. Cities like Chennai has undertaken initiatives like online bus metro rail, new buses and routes tracking, online parking, and mobile garbage collection for capacity building, including efficient traffic management, energy-efficient facilities and water recycling. Likewise in Bangalore "Mapunity", an NGO uses mobile devices and taxi radios to determine traffic movement and provides traffic alerts via text messages¹⁷. However, smart cities may face slow progression due to budgetary issues, insufficient planning and failure to attract residents and/or capital. The replication of technological solutions from developed countries cannot be integrated same to same for the developing countries. The infrastructure of a city could be old and outmoded, hindering the realization of the smart city vision^{18, 19}. All aspects of a smart city cannot be addressed in silos, and it is, therefore, the strategy needs to be highly selective based on a laborious prioritization process¹⁸.

4.0. Varanasi: Master Plan for 2031

To bring advancement in the infrastructure and elevate the living condition, the Varanasi Development Authority (VDA) has come up with the Master Plan 2031 for Varanasi. The Master Plan has taken under consideration of the increasing population of Varanasi for better planning. The master plan will help in assisting the transformation process of Varanasi to Kyoto. Construction of a comprehensive mobility plan in the city which includes proposed metro train

route, ring road and parking slot area, mass transportation and well defined pedestrian path, construction of hotel, motel, restaurants, and resorts to provide better tourist facilities, construction of new Information Technology or Software Technology Parks to facilitate better planning, skillful youth and generate employment opportunities, Rain Water Harvesting system, disaster management plan, land use management for housing, business, industrial, administrative and social activities including park and open spaces, formation of green belt, garbage dumping sites, new and large sewage system are some of the issues that would be dealt in the master plan. To improve the social capital and infrastructure it is planned to develop day care centre, old age home, night shelters, handicapped children house, orphanage, art gallery, library, swimming pool, club and other supporting facilities and provision of better housing for different economic group. Further, The VDA has planned the expansion of industrial and commercial areas in peripheral region in such a way that it may improve the quality of life of people. All the development activity is planned in a way to avoid ruining the heritage and historic version of the city. A series of disaster profile of the cities revealed that the smart cities should be designed in such a way that in case of the event of any disaster there should be a proper and sound mechanism of communicating geo-scientific findings to the first responders using latest tools of geo-informatics and wireless device for promoting quick responses during and at post disaster stage, which has proven track record of reducing public panic during the disaster^{21, 22}. The master plan of Varanasi must be corroborated with geotechnical and geophysical parameters of the sectors where developmental planning can be implemented by considering the fundamental issues of disaster risk reduction and climate change adaptation since the city is located in the flood plain²³. Geo-scientific tools encouraged to be used for development of designed based sustainable structures and constructions in and around the city by taking estimates of geotechnical and geophysical parameters into the account generated through comprehensive seismic microzonation program of India²⁴. It is imperative to understand the new concept of disaster risk resilient cycle in terms of Pre-disaster Risk Response (PDR); During risk response (DRR); and Anti-Disaster Response (ADR) instead of simple concept of Pre-disaster; During Disaster and Post Disaster as Response. It is required to revise the disaster management cycle by incorporating the response at every step of management cycle rather than only to post disaster response.

5.0. Conclusion

To live in a smart city the mindset of the people need to be changed. They will have to learn and practice new living style that shall help them to accommodate easily into the city. Varanasi by far, is an unplanned urban agglomeration whose city boundary is increasing day by day but the facilities and basic amenities are not available with the same ratio. Their living condition and environment therefore deteriorated for want of regulatory support. Transport system of any city gives an inside look of it, a city with better transportation is generally considered world class. For a comprehensive development of Varanasi, a better transport facility is required to minimize the travel time along with it community management, poverty management, employment opportunities and better economic condition is necessary. Cities often face a pressure of budget cuts, outdated infrastructure, ailing urban centers and a dearth of fresh ideas and resources. To overcome this, strategy development and planning is needed to understand, analyze, map, create and vision the current state and reshaping future. While this study may suggests that some areas are more resilient than others, urban planners cannot ignore the evidence that the rapid urbanization has resulted in unplanned and uneven growth, which has increased the vulnerability of certain areas of the city. If this trend continues, the overall region may become more vulnerable and lose its capacity to withstand climate induced and manmade disasters. By embracing new technologies, a city can optimize its operations and transform itself into a sustainable and vibrant urban center. But along with difficulty in grasping the sheer scale and ambition of the smart city initiative, there's also a fear among the local community of the makeover erasing Varanasi's time worn character. The use of technology is an important aspect in building up a smart city but the importance of human and social capital beside technology cannot be ignored. The creativity and resourcefulness of the city's people is more powerful than any machine or individual intelligence. Human-centered approaches to the problems are a requisite attribute of the smart city, and therefore smart cities should put technology truly at the service of their inhabitants and not vice versa. Geo-scientific tools generates important geotechnical and geophysical parameters, which can be used for development of designed based sustainable structures and constructions in and around the city under comprehensive planning of conducting seismic microzonation studies for promoting disaster risk resilient structures in India. The concept of PDR, DRR, and ADR needs to be implemented for development of sustainable smart cities in different parts of India.

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Table 1. An overview of city's major problems and status of resolution

Objectives	Major emphasis	Status
Heritage conservation	<ul style="list-style-type: none"> i. Maintenance of the major historical and heritage sites in Varanasi. ii. Strict rules and regulations to prohibit illegal encroachment of the site area ii. Prohibition on sticking or writing messages and graffiti on monuments 	<p>Agreement on Sister City Cooperation signed in September in Japan will help develop Varanasi as Kyoto style city of Japan.</p>
Mobility	<ul style="list-style-type: none"> i. Urban traffic at major junctions ii. Increasing vehicular load and damaged roads. ii. Encroachment at footpaths v. Improving public transport v. Parking problem at busy routes 	<p>Planning of construction of ring road and Metrorail</p> <p>Varanasi has road network on 11 to 15 % of its land¹⁴.</p> <p>In case of flooding, accessible road is 16 to 30%¹⁴.</p> <p>61% of the population owns motorized vehicle¹⁴.</p>
Infrastructure	<ul style="list-style-type: none"> i. Execution of law/programme/plan in the city ii. Better housing, electricity, water supply, sewerage and drainage and solid waste treatment. 	<p>Purvanchal Viduyat Vitran Nigam Limited meets 51 to 75% of electricity demand and rest 26 to 50 % is met by generators and inventors¹⁴.</p> <p>Varanasi Jal Sansthan meets 51 to 75% of the city's water supply demand¹⁴.</p> <p>51 to 75% population has access to sanitation¹⁴.</p> <p>100% of the collected waste goes untreated and only 11 to 25% is</p>

recycled¹⁴.

Less than 50% houses built with plinth level higher than normal flood level¹⁴.

- iii. Upbringing the backward and weak sections of the society providing better and advanced education and health care
Literacy rate is 74.04%.
Health services are accessible to 76 to 90% of the population¹⁴.
- iv. Employment opportunities and upgradation of economic condition.
15 to 24% of people lives below poverty line and more than 25% of the youth are unemployed.
- v. City must attract investors to strengthen its economic infrastructure including financial banks, IT parks and industrial parks, trade centre, and tourist destination
Dependency on a single source of income is about 75 to 99%¹⁴.

Land use planning	Designing and shaping cities, towns and villages with the goal of making functional, attractive and sustainable urban areas	More than 16% of the total area comprised of green spaces while more than 40% area have been transformed in the last 50 years ¹⁴ .
Economic Development	Promotion of small and large scale local industries like banarasisaree, pan, wooden toy, local handicraft. Popularizing cultural, religious and heritage sites to boost tourism	The city is seeing a big slowdown in the already established handicraft industries and no such new industries are being set up. Cultural events and old religious practices are being lost in the modern vision of the society and are getting very limited.
Environmental planning	Planning of developmental activities by giving consideration to	Varanasi is prone to flooding, heat waves, cold waves and drought.

the natural environment in social, Environmental policy has least political, economic and governance compliance to waste management and factors to form a holistic pollution level. framework to achieve sustainable Ecosystem services degradation. outcomes.

Public
Participation

Citizens support, ideas and advices Citizens are actively participating in the to help reducing the local problem. decision making of the city development Without the help of its citizen a city planning cannot accomplish any target of Frequent and massive campaigning for achieving the desired goals environmental protection and awareness programmes Increase in research in local problems of the city

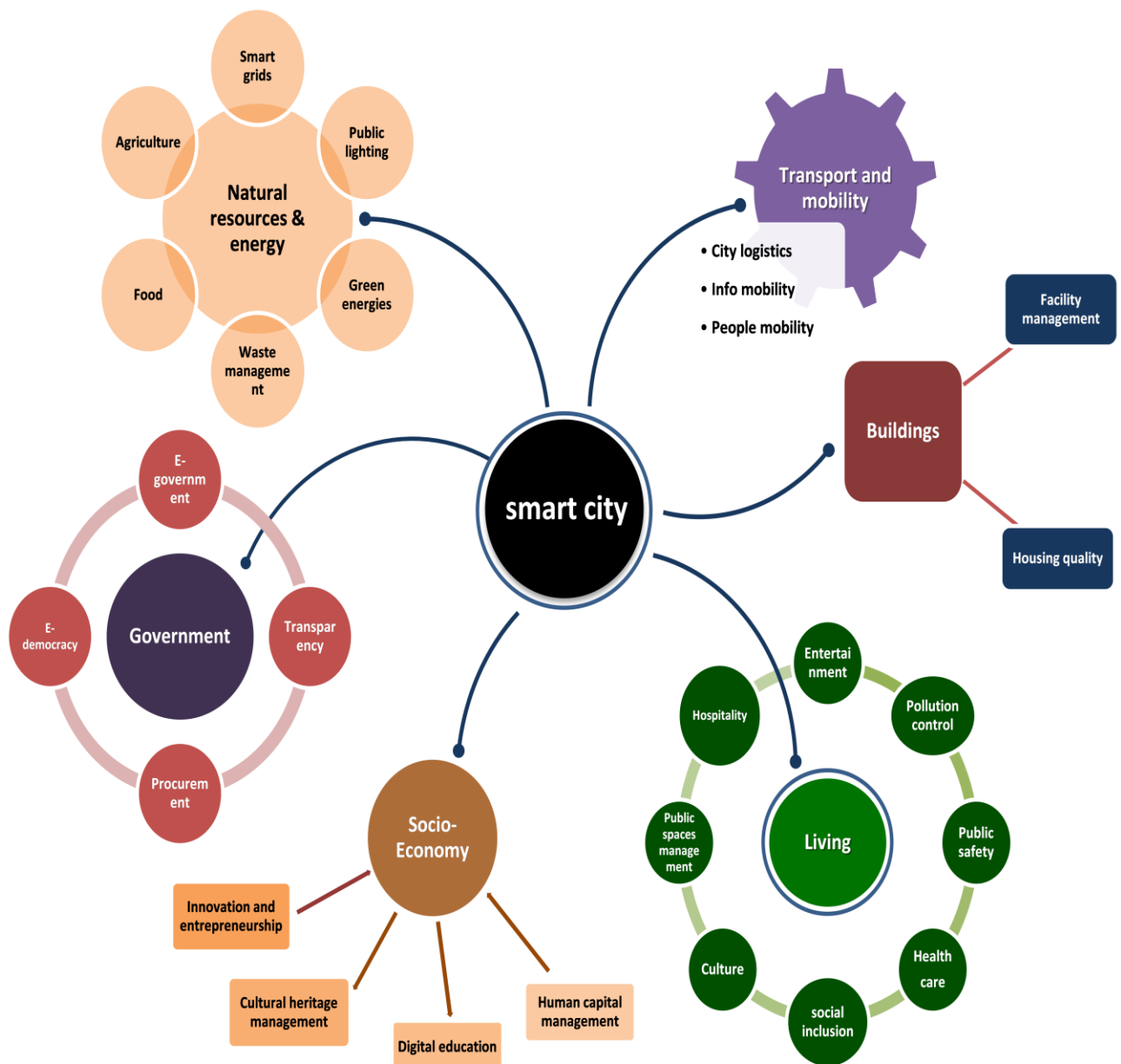


Fig. 1.Inherent components of a smart city (adopted from Neiroto et al., 2014)



Fig. 2. The geographical location of Varanasi.



Fig. 3. Issues need to be addressed for sustainable livelihood in Varanasi.