

Gorakhpur Environmental Action Group (GEAG) is a voluntary organization working in the field of environment and sustainable development since 1975. Ever since its inception, GEAG has been actively engaged in implementing several development projects addressing livelihood issues of small and marginal farmers, particularly women, based on ecological principles and gender sensitive participatory approach. Besides this, GEAG has accomplished several appraisals, studies, researches at the micro and macro levels as well as successfully conducted a number of capacity building programmes for various stakeholders including women farmers, civil society groups and government officials etc.

GEAG has established its identity in North India as a leading resource institution on sustainable agriculture, participatory approaches, methodologies and gender. Acknowledging its achievements, GEAG was awarded with the Lighthouse Activity Award by UNFCCC in 2013. GEAG also holds the Observer status to Green Climate Fund.



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Sanitation Crisis in the Urban Peripheries of the Emerging Cities in U.P.

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The image shows a presentation slide. On the left side, there is a vertical section titled "Notes" in a dark blue font. Below this title are 25 horizontal lines for taking notes. On the right side, the main title of the presentation is displayed in a large, bold, dark blue font, reading "Sanitation Crisis in the Urban Peripheries of the Emerging Cities in U.P.". At the bottom right corner of the slide, there is a circular logo. The logo features a green plant sprout growing from a blue globe. The text "GODA" is written in a stylized font across the globe, and "GODA FOR ENVIRONMENTAL ACTION" is written in a smaller font around the perimeter of the circle.



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List of Abbreviations

- ADA : Allahabad Development Authority
AES : Acute Encephalitis Syndrome
BRD : Baba Raghav Das Medical College
DEWATS : Decentralized Waste Water Treatment System
DPR : Detail Project Report
GEAG : Gorakhpur Environmental Action Group
GMC : Gorakhpur Municipal Corporation
GT : Grand Trunk
JE : Japanese Encephalitis
JNNRUM : Jawaharlal Nehru National Urban Renewal Mission
MLD : Million Liter per Day
NE : North East
NW : North West
SE : South East
STP : Sewage Treatment Plant
SW : South West
SWM : Solid Waste Management
TERI : The Energy and Resources Institute
UP : Uttar Pradesh

Introduction

Most of the emerging cities in India are characterized by an unplanned, uncontrolled and rather haphazard growth. Their peripheral areas have turned into dumpsites for unsegregated solid waste and liquid waste discharge, a place where agricultural and open lands are encroached upon with careless abandon and impunity. This so called development process has generated a series of negative and far reaching environmental and social repercussions, on both urban as well as its adjoining peri-urban areas. In terms of urbanization, India tops the list of the largest number of urbanites living without a safe, private toilet. The actual number is a staggering 157 million urbanites who do not have private toilets, and more than 41 million urban dwellers who practice open defecation (PTI, 2016). The government has made sanitation a priority, but still most of the emerging cities are way behind in achieving the goal of 'Total Sanitation' by 2019.

As per the 2011 census, around 377.11 million people live in urban centers in India. This number is steadily growing, at the rate of 2.73 percent every year. The decadal urban population growth rate during 2001-2011 was 31.8 percent, which was 1.8 times that of the combined urban and rural growth, and 2.6 times the rural population growth. Thus, India is going through a silent but sweeping change in terms of the composition of its population as well as its land use pattern. Census data substantiates this shift. For the first time since independence in 1947, the absolute increase in population was higher in urban areas than in rural areas (Census, 2011). The proportion of rural populations declined from 72.19 percent in 2001 to 68.84 percent in 2011, and the number of towns increased from 5,161 in 2001 to 7,935 in 2011, an addition of 2,774 'new' towns (Chandramouli, 2011). These figures corroborate the fact that due to various socio-economic factors, that include population pressure and poverty, urban regions are seeing a large influx of population from rural areas, which is instrumental in this accelerated growth of new urban centres.

Trends of Urbanization in Uttar Pradesh

Uttar Pradesh, the most populous state in the country, has witnessed a tremendous growth in its urban population during the last three decades. Between 1971- 81, the decadal growth was about 60.62

percent, the highest in the country. In 1981-91 this growth was about 38.97 percent, second only to Orissa. The total urban population of the State is 44,495,063 which is 22.27 percent of total population, accommodated in 981 urban centres of various size classes, as per the 2011 census. However, Uttar Pradesh is one of the least urbanized states of the country as it has a very less percentage of urban population in comparison to other states. Only four states (Meghalaya - 20.08, Manipur - 20.21, Odisha - 16.68 and Assam - 14.08) have a proportion of urban population lower to UP. But the state still makes up for 11.8 percent of the country's total urban population, second only to Maharashtra (31.16 percent). And as per the 2011 Census, every fifth person in the state is residing in urban centres. It is to be noted that during the last 110 years, the growth of urban population was 842.5 percent while growth in number of centres was 181 percent.

Sanitation Crisis in Emerging Cities of Uttar Pradesh

These urban centers of the state of Uttar Pradesh are lagging behind in the availability of potable water and proper sanitation for its citizens. As per the recent National Family Health Survey (2015-16), 77 percent of rural households do not have sanitation facilities in their houses and practice open defecation. The situation of urban areas is not much better, with 32 percent people having no access to toilet facilities and who continue to defecate in the open. The recently published report of the Urban Development Ministry's *Swachh Survekshan* (2017) that ranks India's cleanest cities, reports that only five Uttar Pradesh cities find a place in a total list of 434 cities. These too are positioned only in the bottom ten cities of the list: Gonda (rank 434), Hardoi (rank 431), Bahraich (rank 429), Shahjahanpur (rank 426), and Khurja (rank 425).

Indeed, the above disturbing information should serve as a wake-up call for the state, where the sanitation situation in almost all its emerging cities, is worsening by the day. The city peripheries are laden with garbage heaps, construction debris and raw sewage discharge, permeated with a stench, an ugly and unhealthy eyesore for its inhabitants. This is exactly the kind of environment that lays an invitation for water and vector borne diseases such as Japanese Encephalitis (JE) and Acute Encephalitis Syndrome (AES), which incidentally ravage Uttar Pradesh routinely. And, every year, when

MAP 1
LOCATION OF SELECTED CITIES IN U.P.



summer heat peaks or when monsoon arrives, spread of such water and vector borne diseases escalates (Mitra, A, Wajih, S and Singh , BK, 2015).

Therefore, with the current hectic pace of urban development, the emerging sanitation crisis in peri-urban areas in most of the cities of the state needs to be tackled at a war footing. It is not simply a question of cleanliness, whether a city stinks or is an eyesore, nor the disgraceful fact of UP's low ranking in the list of

clean cities as compared to other states. It is a much more serious question of public health, sanitation and social benefit involved. It would be a tragedy if, in spite of understanding the problem, we fail to take steps to solve it in a timely and effective fashion. The current government claims that its focus is on development, and this may be just the right time to begin a statewide movement on cleanliness, hygiene and health for an equitable and sustainable development throughout the state.

Against this backdrop information, the current study is an effort to develop a better understanding of the urbanization pattern in Uttar Pradesh and establish a linkage with sanitation crisis in the emerging cities and its surroundings. For this purpose, five cities (Allahabad, Gorakhpur, Lucknow, Jhansi and Saharanpur) from different agro-climatic zones were selected as a case study, for field observation and to collect qualitative information on the issues of sanitation (fig 1).

The key guiding questions for the study were:

- ◆ How has the surrounding area changed in these emerging cities of Uttar Pradesh?
- ◆ What are the key issues and challenges of natural resources, health and livelihood in peri-urban areas?
- ◆ What are the drivers of change in land use?
- ◆ How have the changes in land use pattern over the last 10 years degenerated the ecosystem services of the area and enhanced the vulnerability of the people living there?
- ◆ How are these areas used as dumping ground for sewage and solid waste generated by the city, and what is its impact on the inhabitants of peri-urban areas?
- ◆ What steps will be effective for stakeholder engagement in proper management of solid and liquid waste, and also, how to achieve the goals of Swachha Bharat Abhiyan in these peri-urban areas?

Tools and Methodologies

The study is primarily based on qualitative and quantitative information relying on the visual observation of Google satellite images from two different time periods, and an ethnographic approach which includes semi-structured interviews with peri-urban residents, meetings with key informants, direct field observations to gather in-depth understanding

about the drivers of change in land use pattern of emerging cities and how these changes affect the sanitation condition of the peripheral areas.

A. Selection of sample cities through rapid visual assessment of land use changes

Sample cities were chosen on the basis of population size, decadal growth of population and the rapid visual assessment of changes in the land use pattern. In terms of population size, growth and rapid change in land use, five main cities (Allahabad, Gorakhpur, Lucknow, Jhansi and Saharanpur) from different agro-climatic and socio-economic development regions were selected. For assessing the land use changes and identifying hot spots, the Google earth images of all the five cities for two time periods (2006 and 2016) were captured. To analyse it better, a micro analysis of land use change was carried out. For this a grid of 1 km X 1 km (1 sq. km) was superimposed on the current (2016) and past images (2006) of the cities. This was important to be able to understand the factual variation in land use changes at the ground level, on the smaller scale marked by each grid, in the last ten years (2006-2016). Major hot spots (areas that showed marked changes in land use) within a municipal boundary and in the peri-urban areas of the city were then identified and further selected for community consultations.

The image interpretation on current and past Google images helped generate a comprehensive database on built up area, civic forest/green belt, water bodies and open/agriculture land at two different points of time (2006 and 2016) based on visual observation on a percentage basis. These separate databases were further analyzed on an excel worksheet, and grids with high land use changes were pin pointed and filtered. After identification of the areas that showed major changes in the land use pattern in the satellite images, at least one village from each cluster was selected for community consultation. A total of 37 villages (Table 1) were selected and surveyed for the study.

TABLE 1
NUMBER OF SELECTED VILLAGES IN DIFFERENT CITIES FOR COMMUNITY CONSULTATIONS

Name of City	Allahabad	Jhansi	Gorakhpur	Saharanpur	Lucknow
No. of Surveyed Villages	12	10	6	4	5

B. Field Observations

In this phase, city and peri-urban residents were interviewed through a semi-structured checklist, to ascertain the impacts of urbanization on the peri-urban areas during the last 10 years. In this process, local communities were interviewed in depth on the cause of land use change, means of livelihoods, sanitation and the quality of services available. In all, more than 16 people in six villages in peri-urban areas in Gorakhpur, 20 people in Allahabad, 15 people in Jhansi, 20 people in Saharanpur and 18 people in Lucknow were quizzed.

Apart from this, real estate agents and land owners were consulted to gather information about the level and quality of implementation of governance and financing mechanisms. Information regarding reasons for sale and purchase in the concerned villages was also compiled for better understanding and a clearer picture of the existing situation.

Jhansi

Jhansi city is one of the historical walled cities of Uttar Pradesh, located between the rivers Pahuj and Betwa. It is at an average elevation of 285 meters above mean sea level, with a slope from south and south west to north and north east. Jhansi is located at 25°43'33" N latitude and 78°58'33" E longitude in the extreme south west of the state. It is well connected to all parts of the country as the North-South and East-West corridor pass through this city. Physiographically, Jhansi is a plateau of Central India dominated by rocky relief and minerals. The city is the gateway to the Bundelkhand region, a dry and backward area. The availability of minerals, stones and glass has attracted industries in its surrounding areas. Jhansi's climate is semi-arid that receives only 900mm rainfall annually. The average thickness of the aquifers in the region is about 20 to 40 meters and their yield is limited to moderate, made available through dug wells and tubewells. The rocky physiography, less rainfall and deep aquifers are factors for water scarcity in this region, which is the main constraint in the growth and development of the city. However, in 2015, it was selected for the Smart City Initiative by the Government of India.

The growth and urbanization process in the city of Jhansi started soon after independence. Various residential and institutional buildings and colonies were established in the periphery of the walled city; especially in the western part of the city where the water table is comparatively higher. The trend of population growth in Jhansi city is presented in the table below:

The above table indicates that the city has a population of 5 lakh as per the 2011 census; and in the last ten years (2001-2011), the population has increased only by 18.65 percent.

The availability of water (surface or subsurface) is a major controlling factor against the sprawl of the city in the peri-urban zone. The semi-arid climate, hard rocks and hardpan layer under the upper soil restrict the recharge of underground aquifers. The north-western part of city where the Pahuj river can provide water has had more potential for development. The masonry dam on the river is a source of water for the nearby areas. Likewise, the north-eastern part of the city, where Betwa river is able to contribute as a water source, has become the second developing zone of the city. Hence,

the city spread is limited to the western part along the Gwalior Road and also the eastern part. South-western part near the cantonment area of the city is also growing but the process is very slow due to lack of water resources.

The land use analysis of the city with the help of Google earth images at two different points of time (2006 and 2016) also indicate that marked development of settlements has taken place in north-west and south-west direction. Though settlement growth has also been noticed in northeast and southeast direction, but that has been at a comparatively slower rate. The percentage change in agriculture/open space, civic forest, water bodies and built up area is given in the table below:

TABLE 3
LAND USE CHANGE (IN PERCENT) IN PERI-URBAN AREAS OF JHANSI (BASED ON GOOGLE EARTH IMAGE OF 2006 AND 2016)

Direction	Agriculture/open space	Civic forest/ green belt	Water bodies	Built up area
NE	-2.6	-1.02	0	17.15
NW	5.1	1.82	0.06	18.51
SE	-1.36	0	-3.57	15.0
SW	-1.23	-1.04	-14.28	19.8

Source : Computed by GEAG through Google Earth Image of 2006-2016

PHOTO 1
LIQUID WASTE DUMPING GROUND IN VILLAGE NEAR JHANSI



Urbanization and Sanitation
Crisis in Urban Peripheries:
Case Studies

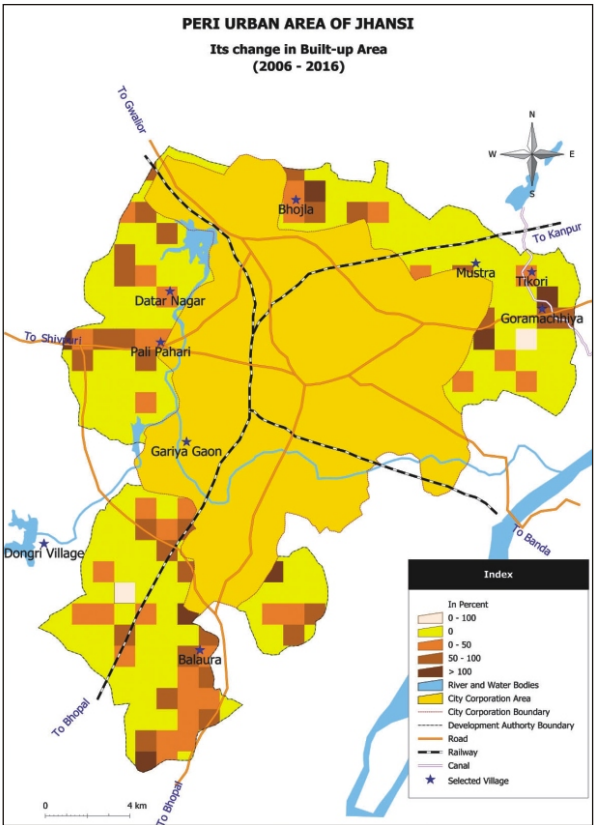
In this section, observation about the nature of urbanization of the five emerging cities of Uttar Pradesh, and its impacts on their peripheries on different aspects in general and sanitation in particular have been assessed.

TABLE 2
DECADAL POPULATION GROWTH IN JHANSI CITY

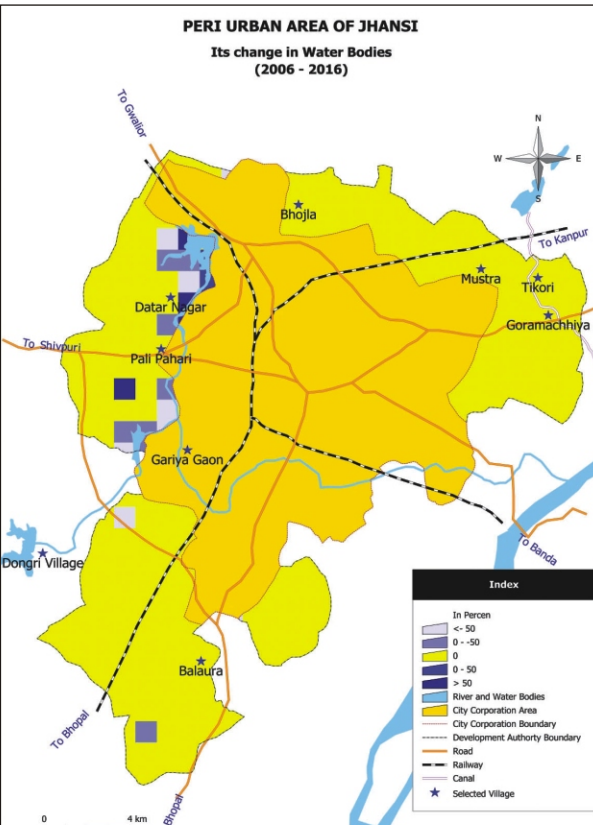
Year	Population	Decadal Growth in %
1971	173,292	-
1981	246,172	42.06
1991	317,844	29.11
2001	426,198	34.09
2011	505,693	18.65

Source : Census of India

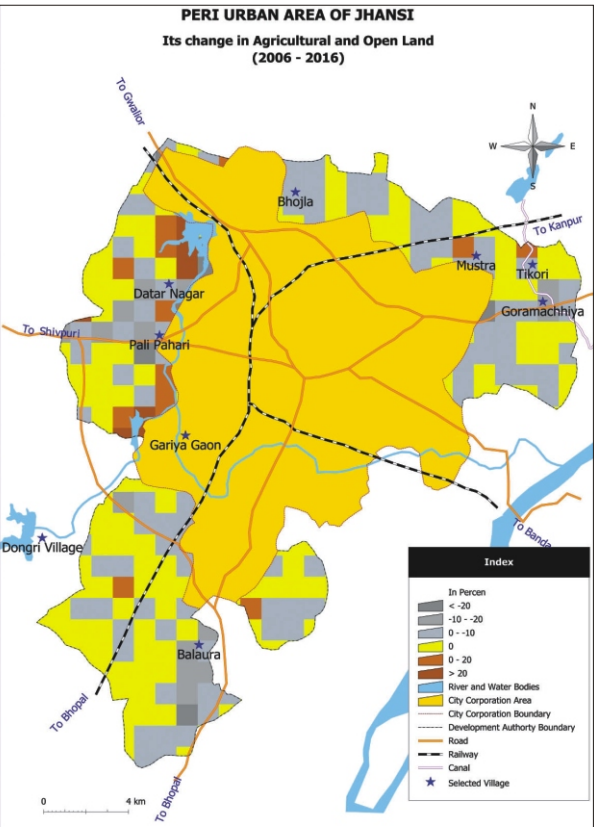
MAP 2
CHANGES IN BUILT UP AREA DURING 2006-16 IN JHANSI



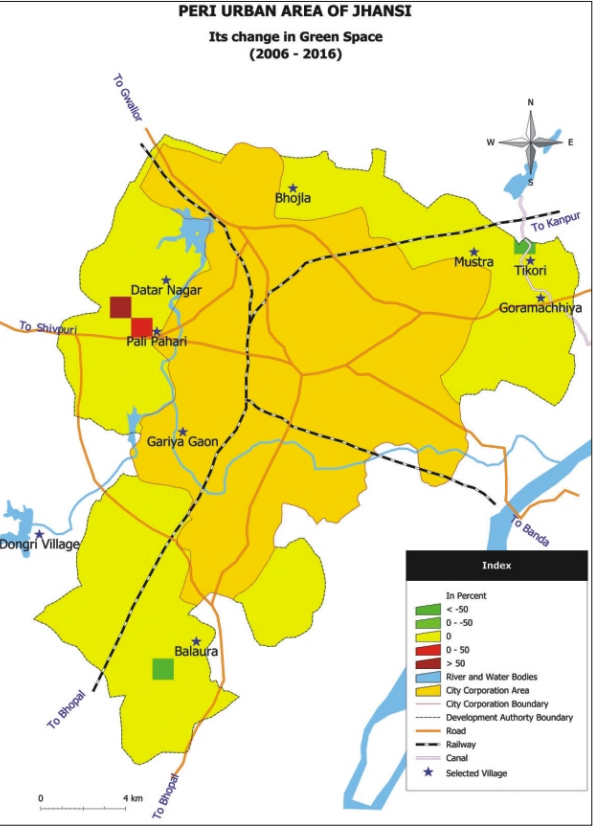
MAP 3
CHANGES IN WATER BODIES AREA DURING 2006-16 IN JHANSI



MAP 4
CHANGES IN AGRICULTURE AND OPEN LAND AREA DURING 2006-16 IN JHANSI



MAP 5
CHANGES IN GREEN SPACE AREA DURING 2006-16 IN JHANSI



In comparison to other selected cities, here the urban expansion is not prominent. In the peri-urban areas though, real estate agents and builders are active and purchasing land from farmers to build colonies. Likewise, some of the industrial or real estate corporate companies and institutional groups have also purchased land to establish factories, colonies and institutions. But due to scarcity of water, the construction process is very slow. Community interaction in the peri-urban villages indicated that people are not willing to settle in Jhansi due to this same reason, scarcity of water. This may be the reason for slower expansion of the city. Most of the peri-urban area land is still unoccupied even after it has been well developed in the form of plots for house construction. Likewise, the industrialists are also not in favor of establishing any factories due to lack of water, inspite of the availability of raw materials and power. Only a few stone crushers and chemical industries are operative in the area which belch dust, smoke and foul smell, creating pollution hazards for the locals. The already settled community in the peri-urban areas also did not reside in this troublesome region out of choice, but rather due to lack of alternative options, and now are bound to live in such a polluted environment.

Dr. Jitendra Pavela, a professor of Bundelkhand University, Jhansi, affirmed that in limited areas of the city such as Civil Lines, Cantonment and their adjacent areas, sewer facilities are available. Rest of the areas are served by open drains which directly carry the grey water to the river Pahuj, which finally disposes it in the river Betwa. Laying a network of sewage lines will be a challenge for civic authorities in this rocky and undulated land. The terrain of the city has a natural large slope and hence there is no problem of water logging in the city except in some low lying areas. However, the city has been selected for a 'smart' city and funds have been diverted to construct sewer lines.

Key sanitation issues in peri-urban areas

Sanitation crisis in the city and its peri-urban villages is being influenced by water scarcity. The harder rock and thick hardpan under the upper soil affects the recharging process. Presently, groundwater is available at a depth of 50 m, though people in the city and also in the peri-urban areas inform that the water table is gradually declining and in summers, the water situation worsens.

Most of the sewer water of the city is disposed off without treatment in the low lying areas of Mustra, Takori, Gharh mau, Pichhor, Gorramachhiya and Kharguwan villages which are located in the north and north east direction. The site visits of Mustra and Takori

PHOTO 2
LIQUID WASTE DUMPING AREA, VILLAGE MUSTRA, JHANSI



village reveal a very interesting and striking story. The area looks like a reservoir and the same untreated water collected here is used for irrigation purposes. Two check dams have also been constructed to regulate the waste water for irrigation purposes. People residing near this reservoir responded that rice cultivation during summer in this semi dry area is only possible because of this reservoir.

The key sanitation issues of the city are:

- ◆ There is no sewage treatment plant in the city to treat the wastewater. The untreated sewage water is used for irrigation, which is creating health problems in the city and also in the peri-urban villages.

PHOTO 3
OPEN DRAIN FOR CARRYING LIQUID WASTE OF JHANSI CITY



Lala Ram and Babu Lal of Mustra village asserted, “Major part of the village on the north side is covered by the city’s waste water, and looks like a black water lake. The village lands are inundated causing foul smell, breeding of mosquitoes and flies, making the land unsuitable for agriculture. There are cases of drowning of children and spread of various diseases, especially conjunctivitis, and even cases of cancer have been reported. Snake bites have become common.”

“The overflow of the accumulated waste is channeled through regulators, and is used for irrigation downstream. On the other side of the village, the crops are grown in both the seasons with good production, due to the availability of this water.”- Rakesh Sahu of Takori Village adjacent to Mustra.

- ♦ Collected wastewater creates several problems such as foul smell, contamination of both surface and ground water, increasing attack of mosquitoes resulting in the outbreak of epidemics.
- ♦ Prevalence of water and vector borne diseases seriously affects the health of children in the peri-urban villages.
- ♦ Solid waste generated in the city is used as filling material on land needed for construction of houses because of higher cost of soil. Most of the solid

waste is dumped in and around the peripheries of the city which itself creates an unhygienic environment for the villagers.

- ♦ Villagers also face problems of sanitation caused by water scarcity, especially in the maintenance of toilets. Many a times, even the villagers who have toilets at home are unable to use them due to this paucity of water.
- ♦ Residents of this urban area are not willing to construct toilets because of lack of water which is essential to flush and clean them.

Allahabad

Allahabad is one of the oldest cities of north India, situated at the confluence of three rivers- Ganga, Yamuna and the invisible Saraswati and occupies a strategic location in the centre of the Ganga plain. It is situated at 25°45'N and 81°40'E at an altitude of about 103 meters above sea level in the south-eastern part of UP. The city is situated in the middle Ganga plain, which is a monotonous alluvial plain with humid sub-tropical climate having 1027mm annual rainfall. Its slope is from west to east and the depth of groundwater table is between 10 to 15 meters. A plane surface and availability of ground water are the favourable conditions that aid growth in this city.

The city became a municipal corporation in 1978. The population of Allahabad city grew from 9.75 lakh in 2001 to 11.1 lakh in 2011. The decadal population growth gradually dropped down to 30 percent in 1991 and 14 percent in 2011 (as against decadal state urban growth rate of 20 percent). Allahabad is one of the most important urban centres in the region because of Sangam, the high court, availability of health facilities and varied employment opportunities.

The population growth is shown in the table below:

TABLE 4
DECADAL POPULATION GROWTH IN ALLAHABAD CITY

Year	Population	Decadal Growth in (%)
1971	4,90,622	-
1981	6,16,051	25.57
1991	7,92,858	28.70
2001	9,75,393	23.70
2011	11,12,544	14.06

Source : Census of India

The city of Allahabad is situated at the confluence of the rivers Ganga and Yamuna, which determine the morphology of the city. The interaction with the citizens

of Allahabad reveals that during the colonial period, a satellite town Naini was developed between the railway lines to Mughalsarai/ Howrah and Chennai/ Mumbai close to the Central Jail, for which it was famous. A new town started to develop around the industrial state in the south beyond Yamuna River. This is called Naini Industrial Area and Rail Transport Hub Area.

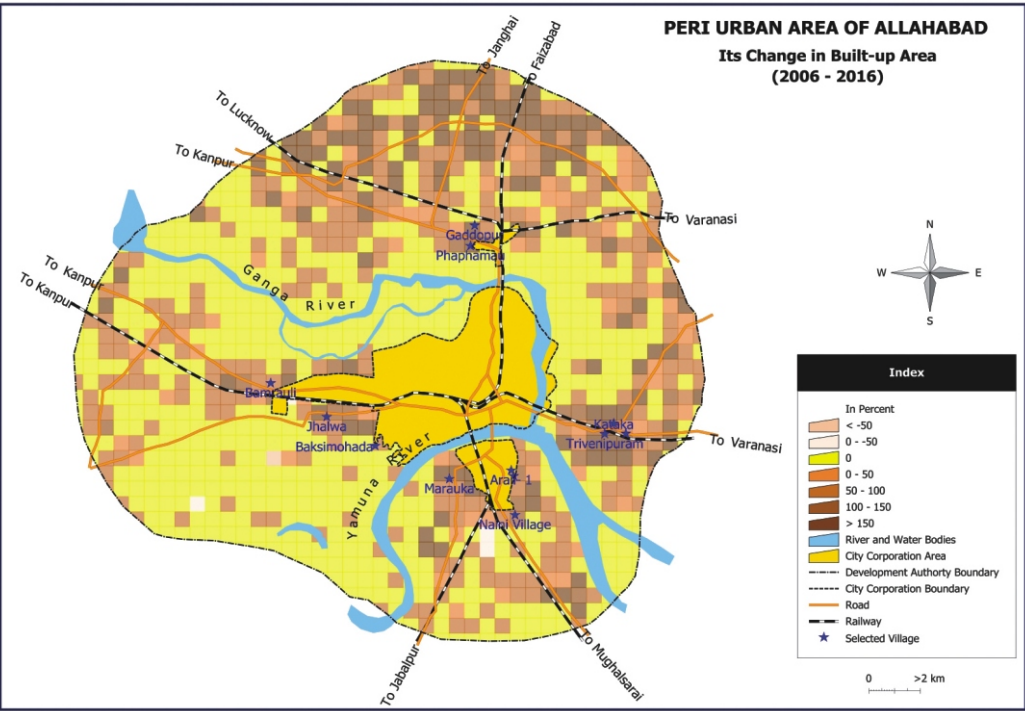
After the construction of a pucca bridge on the Ganga in 1958, the city expanded along the GT Road which enters the city from West Subedar Nagar and runs eastward to cross the Ganga by a pontoon bridge near Daraganj. Development beyond the confluence in Jhusi and adjacent to it, started after 1960 but picked up steam only after 1980, when the Indian Oil Gas filling station, Trivenipuram Colony, Jhusi ADA Colony and Avas Vikas Colony were established. Soon after these, major vehicle showrooms, banks, workshops and AIR sprang up on the Varanasi road.

The third prong of the city's expansion was between both the rivers along the GT road towards Kanpur. Bamrauli Airport, Jhalwa Colony, Subedar Nagar, Bharwari, Karali, Sulemsarai, Deo Prayag, Chandra Puram and other residential and institutional set-ups were established due to availability of open land, accessibility and freedom from floods of the Ganga and Yamuna rivers. In the north direction, development is bounded by river Ganga and in south by river Sasur

PHOTO 4
ROADSIDE WASTE DUMPING IN ALLAHABAD NEAR BAXI MOHARA VILLAGE

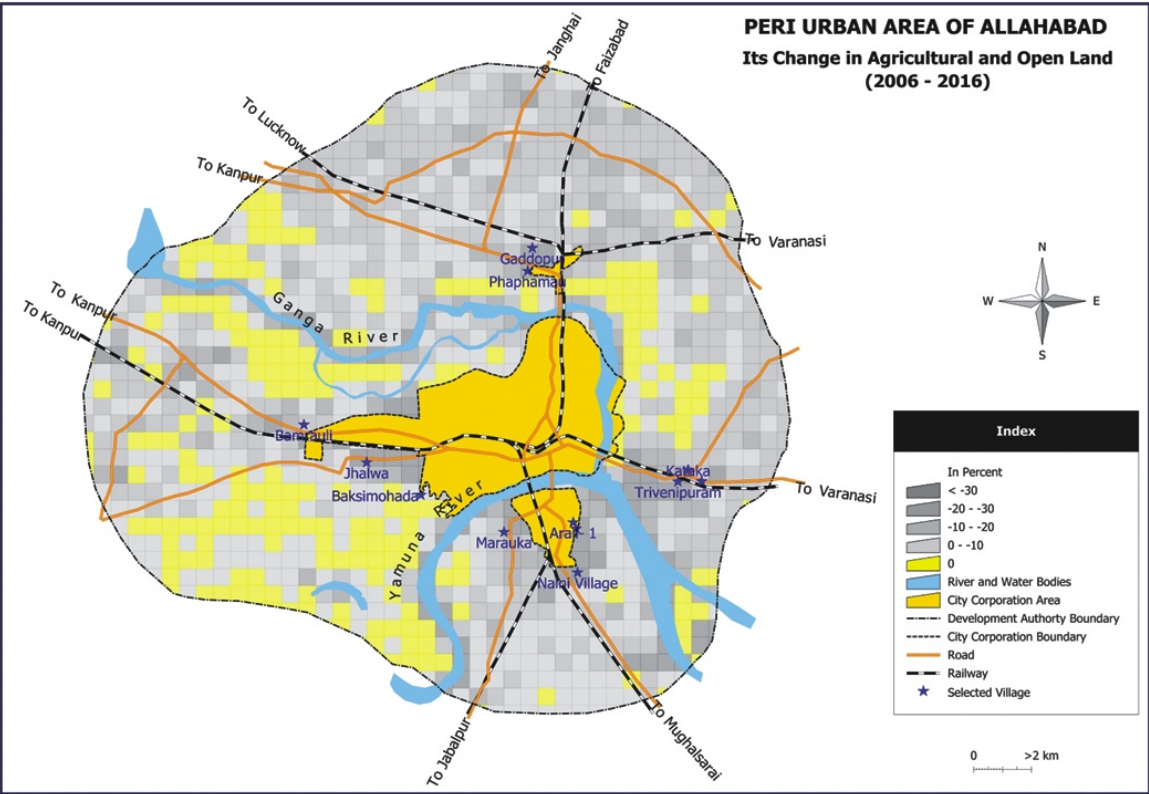


MAP 6
CHANGES IN BUILT UP AREA DURING 2006-16 IN ALLAHABAD

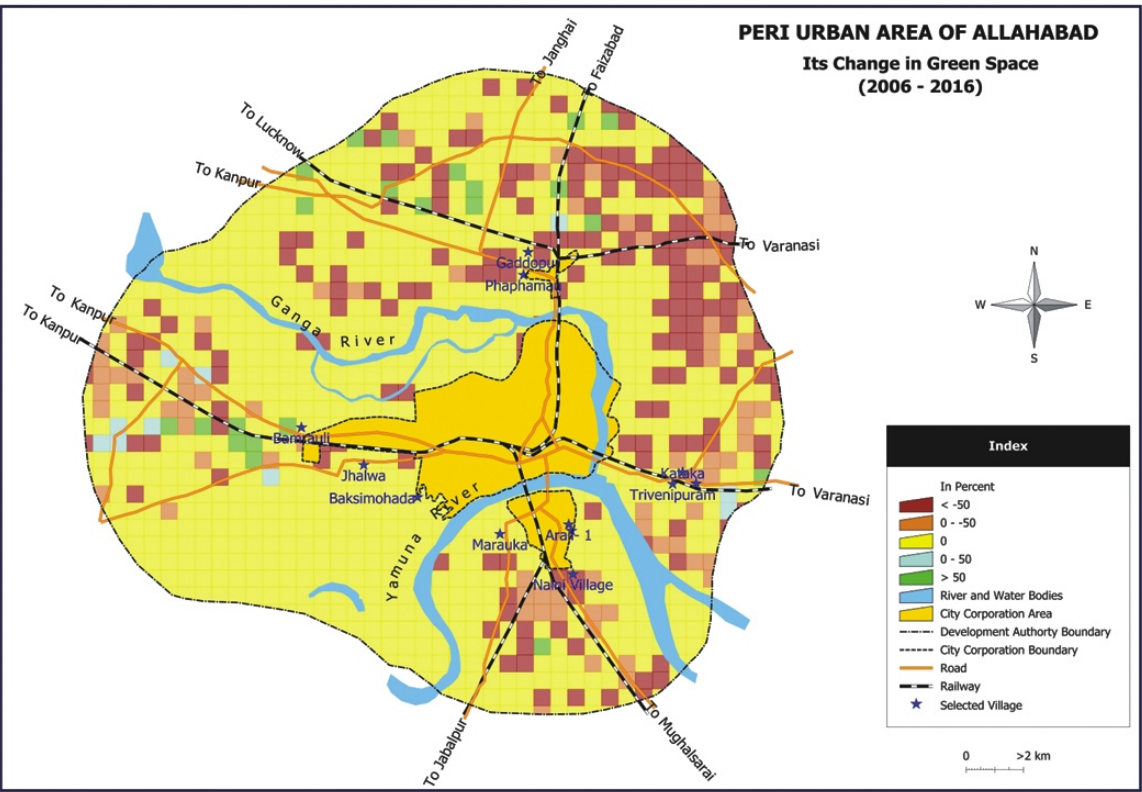


Source : Computed by GEAG though Goggle earth image of 2006 and 2016

MAP 7
CHANGES IN AGRICULTURE AND OPEN LAND AREA DURING 2006-16 IN ALLAHABAD



MAP 8
CHANGES IN GREEN SPACE AREA DURING 2006-16 IN ALLAHABAD



Khadori, a tributary of Yamuna which has now become a wastewater disposal drain.

The fourth area of extension was in the north east direction beyond the Ganga river. This began after the construction of a bridge on the Ganga in 1975 near Phaphamau, a railway and roads junction to Faizabad and Lucknow radiating in the flood plains of the river. Various institutions including a Homeopathic College, Govt. Degree College, Open University, ADA and Avas Vikas Colonies were established. Private colonizers developed some land and a high income group colony has come up at the junction points of Faizabad and Lucknow road. In this side, Phaphamau is the only one ward No. 25 and most of the other areas that are well developed are still not included within the corporation

boundary. The Municipal Corporation has sent a proposal to the state government for their inclusion into corporation boundary, but that is still under consideration. Allahabad city has old sewer lines, but under JNNRUM mission, major parts of the city have been covered. There are three STPs for treating grey water but the newly developed trans Ganga-Yamuna area does not still have a sewer system till date, except for a few well planned colonies such as Trivenipuram, Jhunsu Awas Vikas colony and Jhalawa colony.

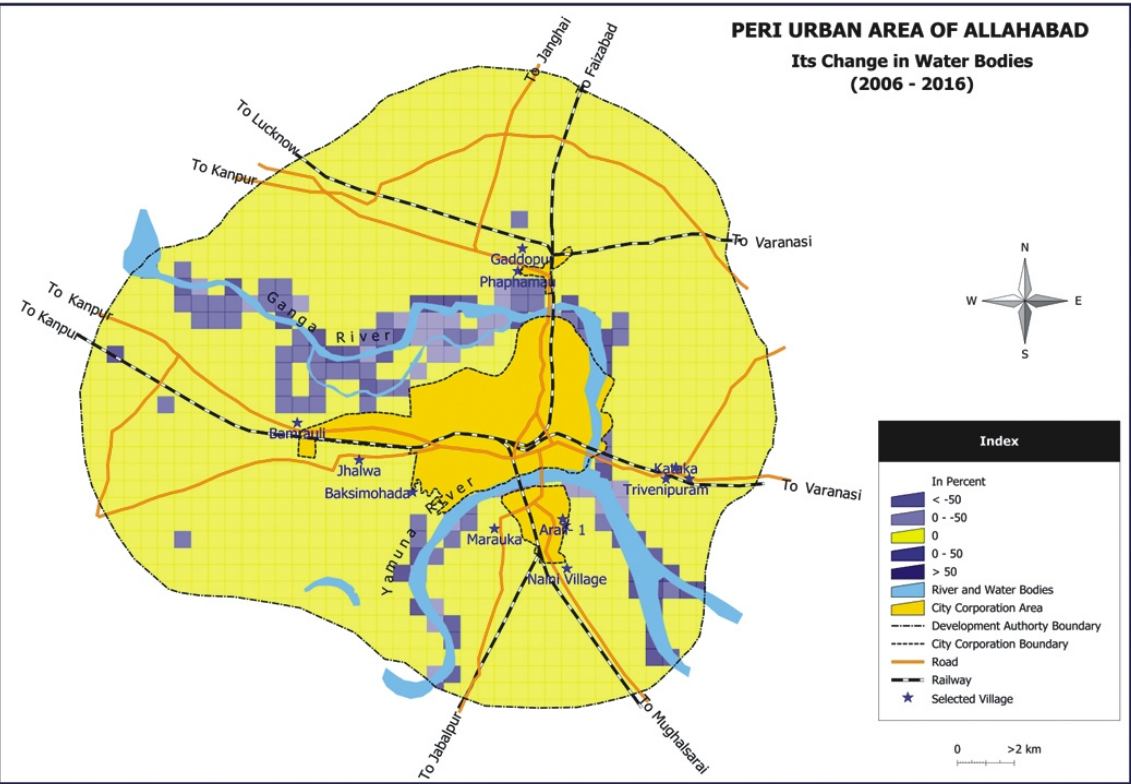
The analysis of Google satellite images of the city during the period (2006 and 2016) and its interpretation was conducted to understand these expansion trends. The analysis reveals that the maximum growth of the city has taken place on the

TABLE 5
LAND USE CHANGE (IN PERCENT) IN PERI-URBAN AREAS OF ALLAHABAD (BASED ON GOOGLE EARTH IMAGE OF 2006 AND 2016)

Direction	Agriculture/open space	Civic forest/ green belt	Water bodies	Built up area
NE	-13.48	-34.57	5.6	84.01
NW	-11.73	-10.54	-3.55	54.10
SE	-23.3	-18.99	4.22	62.98
SW	-13.0	-1.42	0.55	36.0

Source : Computed by GEAG though Google Earth Image of 2006 and 2016

MAP 9
CHANGES IN WATER BODIES AREA DURING 2006-16 IN ALLAHABAD



north-eastern boundary. Table 5 indicates the percentage change in the agriculture/open space, civic forests, water bodies and built up area over the last 10 years.

Key sanitation issues of peri-urban areas

The agriculture lands in peri-urban villages are being converted into residential areas. Speculative land market and increasing number of brokers have lured small and marginal farmers to sell their valuable land. The other key issues include:

- ◆ Most of the households have constructed toilet in their homes and also use them.
- ◆ Groundwater table is declining in peri-urban villages. People informed that during summers, shallow hand pumps dry up.
- ◆ Most of the solid waste and waste water is disposed in nearby low-lying areas especially beside the Baksi embankment along the river Ganga, and in the western part of the city along the Ganga and Yamuna rivers. The city has no proper plan for solid waste management. In the south, beyond the river Sasur Khaderi, waste is

disposed off to nearby low lying areas. Though people have agitated on this issue at the Collectorate in a bid to put a stop to it, but no effective measures have been adopted yet. The whole area still stinks throughout the year, more so because of the disposal of slaughterhouse waste in Karalibag area.

- ◆ Though sewage water is being treated before finally disposing into the river Ganga and Yamuna, some of the STPs are still ineffective. One river, Sasur Khaderi, which was an important drainage of the southern part of the city, and also the tributary of Yamuna, is now a waste drain disposing the waste water of the whole western and southern part

Mr. Sahid of village Baksi Mohda informed, "Since last 10 to 15 years about to 40 to 50% of the total agricultural lands near river Sasur Khaderi have been sold off after the construction of two bridges, but most of the purchased land is still undeveloped. The solid waste of the city, especially from Karaily area is disposed of along the road and river, and burnt there itself. The untreated city liquid waste is drained in the river causing health problem, especially respiratory diseases such as bronchitis, cough and asthma."

PHOTO 5
INOPERATIVE STP NEAR TO VILLAGE BAKSI MOHDA, ALLAHABAD



of the city. A STP has been constructed to treat the water flowing in the river near village Baksi Mohda but at present it is defunct, spreading foul smell in the whole area.

Lucknow

Lucknow is the capital of the state of Uttar Pradesh and is also the administrative headquarters of the eponymous Tehsil, District and Division. It is the largest city in Uttar Pradesh, the eleventh most populous city and the twelfth most populous urban agglomeration of India. Lucknow has always been known as a multicultural city that flourished as a North Indian cultural and artistic hub and the seat of power of the Nawabs in the 18th and 19th centuries. It is situated in the heart of the great Gangetic plain in the part of Sai-Gomti sub basin. Its general elevation is about 120 meters showing easterly slope. The drainage of the city is controlled by river Gomti which meanders through the city. The climate of the city is sub-tropical and the normal annual rainfall is 966 mm. The groundwater level in most parts of the city is between 20 to 30 meters, and Lucknow city itself is surrounded by a number of small towns and villages.

Mr. Jitendra Kumar of village Darogakheda, Sarojini Nagar, Lucknow says, "A lot of changes have taken place here in last 10 years. Almost 50% of the agricultural land has been sold. Two new colonies have been established in the village in these ten years. There are no facilities for maintaining cleanliness; the waste water flows on the road and water logging is common."

Being the capital of Uttar Pradesh, Lucknow city is expanding at a rapid pace. As per Census 2011, the city had a population of 28,17,105 while the decadal growth during 2001-11 was 28.87 percent.

TABLE 6
DECADAL POPULATION GROWTH IN LUCKNOW CITY

Year	Population	Decadal change (%)
1971	7,74,644	-
1981	9,47,990	22.38
1991	16,19,115	70.79
2001	21,85,927	35.01
2011	28,17,105	28.87

Source : Census of India

The trend of expansion since 1990 is high; and during the last 20 years, the growth of population was 74 percent.

This expansion has exerted tremendous pressure on its peri-urban areas. The agricultural and open lands are being converted into built up area and most of the villages between the city boundary and Lucknow Development Authority boundary have been converted into urban areas. The city does not have any physical constraint for over growth in the peri-urban region. But highways radiating to Faizabad (East), Kanpur (West and South West), Sitapur and Hardoi (North and North West) are being developed exponentially due to

Mr. D.K Singh, who is the district agricultural officer of Lucknow says, "Agriculture is shrinking due to urbanization. Urban colonies have been established on agricultural lands. There is no proper management of leading the liquid waste to where it needs to be dumped which has also caused damage to rest of the agricultural land. This way, the farmers are forced to leave the land."

availability of the open land and attraction of nodality as the capital. The Google satellite image interpretation of 2006 and 2016 has revealed the following changes in land use in different directions of city.

TABLE 7
LAND USE CHANGE (IN PERCENT) IN PERI-URBAN AREAS OF LUCKNOW (BASED ON GOOGLE EARTH IMAGE OF 2006 AND 2016)

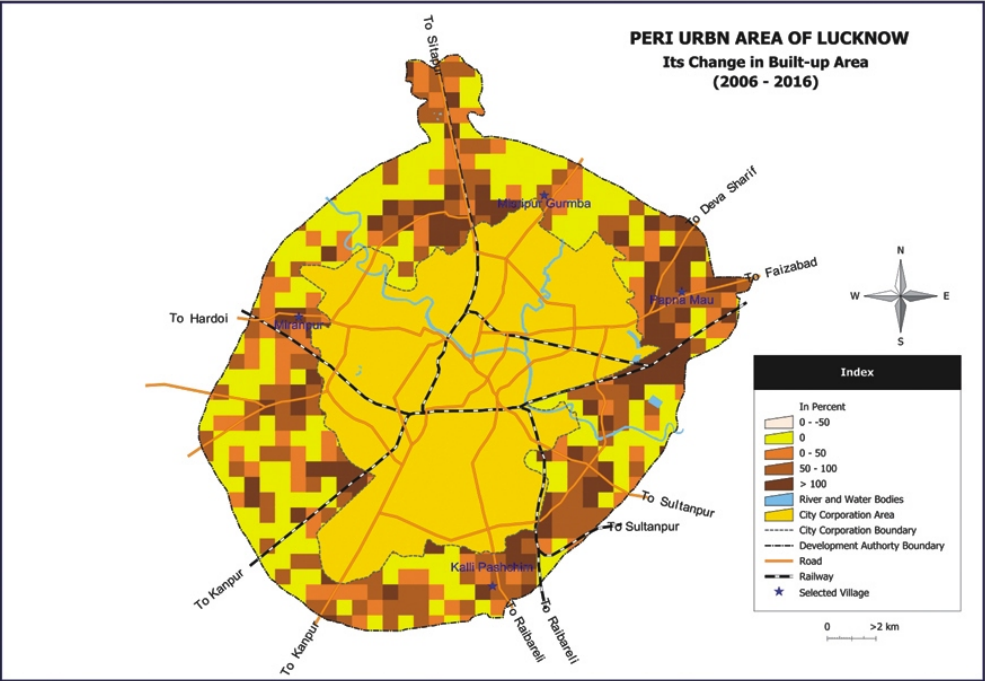
Direction	Agriculture/open space	Civic forest/ green belt	Water bodies	Built up area
NE	-37.0	-3.36	-1.0	101.0
NW	-31.0	-10.01	-2.0	52.00
SE	-38.8	-1.5	-1.3	64.00
SW	-30.59	-7.7	0.0	56.46

Source : Computed by GEAG though Google Earth Image of 2006 and 2016

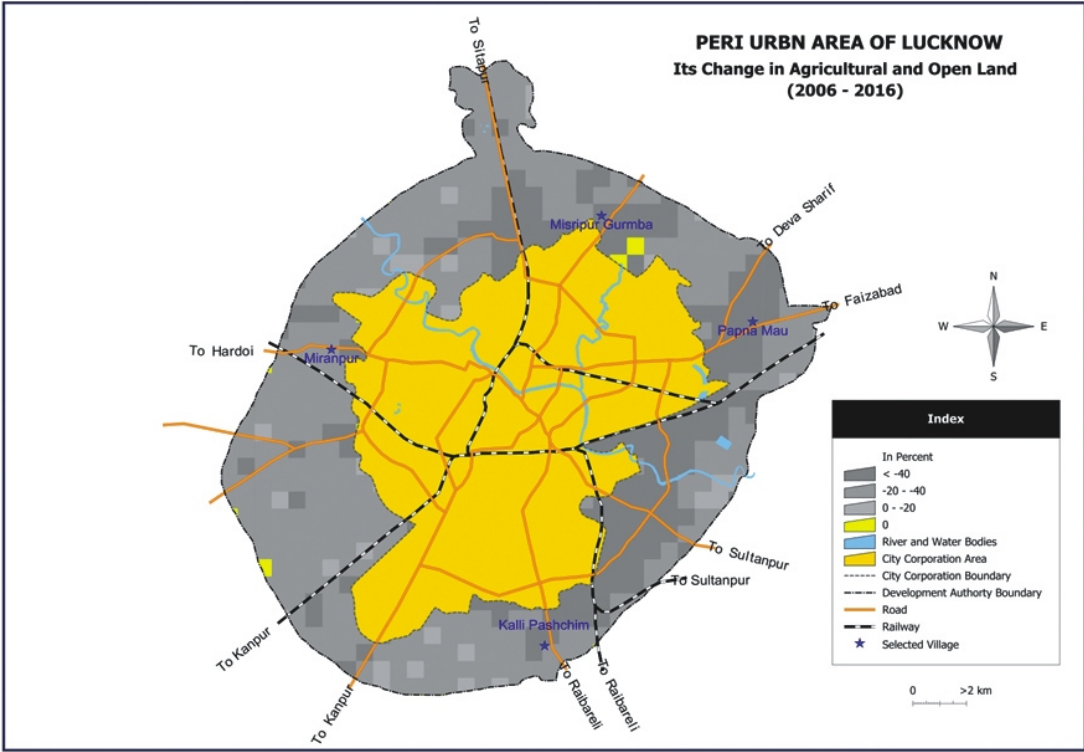
The city of Lucknow has expanded more towards north east and south-east directions. The percentage change in the built up area in different directions is given in the

above table. The city has old sewer lines in most of the old city area but now under JNNRUM mission, most of the city area has been provided the sewerage facility.

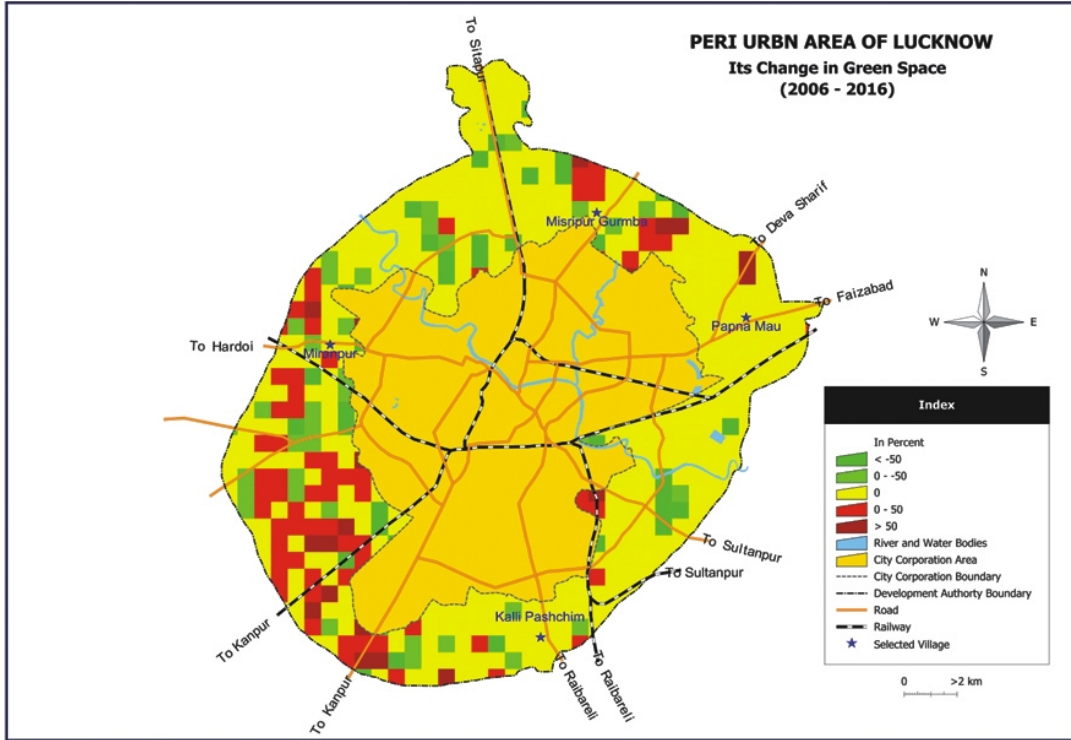
MAP 10
CHANGES IN BUILT UP AREA DURING 2006-16 IN LUCKNOW



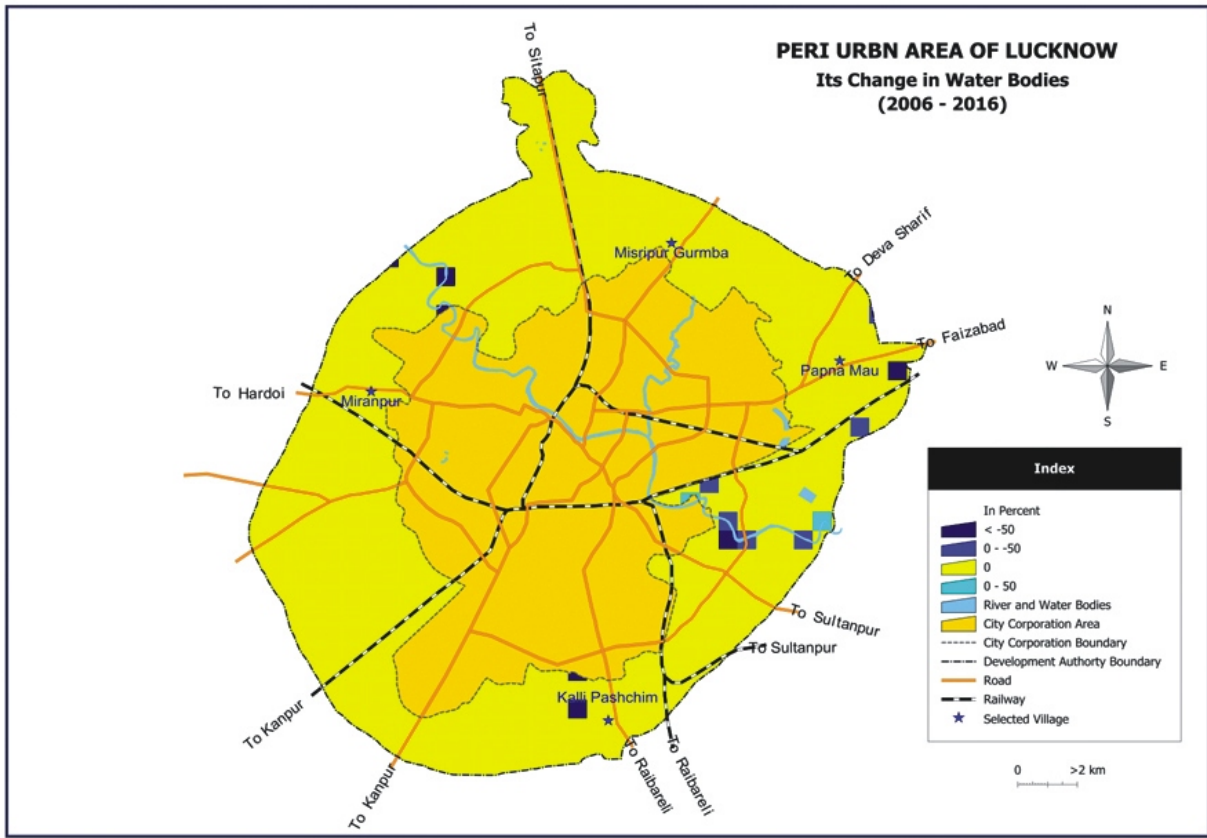
MAP 11
CHANGES IN AGRICULTURE AND OPEN LAND AREA DURING 2006-16 IN LUCKNOW



MAP 12
CHANGES IN GREEN SPACE AREA DURING 2006-16 IN LUCKNOW



MAP 13
CHANGES IN WATER BODIES AREA DURING 2006-16 IN LUCKNOW



This city has many STPs, but those which are close to Development Authority boundary, especially in the east, north east and south west, are still not connected with the city's sewerage system.

Key Sanitation issues in peri-urban areas

Interaction with the community in five villages, two from Chinhat Tehsil (east of the city), two from the south and one from the south-east zone of Lucknow peri-urban areas, have revealed the following issues regarding the peri-urban areas of the capital:

- ◆ In most of the peri-urban villages of the city, only 10 to 20 percent area is under cultivation or left fallow. Rest has been sold out to the developers, industrialists or individuals for construction of residential colonies/houses. Some of the open land has been given on Patta to the landless farmers.
- ◆ Area under water bodies in the peri-urban areas is declining. People of peri-urban areas informed that water bodies were the main source of irrigation, bathing of humans and animals,

- ◆ cleaning of utensils and ground water recharge, but with urban expansion, most of the water bodies located in the peri-urban areas have been encroached upon, filled up and houses have been built over them.
- ◆ The increasing rate of ground water usage has caused a fall in the water table. People also informed that without proper drainage system development, water logging incidences have also increased in the colonies of the peri-urban areas.

Mr. Akashdeep of village Dhava, Chinhat, District Lucknow said, "90% of the village land has been sold and utilized for building houses. The water reservoirs of the village have been encroached by the residents. The two water reservoirs which are not encroached have been converted into dumping grounds. There are no facilities regarding cleanliness, and garbage of the city is dumped in water bodies resulting in the contamination of ground water. This has resulted in a drastic increase in diseases."

- ◆ The drains constructed in the peri-urban areas are neither properly constructed nor cleaned, which creates stagnation of water in the drainage and causes foul smell and breeding of the mosquitoes and flies which ultimately cause communicable diseases.
- ◆ Factories established in the peri-urban areas are major sources of pollution because they do not have the treatment plants for smoke, liquid and solid waste and they dispose their untreated waste in the nearby locality, causing pollution in the area.

Saharanpur

Saharanpur is a city and a Municipal Corporation in the north west of the state of Uttar Pradesh. It is the administrative headquarters of Saharanpur Tehsil, District and the Division. It is located at 29° 97'N 77° 55'E and it has an average elevation of 269 meters above mean sea level. Saharanpur is also a part of Doab region which is situated between Ganga and Yamuna rivers and its site is a monotonous plain terrain with ample open spaces and a general slope from north to south. It has a semi humid sub-tropical climate and records an average temperature around 23.3°C and average annual rainfall is about 1058 mm. The depth of groundwater is 10 to 20 meters. In 2009, the Saharanpur municipal board became a municipal corporation which is called Saharanpur Mahanagar Palika. The city has also been selected under the Smart City Programme. As per Census 2011, it has a population of 7,05,478 which was 4,55,754 in 2001 with a record growth of 54.79 percent (Table 8).

Saharanpur is a flourishing business city and an important regional centre for wholesale and retail

TABLE 8
DECADAL POPULATION GROWTH IN SAHARANPUR CITY

Year	Population	Decadal Change in (%)
1971	2,25,396	-
1981	2,95,355	31.04
1991	3,74,945	26.95
2001	4,55,754	21.55
2011	7,05,478	54.79

Source : Census of India

trade, particularly in grain, timber, textiles, food and beverages. It is famous for its wood carving cottage industry as well as a thriving market for local agricultural produce including Basmati rice and mangoes. A variety of industrial enterprises located here include textiles, sugar, paper and cigarette factories. The sewer lines in the city cover only 50 of the city area and have only one STP capable of treating only 25 of the total sewage generated by the city. The rest is drained out untreated, into the rivers Damola and Pawahai. Some drains are constructed for sewage disposal but are choked with silt and garbage, and without proper maintenance fail to drain the water efficiently. The banks of the two rivers, Damola and Pawahai that flow through the city, have been occupied by slum dwellers. The neighborhood of Dehradun-Saharanpur-Delhi road is developing very fast due to its accessibility and another smaller developing area is visible on the Saharanpur-Deoband road.

The analysis through Google Earth image of 2006 and 2016 indicates that the city is growing more towards the north-east direction.

TABLE 9
LAND USE CHANGE (IN PERCENT) IN PERI-URBAN AREAS OF SAHARANPUR (BASED ON GOOGLE EARTH IMAGE OF 2006 AND 2016)

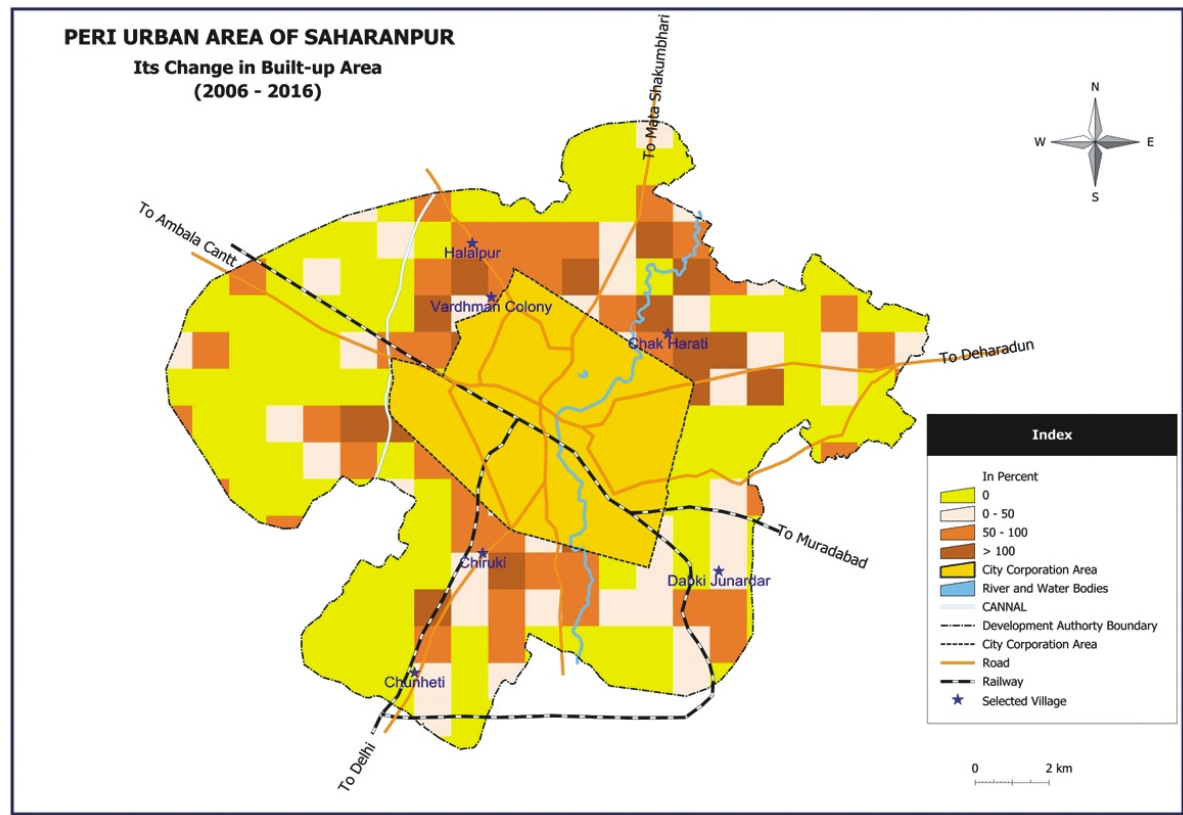
Direction	Agriculture/open space	Civic forest/ green belt	Water bodies	Built up area
NE	-5.24	-11.6	-4.0	43.70
NW	-3.08	-29.4	-3.6	32.00
SE	-3.73	-17.0	-7.01	33.50
SW	-5.16	-22.9	-2.90	36.40

Source : Computed by GEAG though Google Earth Image of 2006 and 2016

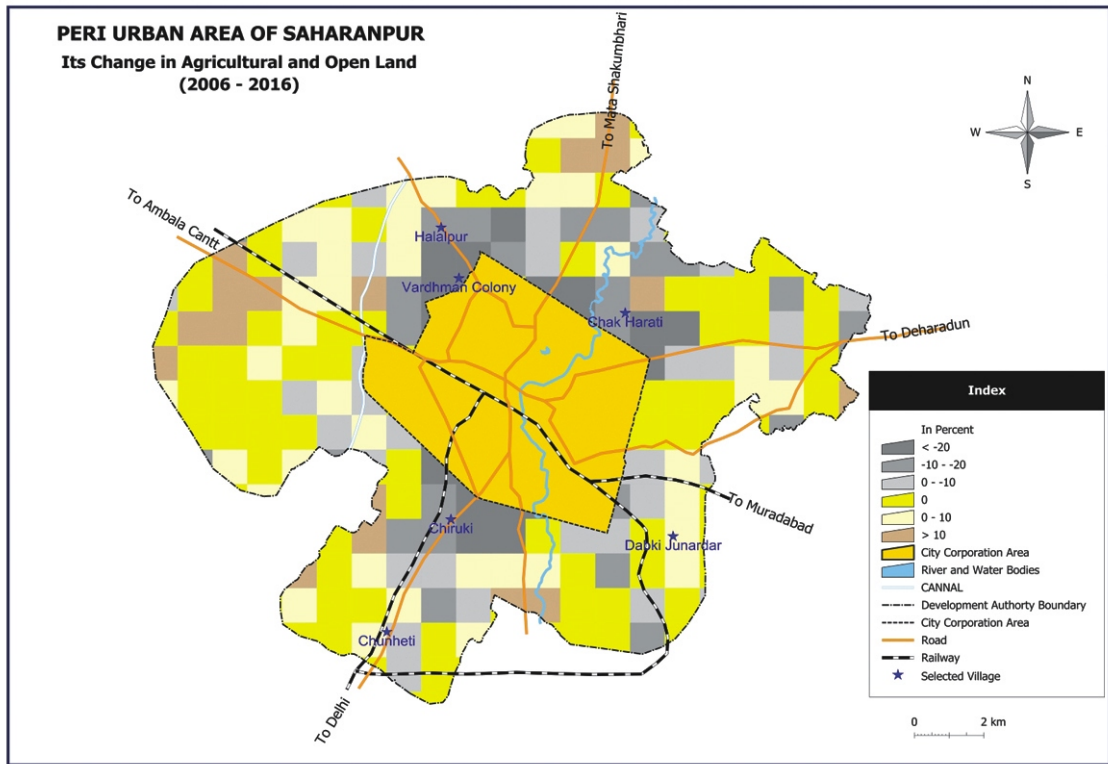
PHOTO 6
SOLID WASTE DUMPING PLACE IN PERI-URBAN VILLAGE



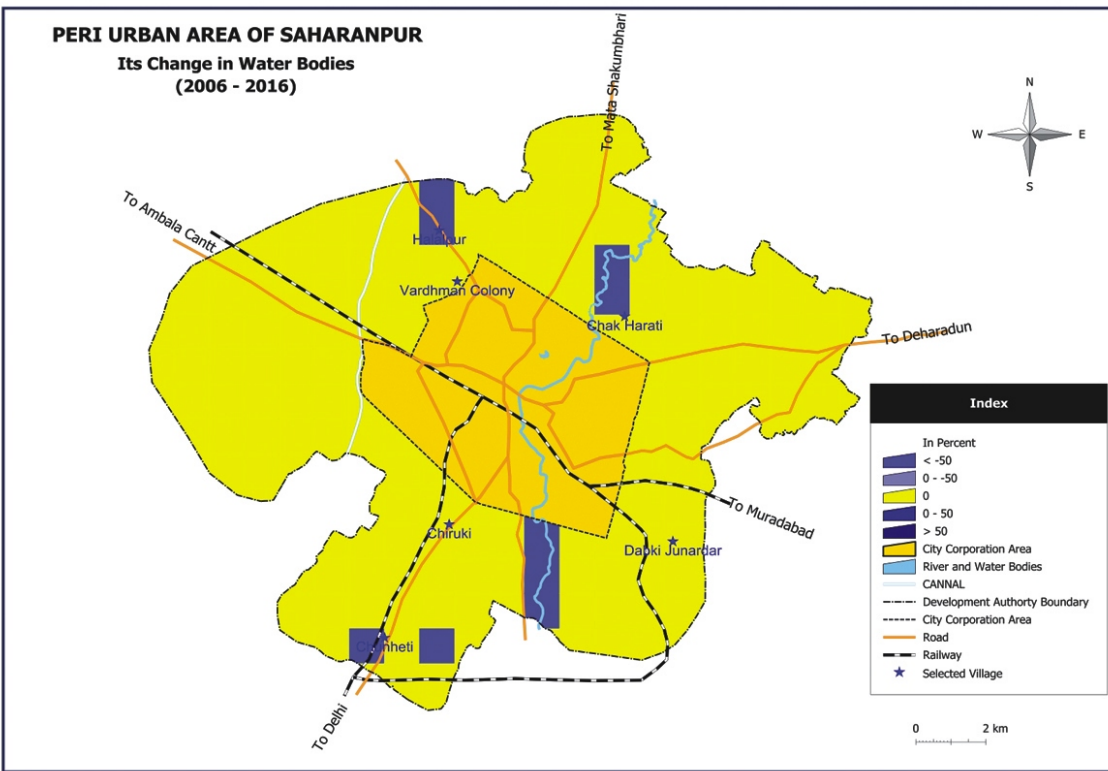
MAP 14
CHANGES IN BUILT UP AREA DURING 2006-16 IN SAHARANPUR



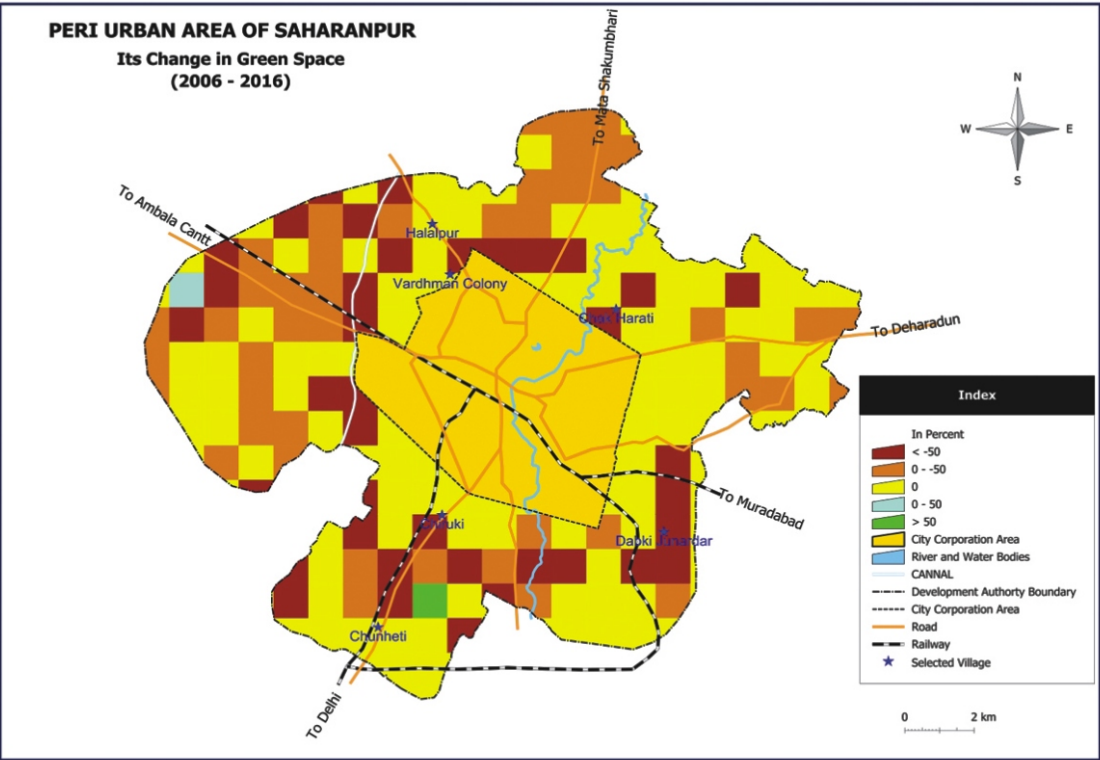
MAP 15
CHANGES IN AGRICULTURE AND OPEN LAND AREA DURING 2006-16 IN SAHARANPUR



MAP 16
CHANGES IN WATER BODIES AREA DURING 2006-16 IN SAHARANPUR



MAP 17
CHANGES IN GREEN SPACE AREA DURING 2006-16 IN SAHARANPUR



Interaction with the community in the peri-urban part of the city reveals that about 60-80 percent of the open or agricultural lands have been sold out to the colonizers, industrialists and private house developers. Water bodies are filled up and developed for construction of houses. Real estate agents and land contractors are selling the land after developing plots, at exorbitant prices.. Most of the village residents who sold their agricultural land have now become unskilled labourers, least interested in agriculture or their traditional occupations. Most of the villages do not have any source of safe drinking water. Local hand pumps and India Mark II hand pumps are the only sources of drinking water which is not potable due to contamination issues.

Key Sanitation issues in peri-urban areas

The unplanned development of the city is also causing water logging in the peri-urban areas. The interaction with people of village Chakdevli of district Saharanpur reveals that poor drainage system in the peri-urban villages is a serious issue and the main cause of water logging. They further added that even in cases of light rainfall, the houses in low lying areas get inundated.

This stagnant water plays an important role in increasing the mosquito menace and other vector borne diseases. Interaction with the community in villages Manoharpur, Chiidwana, Chakdevale and Halalpur on urban expansion and sanitation crisis of the peri-urban areas reveals the following points:

- ◆ Peri-urban villages of Saharanpur are developing very fast due to industrial development in the outskirts of the city and availability of education and health services.

Mr. Ram Prasad of Peer Mauza (40 years), "There is no system of waste collection and management. The municipal corporation dumps it wherever they find the open land. Generally, the waste is disposed along the road and canal which creates foul smell during rainy season after decomposing. Summer winds disperse the waste materials to neighbouring village and agricultural lands. The liquid waste flows in the streets of the village. Only 40 to 50% HHs have toilets. The conditions show the criticality of the sanitation in the village."

- ◆ Solid waste of the city is dumped in low lying areas (Ambala Road) and open land along the railway line, where it decomposes and pollutes the land, soil and groundwater after percolation into sub surface along with the rain water.
- ◆ Though in newly developed colonies of peri-urban areas, households have built their own toilets, but among the original residents of the villages, only 50-60 percent households have toilets, while the rest resort to open defecation.
- ◆ Grey water of the city is discharged into open spaces of the peri-urban areas. The villages adjacent to the municipal boundary are worst affected and are forced to live along the water and air pollution discharged from the industries.
- ◆ The Saharanpur Development Authority and Municipal Corporation have been inactive since the last one decade. The elections for Mayor or Corporators could not take place since the last few years due to litigation. The development of the city is not properly regulated, causing problems of irregular growth, water logging, disposal of waste and finally intensifying the problem of sanitation. Due to the absence of a regulatory body, land use of the peri-urban areas as prescribed in the Master Plan is openly violated and construction goes on in the green belt too without any proper development of infrastructure for roads, drains or drinking water.

Gorakhpur

Gorakhpur is a city located on the confluence of rivers Rapti and Rohin in the north-eastern part of Uttar Pradesh. It is the headquarters of the Tehsil, District and the Division of the same name, lies in Latitude 26°45' N. and Longitude 83°22' E at 100 km south of the Indo-Nepal international border. It is situated in the Ghaghra-Gandak doab, a part of vast Gangetic plain made with alluvial filling. Its average height is about 94 m above sea level; climate is moderate sub-tropic with an annual average temperature of 25.68°C and annual rainfall of 1379 mm. The groundwater level of the city ranges from 8 meters during post-monsoon to about 15 meters during pre-monsoon, and hence sufficient groundwater is available.

Currently, the city of Gorakhpur has a total population of 6.73 lakh within an area of 147km², with an average density of about 4,571 person/km² (Census, 2011). Gorakhpur is one of the fastest growing cities in the Middle Ganga Plain (second largest city after Varanasi). The growth was faster in the last three decades with a

record growth during 1981-1991 (61.31 percent). With infrastructural developments, radical changes in land use and population have occurred since 1971. The small town of 39 km² of 1981 has now become a city of 147km² (2011), which incorporates 47 villages at its fringes into the boundary of Gorakhpur Municipal Corporation (Wajih S et al, 2009).

The population is unevenly distributed across the city,

TABLE 10
DECADAL POPULATION GROWTH IN GORAKHPUR CITY

Year	Population	Decadal Change in (%)
1971	2,30,911	-
1981	3,13,418	35.73
1991	5,05,566	61.31
2001	6,22,701	23.13
2011	6,73,446	8.15

Source : Census of India

with dense population in the core area. A lower population density exists in the newly developed wards in the northern parts which were developed after the establishment of the fertilizer corporation and medical college on Nautanwa and Maharajganj road respectively. The rapid influx of population from nearby rural areas (as well as from outside the state) has exerted tremendous pressure on the city's infrastructural capacity. The concentration of population is high in the western and south western parts. The areas with low and very low population density are in the outer zone of the city especially in north, north east, south west and east of the city (ibid).

Between 2001-2011, Gorakhpur's population grew annually at an average rate of two to three percent due to migration not only from the surrounding areas but also from states such as Bihar, thereby immensely straining civic amenities (Mitra, A. and Singh, B.K. (2011). In almost all the consultations conducted in the peri-urban areas, people responded that increasing urban population, emergence of a speculative land market, reliable transport infrastructure, new educational and commercial institutions have increased the pressure on peri-urban land. Due to easy availability of land at prices lower than that at the core urban part, people from diverse backgrounds including a large proportion of urban middle class as well as migrants from Varanasi, Lucknow and Bihar prefer cheap and affordable housing in the peripheral areas. As per the master plan records, during the last 30

years (1970-2001), more than 25 unauthorized colonies have developed, most of them outside the city boundary. Apart from this, people are also purchasing land in the peri-urban areas as a long-term investment. They believe that land prices will rise substantially when GDA will earmark the area for housing development. The analysis of Google images of 2006 and 2016 indicated that during the last 10 years, large tracts of

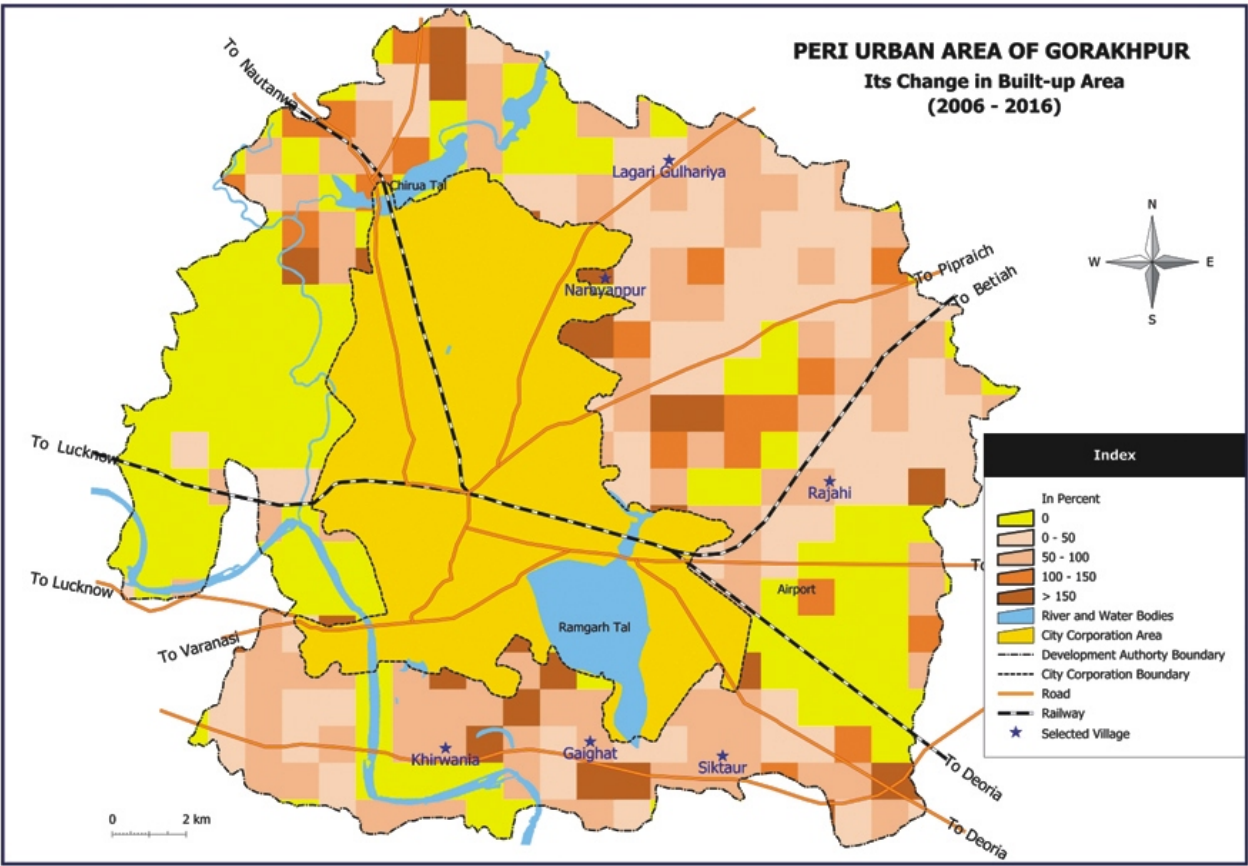
agriculture land in north east and south east directions have been converted from agriculture to built up area. (Table 11). These areas are free from floods and water logging and so land sharks are more active here. They acquire agriculture lands of small and marginal farmers, and play a critical role in converting open green spaces/agricultural lands into residential areas.

TABLE 11
LAND USE CHANGE (IN PERCENT) IN PERI-URBAN AREAS OF GORAKHPUR (BASED ON GOOGLE EARTH IMAGE OF 2006 AND 2016)

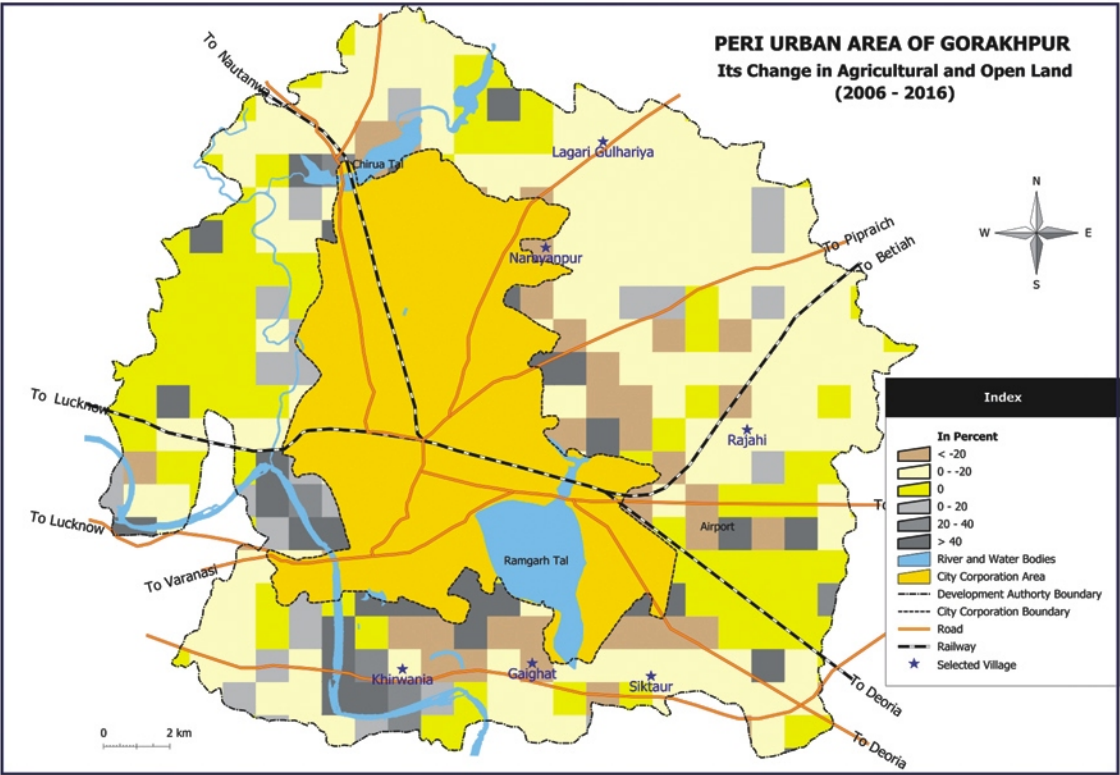
Direction	Agriculture/open space	Civic forest/ green belt	Water bodies	Built up area
NE	-12.54	-1.12	-1.14	65.86
NW	8.29	-1.12	-2.50	38.54
SE	-0.14	-4.93	1	66.99
SW	10.20	-30.98	-19.45	46.57

Source : Computed by GEAG though Google Earth Image of 2006 and 2016

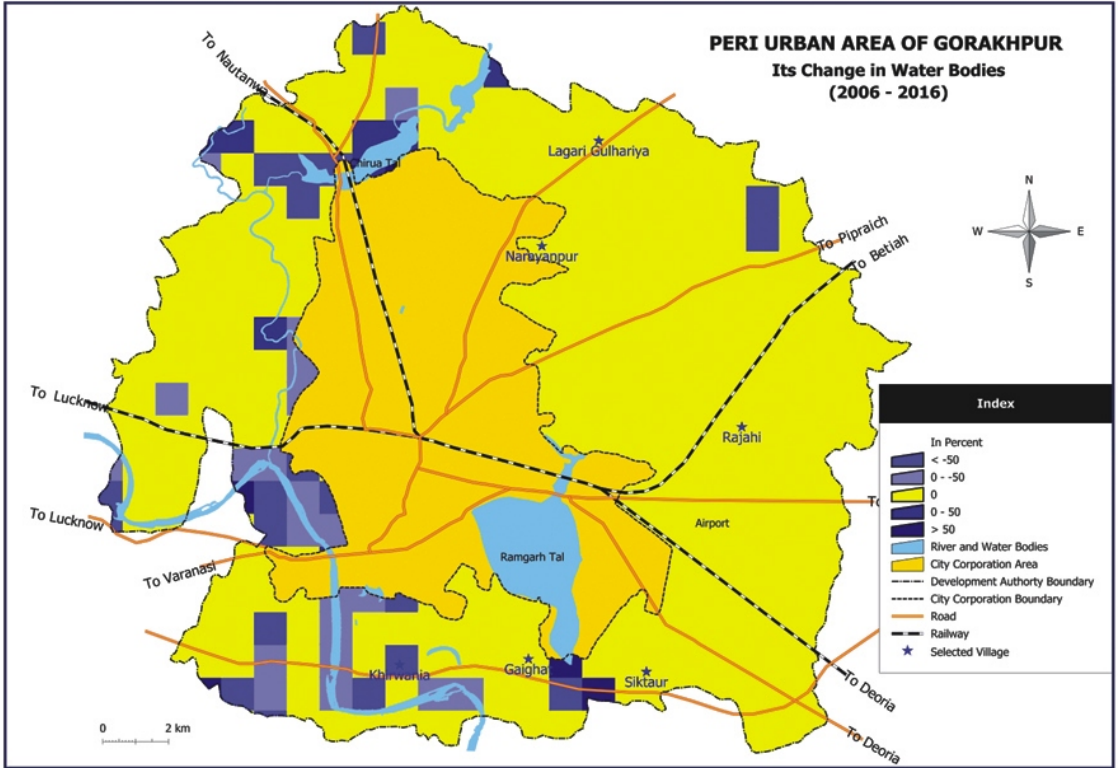
MAP 18
CHANGES IN BUILT UP AREA DURING 2006-16 IN GORAKHPUR



MAP 19
CHANGES IN AGRICULTURE AND OPEN LAND AREA DURING 2006-16 IN GORAKHPUR

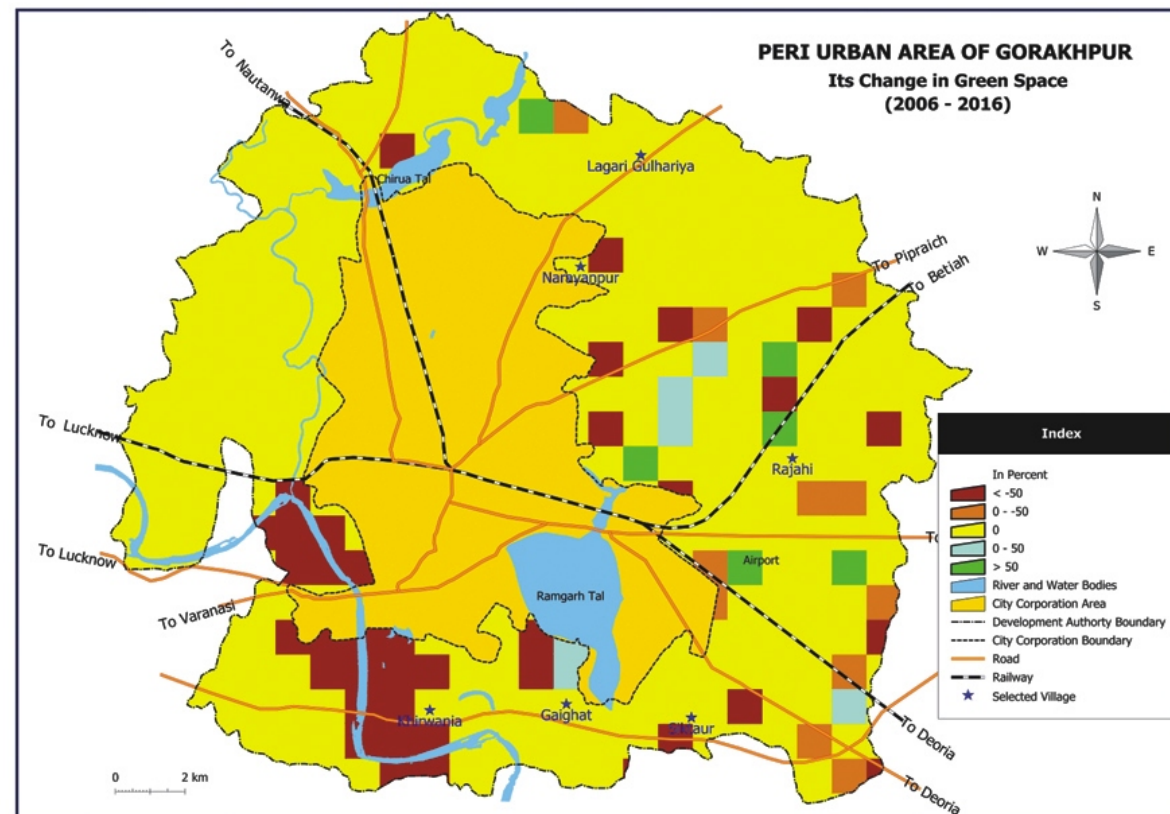


MAP 20
CHANGES IN WATER BODIES AREA DURING 2006-16 IN GORAKHPUR



MAP 21

CHANGES IN GREEN SPACE AREA DURING 2006-16 IN GORAKHPUR



The above analysis of land use changes in the periphery of Gorakhpur shows that during the last 10 years, the built up area has increased in all directions but more prominently in the north-east (NE) and the south-east (SE) directions. It is 66.99 percent in the SE, 65.86 percent in the NE, 46.57 percent in the South West (SW) and 38.54 percent in the SE direction respectively.

In all the segments, the area under civic forests and water bodies has decreased significantly. The proportion of area under water bodies in the SE has decreased prominently by 19.45 percent. In the last 10 years, the ratio of agriculture land has decreased by 12.54 percent in the NE. This means that agriculture land has been converted into residential areas. In this direction, residential areas are developing very fast along Gorakhpur-Nautanwa up to Chilua Tal, along Maharajganj Road up to medical college, on Pipraich road up to Padri Bazar. In the SE also, the same phenomenon is happening. Big residential colonies have been developed by the GDA, Avas Vikas Parishad (Housing Development Board) and private colonizers are on a building spree between Deoria road and Deoria bypass.

Key sanitation issues of peri-urban areas

- Increasing volume of solid waste in the city and shrinking disposal choices are creating serious environmental issues in the peri-urban villages. In 2016, there were violent clashes between peri-urban communities (Mahewa) and the municipal authorities over mindless dumping of garbage. As per the GMC records, the city generates 601 metric tons of municipal waste daily. The GMC claims that they collect 90 to 92 percent of city's solid waste, but garbage management practices violate the Municipal Solid Waste (Management and Handling) Rules, (Municipal Solid Waste) 2000. Gorakhpur's solid waste is either being used as landfill material (peri-urban villages like Chakra Doam, Mahewa, Baharampur) or is dumped in some of the demarcated locations especially in the low lying areas in the outskirts (Mahewa, Nausad and Maheshara). Community interactions in the older part of the city (Mahewa and Turkmanpur) and adjoining villages at the city boundary reveals that solid waste in these localities is not collected on a regular basis. GMC also acknowledges that due to lack of human resources and funds, the solid waste management work has not accelerated. They accept

that rampant use of polythene and uncollected waste has become a cause for water stagnation. In 2015, the GMC started door-to-door collection of waste in eight wards of the city as a pilot project, but due to some technical issues, the process was not scaled up. The city has developed a Detail Project Report (DPR) on solid waste management as per the guidelines of MSW, 2000. It proposes to establish four Solid Waste Management (SWM) dumping stations at the following locations: (a) In south, at the Deoria Gorakhpur bypass road (b) In north, near the Gorakhpur Pipraich road (c) Near the Chilua Tal (d) To the west of Maluni Bandha Road. It is also proposed to develop an SWM plant on 32 acres of land in Maheshara in the north of the city. This will involve segregation, treatment, and composting of solid waste.

- The peri-urban areas also suffer from the city's liquid wastes. As per the GMC records, every day the city discharges 66.395 MLD of sewage directly into the peri-urban villages, lakes (Chilua Tal) and in the Rapti. Currently, the city has only 22 percent of area under the coverage of sewerage system (55 km) but this too has become decrepit (Wajih S,et al, 2009). The rest of the city is covered by 229 open drains, which not only carries the storm water, but also the sewage from homes. The flat topography of the city constrains building an effective drainage

system without pumping. The city consultations revealed that a project worth Rs. 80 million has been sanctioned by the state government for extending the drainage facility. It involves widening and upgrading of five (trunk) *kutcha* drains. Untreated waste water is discharged into the Rapti and Chilua Tal pumping stations. The UP Jal Nigam had submitted a proposal to the state government for extension of the sewerage system in the city in which a sewerage farm was proposed at the Malauni Bandha road for disposal of sewage in the city. Besides this, Jal Nigam is implementing a project for cleaning and beautification of the Ramgarh Tal (TERI, 2012). It is being partially funded through both central and state governments. However, not much progress is visible on ground.

- Gorakhpur and its surrounding areas have now become the epicenter of health epidemics. Official health records and interaction with community in most of the peri-urban villages has revealed that about 60-70 percent population (in which children are more susceptible) is suffering from abdominal diseases due to intake of polluted and contaminated water. Japanese Encephalitis, AES, Jaundice, Cholera, Colitis, Diarrhea, Worm, Dysentery, and skin diseases have become rampant. Every day, cases of child fatality are reported in the media due to various diseases. Data from health

PHOTO 7

WASTE DUMPING ALONG EMBANKMENT TO RIVER RAPTI BANK



department shows 62 out of 1,000 children born in Gorakhpur die before the age of one year, as against 48 out of 1,000 in UP and 40 out of 1,000 in India (Times of India, 13 August 2017).

- ◆ The peri-urban areas of Gorakhpur are notorious for water and vector borne diseases. In Harijan Basti of Chakra Doyam, housing about 50 poor Dalit households, residents complain that the city's waste water, sewage and sludge is siphoned right into their dwellings (Mitra, A, Wajih, S and Singh, B.K., 2015). Due to this waste water, skin disease, diarrhea, jaundice, colitis and cholera are very common among the children in the village. They also said that the embankment constructed in the pre-Independence period to keep floodwater out of the urban wards causes water logging for more than three to four months. Sometime small children drown in these seasonal water bodies leading to clashes between villagers and urban ward residents.
- ◆ Heaps of garbage near human dwellings, paddy cultivation and prolonged water logging due to faulty alignment of embankments in the peri-urban villages of the city are promoting a conducive environment for mosquitoes to breed, and for animal to human transmission of viruses and bacteria through insect vectors. Bacteria (Bush

Typhus for instance), too, thrives in unhygienic surroundings which attack the ill-nourished bodies of children from poor families. Malaria and Dengue are the common vector borne diseases of the area. Japanese Encephalitis and Acute Encephalitis Syndrome are now rampant and have unfortunately made this whole region (entire eastern Uttar Pradesh and adjoining parts of Bihar) notorious all over the world for its health epidemic. It is a disease carried through mosquitoes, which breeds in unclean environments and prolonged waterlogged areas (Singh, A, 2010). As per official records of BRD medical college, one of the major government public health centres in the region for encephalitis treatment, every day 20 child fatality cases are being recorded due to Japanese Encephalitis and Acute Encephalitis Syndrome (Singh M, 2017). Though state government has initiated vaccination for JE but still the situation is not under control. In this regard, more research is needed to design effective steps to control the disease. One such study entitled 'Vulnerability Assessment of Gorakhpur City' conducted by GEAG through community consultation in 2010 reveals that clearing of forest/vegetation, increasing rodent population as well as climate change, could be additional factors contributing to reemergence of AES virus.

Conclusions

The five case studies of urban centres of Uttar Pradesh show that haphazard urbanization processes in these different agro-climatic zones have significantly influenced land use pattern and aggravated the deteriorating sanitation situation in the peri-urban regions.

The evidence collected from cities indicates that emerging cities of Uttar Pradesh are heading towards a major sanitation crisis in the coming years and the peri-urban areas will be the worst areas to live in. Haphazard growth in peri urban areas is already leading to the choking and obstruction of existing drainage lines, and there is also no sanitation infrastructure to link the growing city to the main sewer system of the city, which is essential for future development of the peri-urban area. These areas should be developed in such a way so that in the future they can be integrated seamlessly into the city system as soon as the city boundary expands.

Efforts made at meeting the sanitation challenges in the city and its rural surroundings have been found to have very limited results, with as high as 77 percent of the population not having toilet facilities, coupled with a very low use of existing toilets in urban and rural areas. Massive campaigns have been launched to restrict open defecation and encourage construction of personal toilets; And most of the villagers are both acquainted with the campaign and willing to construct

toilets. But malpractices of government machinery, demand of bribes for subsidy disbursement and availability of funds are some of the constraints that prevent them from doing so. Poor solid waste management and discharge of raw sewage into the river and water bodies of the peri-urban areas is also an open invitation to future health epidemics.

Considering the importance of peri-urban areas for urban resilience, these peripheral spaces should not be considered as a 'waiting room' for future urban areas. A fundamental change in behavior and mindset is needed among the planners and policy makers to prevent further land use change and illegal construction activities. The selling of agriculture land for short-term benefits can be reduced by motivating and demonstrating resilient farming models of agriculture and its long-term benefits to the farmers.

It is perhaps the right time to critically evaluate the development process and pay attention to the underlying complexities of sanitation crisis in the peri-urban areas. If people of peri-urban areas are meticulously helped to improve farming, horticulture, and animal husbandry in an eco-friendly way, no one will easily sell off their valuable lands to builders, but rally together to protect the open spaces and water bodies in their areas.

PHOTO 8

WATERLOGGING IN A PERI-URBAN VILLAGE KHIRWANIA, GORAKHPUR





Suggestions

Effective master planning and proper enforcement

The Development Authority of the respective cities is responsible for regulating land use, planning and development of the peri-urban zone between the city boundary and the development authority limit. The brokers, colonizers, developers and private house builders are developing housing in peri-urban areas against the existing master plan. Most flood-prone and other restricted areas are also being developed illegally which is the major cause of water logging and flooding in peri-urban zone as well as in city areas. The colonizers are indifferent to the natural drainage and slope of the land, and only look at economic gains during the development of the plots and construction of buildings. With a myopic vision, they construct the boundary wall, filling the land and other infrastructure without considering the larger picture in terms of natural drainage and water flow, which further adds to the problem of inundation. The Development Authority must regulate and monitor this development as per the master plan, building manuals and existing physical features of the land eg. relief and slope, in an effective manner.

Awareness amongst citizen groups and community

A sanitation awareness campaign should be launched to educate rural people about the urgent need and benefits of sanitation. Civil society and other village stakeholders, especially the Pradhan and other Panchayati Raj Institution's members, must be trained and sensitized about the issues of sanitation and its effect on the health and well being of the community.

The community itself should be apprised of the importance of personal toilets and adequate sanitation hygiene, as some of the HHs that have built toilets, still avoid using them and instead prefer open defecation.

Decentralized community owned solid and liquid waste management

Decentralized, community owned, less energy consuming, cheap and sustainable treatment plants should be established in villages to treat their waste water and solid waste. An exemplary initiative has been implemented in Gorakhpur city where Mahewa ward

committee has established a bio-degradable solid waste treatment system in their ward. Here door to door collection of waste from 100-120 households is managed by a drum system, which happened after a rigorous motivation campaign carried out by GEAG. Decentralized Waste Water Treatment System (DEWATS) has also been initiated in a peri-urban village, Semra Devi Prasad, which treats the waste water of the village and uses this treated water for irrigation. The government must initiate this self dependent outlook and establish such models in peri-urban villages as well as in the city localities, to treat waste at the local level in a decentralized manner. Along with this, dumping of solid and liquid waste in peri-urban areas must be prohibited to improve the sanitation and hygienic condition of these villages. The city government should also try to install the system of waste segregation and its complete management before its final disposal in any locality.

An enabling environment to formalize colony development is necessary to ensure that land for decentralized waste water treatment and solid waste management is kept reserved and this will further help the colonies conveniently install such plants. Policies and rules must be more stringent to enable the colonizer to sell plots only after providing the backbone infrastructure (for water, energy, sewerage line and roads). Adequate open land for gardens, playgrounds and community needs must be reserved before sale of plots can occur. This can be an important addition to Real Estate Regulation Act (2016), which will ensure that prospective buyers not only get basic essential services, but also inherit a healthy and sustainable habitat.

Restoring existing water bodies

In the cities and their peripheries, there are many water bodies. These generally lie abandoned or degenerate into foul cesspools as waste water and solid waste is dumped into them with impunity. In other scenarios, they are totally neglected without any attention to maintain their ecosystem or purity. Either way, it is a challenge to restore these existing water bodies in a city which is solely lost in the humdrum of construction and development. What is forgotten is that these water bodies help recharge groundwater, a fast depleting resource in peri-urban regions due to an accelerated pace of development. During heavy rains and even earthquakes, they act as a shock absorber and help the city become more resilient. However, in some cases, where such water bodies are linked with the drinking water supply for the town, they are given some

attention. To restore water bodies, the most important aspect is to maintain their quality of water. For that purpose, no untreated water or effluents must be allowed to drain into these water bodies, and only tertiary treated water should be allowed to flow into them. Moreover, it has been observed that the adjoining areas of such water bodies are abandoned, and this makes it difficult to approach them. In most cases, the bank of the water body has sufficient space which can be utilized as a site for walking, and a little effort can make these areas aesthetically appealing to local residents through plantations along the banks, and turn them into rewarding picnic or scenic beauty sites. The corporation and the district authorities of respective cities need to engage the services of a technical consultant and prepare a comprehensive plan to revive these water bodies.

Frequency	Percentage
Daily	85%
Not daily	15%

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- ◆ Mitra, A. and Singh, B.K. (2011) Servicing the city: migrant workers and deprivation in Gorakhpur, Uttar Pradesh, India. Gorakhpur Environmental Action Group
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- ◆ National Family Health Survey- 4, 2015-16, Uttar Pradesh State factsheet, Published by International Institute for Population Sciences (Deemed University), Deonar, Mumbai
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Notes

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