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Socio-Economic and Environmental Challenges of Urbanization: Case Study of Varanasi City

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Abstract- ***This paper reflects on the socio-economic and environmental aspects of Varanasi city. These are two integral and interconnected dimensions of urbanization. Varanasi is one of the oldest cities in the world, having a rich cultural heritage, spiritual and economic significance. The city offers a particularly interesting case for studying both aspects. Varanasi is not only a holy land of religious pilgrimages, but also a centre for trade, education, handicrafts, and tourism. With a population exceeding one million, Varanasi is a gradually developing urban centre of Uttar Pradesh. The analysis focuses on various factors affecting Varanasi's urbanization pattern and rate by using secondary data sources. The study's objective to provide a detailed and relevant analysis of the socio-economic and environmental challenges of Varanasi city. This work emphasizes the necessity of integrated urban planning, efficient governance, and community involvement.***

Keywords: Socio-economical, Good Governance, Environmental challenges, Urbanization and Varanasi.

I. INTRODUCTION

Urbanization (Pragya, 2024) is the transformation phase where societies change from rural societies to towns and cities. It often begins with small villages and grows as populations increase and new opportunities arise. Over time, cities become canters for economic activity, social life, and cultural exchange, driving modernization and development. As cities grow, they change how people live by creating more opportunities for work, social mobility, and innovation.

In parallel, urban growth brings social, economic, and environmental challenges like inequality, congestion, weak infrastructure, and environmental stress. The speed and scale of these changes mean that careful management is needed, as poor planning can make problems worse and threaten sustainability. Seeing urbanization as both a challenge and an opportunity highlights the need for thoughtful planning, community involvement, and sustainable policies to support balanced and lasting development for today and the future.

II. STUDY AREA

Varanasi, The City of Lord Shiva also known as 'KASHI' is the oldest city in the world lies on the banks of the holy river Ganga, has attracted pilgrims, scholars, and traders for thousands of years and stand as living symbol of India's spiritual, cultural, and historical legacy. Proof of provenance of Varanasi found in ancient Hindu sculpture such as Rigveda, Ramayana, Mahabharat, Puranas and archaeological evidence suggesting settlement as early as 1800 BCE. Hindu mythology attributes the city's foundation to Lord Shiva, infusing Varanasi with deep religious importance for Hindus, Buddhists, and Jains alike. Since 11th century (2nd millennium BCE) Varanasi emerged as a leading urban centre in Gangetic plain, thriving a capital of Vedic culture and a hub of trade in silk, perfume, ivory and sculpture. The city's legacy continues through the ages. Lord Buddha have delivered his first sermon at Sarnath nearby Varanasi around 6th century BCE, making Varanasi a site of immense Buddhist reverence as well. The religious aura of Varanasi is beyond compare. It has more than 3,000 temples, including the famous Kashi Vishwanath Temple just dedicated to Lord Shiva. The city is considered the holiest place in Hinduism. It is believed that a pilgrimage and ritualistic bath in the Ganges at Varanasi can wash away a lifetime of sins, and it is further said that the performance of hands last rites here guarantees the departure of a dying soul from the cycle of rebirth and to MOKSHA. The city is also of importance to the Jains, on account of it being the birthplace of some Tirthankaras. For centuries, Varanasi stood as a golden hub for learning and became a haven for many sages, philosophers, and

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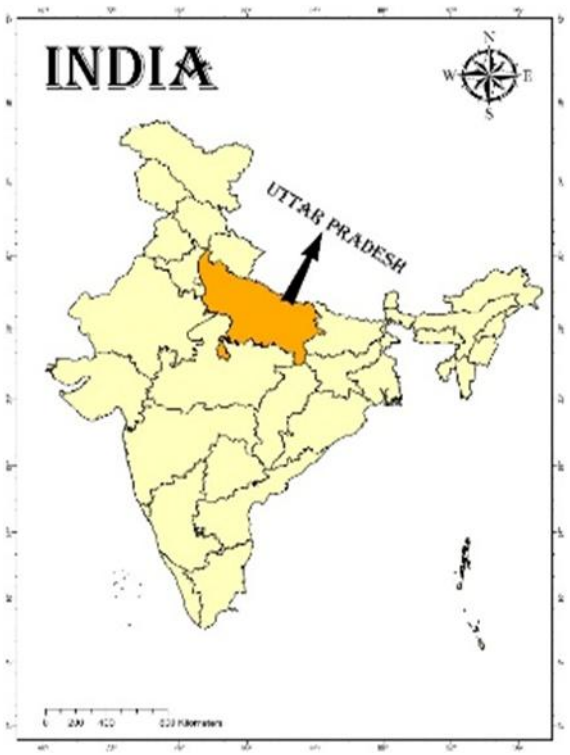
artists. The city witnessed multiple dynastic rules including the Mauryas, Guptas, Mughals, Marathas, and the Britishers that left behind an epic legacy of temples, fortifications, literature, and art. It suffered many periods of decline, the most significant of such being in the 12th–17th centuries invasions, but it always found a way to recover and regain its spiritual leadership in time. Varanasi in the Hindi heartland has always been the centre of cultural affluence, speakers of legendary poets, artists, musicians, and thinkers. The ghats of the city on the Ganges are the place where rituals, festivals, daily life at their fullest perform. As a city that still heavily relies on the past but very much alive and thriving in the present.



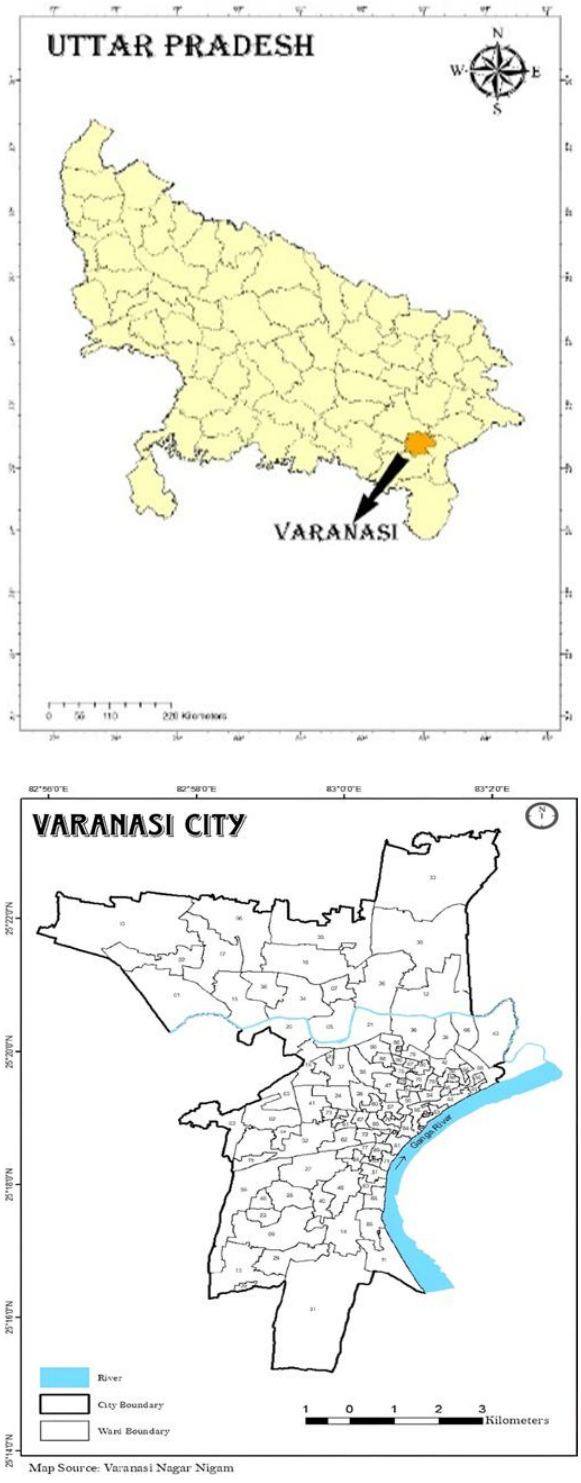


Fig. 1. The Map of the study area

Varanasi situated on the left bank of Ganga River in south-eastern part of Uttar Pradesh, India. Latitudinal extends 25º14'N - 25º23.5'N and Longitudinally extends 82º56'E - 83º03'E covering 82.1 km2 of municipal corporation. It is divided into 8 municipal

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zones and 90 wards. Total population of Varanasi city is 1,198,491 (Varanasi Population, 2011) out of this 635,140 Males and 563,351 Females which show sex ratio of about 887 females per 1000 males. The overall literacy stood at 79.49% where male literacy was higher at 84.01%, while female literacy lagged behind at 74.41%.

III. METHODOLOGY

This research is a case study of Varanasi city focusing on the socio-economic and environmental challenges of urbanization. To understand these issues deeply, the study opted secondary data. Secondary data was collected from many reliable sources such as Census of India 2011, District Statistical handbook of Varanasi, and reports from govt. departments and agencies like the Central Pollution Control Board (CPCB), The National Mission for Clean Ganga (NMCG) and the Varanasi municipal corporation. Urban development plans and reports from the Smart Cities Mission were also studied along with academic publications.

The collected data were processed and analysed using simple statistical methods. Tables, Graphs, and charts were prepared to represent the findings.

IV. OBJECTIVE

The following are the objectives of this study –

i. To analyse the demographic trend, growth and impact on Varanasi City
ii. To evaluate the spatial pattern and rate of urbanization in city and identify factors affecting it.
iii. To access the environmental changes over the years in City.
iv. To explore the interconnection between socio-economic development and environmental changes in context of urbanization.

V. PROBLEMS AND FIDINGS

Factors which are affecting urbanization is classified into two category –

5.1 SOCIO-ECONOMIC

5.1.1 Rapid population growth

Population growth is a natural process but when it occurs fast it turn into a serious challenge. It does not only affect the quality of life but also slow down balanced development. Population Growth in Varanasi is clearly visible as shown in the following data.

Table 1
Decadal population and Sex Ratio in Varanasi City.

Year	Total Population	Male	Female	Sex Ratio
1981	929,270	500,199	429,071	858
1991	1,092,070	579,541	512,529	885
2001	1,091,918	583,552	508,366	871
2011	1,198,491	635,140	563,351	887

Source:- (Office of the Registrar General and Census Commissioner, 2011)

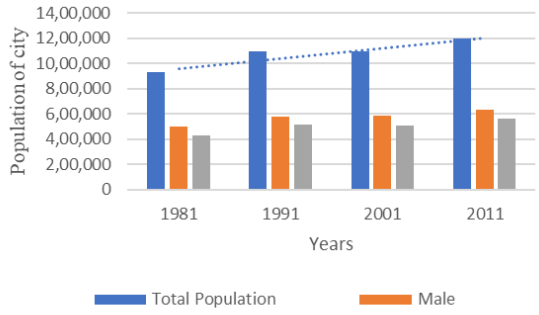

Fig. 2. Population Growth Trend in Varanasi City

The total population growth in last 3 decades, growing from 929,270 in 1981 to 1,198,491 in 2011 grew by 28.97%. In years 1981-1991 population grow from 929,270 to 1,092,070, representing a growth of 17.52%. The sex ratio improved during this time, climbing from 858 to 885 females per 1,000 males. Between 1991 and 2001 there is a declining in population growth where the population decrease from 1,092,070 to 1,091,918 marginal decline of 0.014%. The sex ratio also falls from 885 to 871 females per 1,000 males. In years 2001-2011 population grown 9.76%, reaching nearly 12 lakh and sex ratio improved to 887 females per 1,000 males. Normal sex ratio is around 950-980 females per 1,000 males. In case of Varanasi city, the sex ratio (from 858 to 887) is extremely low and point to a severe deficit of females in the population.

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5.1.2 Literacy-Gender gap

According to the Census of India 2011, Varanasi city's average literacy was 79.27% in which Male literacy rate was 83.46% and Female literacy rate was 74.55% (Varanasi Population, 2011). Literacy gender gap refers to the difference between male and female literacy. It is generally used as an indicator of gender inequality in access to educational and social development. In case of Varanasi city, data as follow

Table 2 Decadal Literacy Rates and Gender Gap in Varanasi City

Year	Male Literacy (%)	Female Literacy (%)	Gender Gap (%)
1981	55.33	34.49	20.84
1991	73.22	52.32	20.90
2001	78.76	64.28	14.48
2011	83.46	74.55	8.91

Source: (Office of the Registrar General and Census Commissioner, 2011)

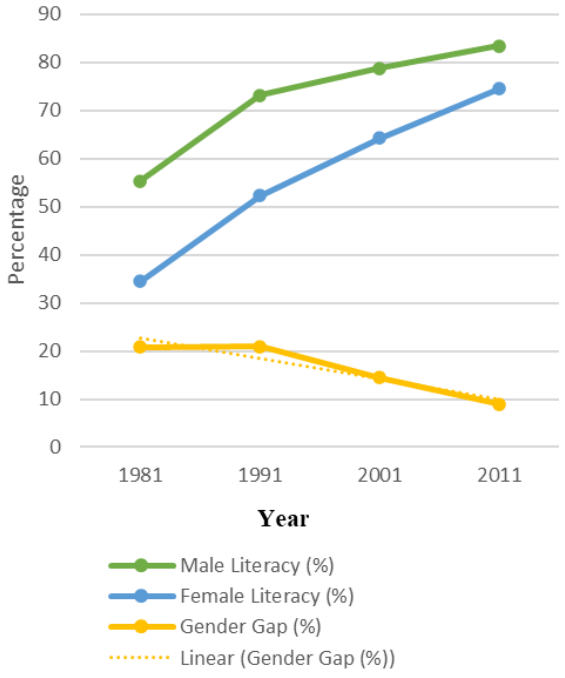

Fig. 3. Diagram of Literacy Rates and Gender Gap in Varanasi City

Overall literacy rates for males and females registered a remarkable growth, with an increase of 28% and 40% respectively from years 1981 to 2011. The gender gap remained unchanged in years 1981 (20.84%) and 1991 (20.90%). The accelerated progress in gender equality took place between 1991 (20.90%) to 2011 (8.91%). In year 2011, literacy rates for both sexes were very high (74%), and the gender gap had reduced to almost half from 1981. 8.91% difference remained reflecting gender equality in education had not yet been achieved. Despite a high rate, 25.45% of females and 16.54% of males in city were still counted as illiterate.

5.1.3 Employment status

Worker status is an important indicator to understand the nature and quality of employment. It divides the workforce into main workers, who are working in regular and stable employment and marginal workers who are working depending on seasonal or irregular employment. Varanasi city's worker status as shown below-

Table 3 Worker Status and Population in Varanasi City (2011)

Indicator	Population	Percentage
Total Population	1,198,491 persons	100 %
Total Workers (Engaged in Work)	402,122 persons	33.56%
Male Workers	324,925	80.9 %
Female Workers	77,197	19.1%
Main Workers (employed more than183 days)	339,268	84.38%
Marginal Workers (employed less than183 days)	62,854	15.62%

Source: (Office of the Registrar General and Census Commissioner, 2011)

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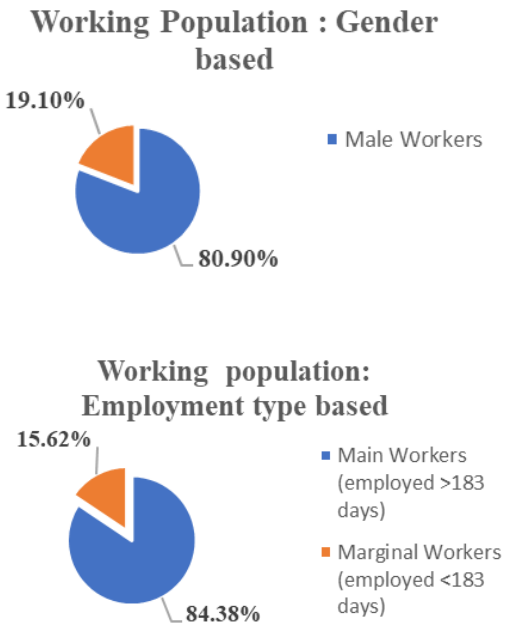

Fig. 4. Diagram of Composition of Working Population by Gender and Employment Type (2011)

Out of the total population only 402,122 (33.56%) were engaged in work. 324925 (80.2%) male workers representing a large majority of working population. Remaining 19.1% of the working population are female. Main workers who have regular and stable employment (Employed more than 183 days) comprise 339,268 persons, which is 84.38% of total workers. Marginal workers who depend on seasonal or irregular employment, include 62,854 persons, 15.62% of total workers.

5.1.4 Road network and traffic congestion

A well-developed road network is essential to urbanization because it facilitates economic growth, increases accessibility, shape population distribution, and contribute to the overall quality of life in urban areas. In Municipal corporation Varanasi total length of road is 1170 km, which constitute National Highways No.2, 29 and 56, PWD department roads and other roads maintained by municipal corporation. Total length of the roads, Municipal corporation Varanasi has about 70% roads that are internal arterial roads & narrow streets of the old town location.

Table 4 Road Network Classification and Length in Varanasi City (2015)

Category	Length (Km)	Percentage (%)	Remarks
Kutcha Roads	104	8.0	
Black Topped Roads	649	55.4	National Highways are maintained by PWD. Nearly 70% roads are under MCV.
Other Roads	417	35.6	

Source: ((MoHUA), 2015)

To understand the pressure on the road network and the composition of vehicles using it. This is very important to examine the numbers of vehicles by class. The table below present the distribution of vehicles across different categories.

Table 5 Distribution of Registered Vehicles by Class (2020-2024)

Vehicle Class	No. of vehicles
Ambulance	187
Bus	738
E-Rikshaw	19057
E-Rikshaw with Cart	1288
Goods Carrier	10951
Motor Cycle	303923
Motor Car	50855
Motor Cab	2314
Three-wheeler Passenger	14398
Total	403711

Source:- (Ministry of Road transpoart & Highways, 2025)

Here showing the transport pressure in Varanasi city, it highlights the intensity and distribution of vehicular load on road network by road density, vehicle density, traffic load index, and road spaces per vehicles. The data is analysed using specific methods to understand traffic patterns and infrastructure demands.

(a). Road Density –

$\frac{\text{Total Road Length}}{\text{Area}} = \frac{1170 \text{ km}}{82.1 \text{ km}^2} = 14.2$ km road/km^2

Varanasi city has a road density of 14.2 km per square km.

(b). Vehicle density –

$\frac{\text{Total no. of Vehicle}}{\text{Total area}} = \frac{403711}{82.1} = 4917$

In city there are 4917 vehicles per km$^{2.}$.

(c). Traffic Load Index –

This method is used to show number of vehicles per square kilometres.

$\frac{\text{Total no.of vehicles}}{\text{Total road length}} = \frac{403711}{1170} = 345$

345 vehicles per km of road in Varanasi city.

(d). Road Spaces per vehicles –

$\frac{\text{Total road length}}{\text{Total no.of vehicles}} = \frac{1170}{403711} = 0.0029$ km or 2.9m per vehicle.

This shows that Varanasi city has very high traffic pressure. Each vehicle gets less than 3 meters of road space, which reflect the congestion problem.

5.1.5 Slum area

Slum (Ajay Bhardwaj, 2021) is an overcrowded, highly congested, unplanned urban settlements identified by poor living standards, lack of basic services such as clean water, electricity, sanitation etc. Slums are the extreme poverty area and it often develop informally without legal approval or urban planning. There are 209 slums in Varanasi city. In which 176 slums built on private land, 29 slums built on land of local body, 3 under the land of State government of Uttar Pradesh and 1 slum belongs to Central government of India. The total population living in slums is 407468, which are 34% of the city population (as per census 2011). Out of the total 209 slums in the city, 160 slums have existed for more than 75 years.

Table 6 Population and Slum Status in Varanasi City (2015)

City Population	1,198,491
Slum population	407468
Percentage of slum population	34%
City Area (Ha)	8210
Total Area under slums (Ha)	574.7
Percentage of slum area to city area	7%

Source: - (Studies, 2015)

Considering the physical location of the slums, 108 slums are settled on non-hazardous and non-objectionable sites, 17 slums lie along to railway lines, and 12 slums are near major runnels, 10 slums are along other drains, 21 slums are along waterbody banks, 5 slums are on river/waterbody beds, and 7 slums are hazardous. All the slums are located far distinct from hazardous locations or activities, making all slums non-hazardous. Most slum settlements are concentrated around the core area of the city, along the highways, and around other dominant locations.

5.2 ENVIRONMENTAL CHALLENGES

5.2.1 Solid Waste Management

Solid Waste Management (SWM) (Vijai Krishna, 2019) is a method of dealing with wastes in a way that is not harmful to the environment. It includes the processes specifically collecting, storing, transporting, processing, recycling, and safe disposal of waste material. Depending on the amount and nature of the waste, it can be managed by composting, recycling, turning it into energy, or disposing of it safely in landfills. Waste is generated from many sources like Homes (Kitchen wastes and Gardens), Markets and commercial places (Shops, Malls, Hotels, Restaurants), Industries (Packaging plastics, Raw material wastes), Institutions (Schools, Colleges, Hospitals, Offices), Parks (Leaves, Branches), and Streets (Dust, Scrap).

Types of Solid Waste in city–

(a). Municipal Solid Waste (MSW): Waste which are generated from residential areas, markets, construction debris, sanitation activities, and streets. It includes solid and semi-solid wastes.

(b). Industrial Solid Waste (ISW): These type of generated by industries. Generally, these are hazardous waste because it may contain toxic, corrosive, or flammable substances which is harmful to environment.

(c). Biomedical Waste (Hospital Waste): It produced by Hospitals, Clinics, and medical institutions. It includes Syringes, Bandages, swabs, soiled materials,

body fluids, medicines, chemicals, and anatomical waste. Which are highly infectious and dangerous if not handled scientifically.

The maximum waste generated in Varanasi city (Holistic Waste Management Strategy for Varanasi City, 2018) comprises biodegradable, compostable, and recyclable materials. Organic waste is the largest component, forming about 41.95% of the total waste. Plastic waste is also a significant component due to religious and vegetable market activities. People are aware about recycling, and many recyclables are separated and sold to local Kabadiwalas. Proper waste separation at the source is still a big problem for Varanasi Municipal Corporation (VMC).

Table 7 Population and Waste Generation of Varanasi city (2011-2031)

Year	Population (appx.)	Floating Population (per day)	Total Population Considered	Per capita waste generation (kg/day)	C&D Waste (MT/Day)	Total waste generation (MT/Day)
2011	11,98,491	-	11,98,491	0.400	-	479.39
2018	14,41,251	25,000	14,66,251	0.400(solid) + 0.240 (C&D)	6.00	576.50
2021	15,58,805	-	15,58,805	0.400	17.50	600.00
2031 (Projected)	20,30,047	-	20,30,047	0.450	-	889.74

Source: (Varanasi, 2019)

In 2021, the average waste generation in Varanasi city was 0.400 kilograms per capita per day, which total approximately 600 metric tonnes per day. City's population is increasing with a decadal growth rate of 2.67% per year as per 2001-2011 trend. If this trend continues, the solid waste generation is projected to reaching around 623.92 metric tonnes per day by 2028 and approximately 889.74 metric tonnes per day by 2031, which requiring expanded infrastructure and improved Solid Waste Management strategies.

5.2.2 Air Pollution

Air pollution is one of major problem in urbanization, affecting the health, environment, and quality of life in rapidly growing cities. Growing industrialization, increasing vehicle emission, and unplanned urban expansion contribute to declining air quality. Here linear trend analysis of Air Quality Index (AQI) and Particular Matter (PM) with diameter ≤ 2.5 from year 2014 to 2024.

Table 8 Status of Annual AQI and PM2.5 in Varanasi City (2014-2024)

Years	Annual Average AQI	Count of pm 25
2014	146	49
2015	145	267
2016	199	358
2017	225.5	361
2018	186.5	136
2019	388	357
2020	120	366
2021	124	362
2022	103	359
2023	82	353
2024	86	364

Source: (Project, 2025)

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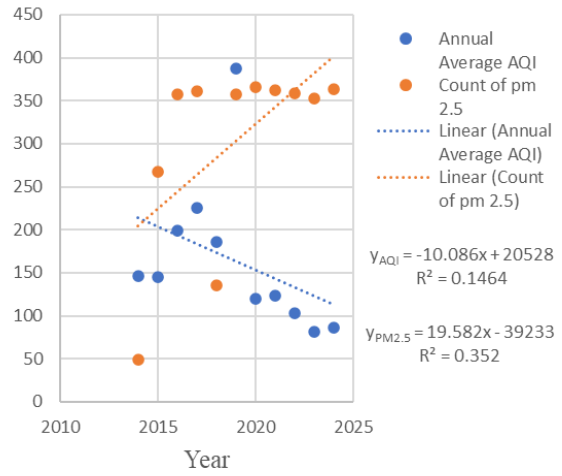

Fig. 4. Trend of Annual AQI and PM2.5 in Varanasi City (2014-2024)

Linear Trend shows how a variable changes over time.
Formula: Y = a + bt
Where Y = dependent variable, a = intercept, b = slope/trend, t = time
Interpretation –
If b > 0 → Increasing trend, If b < 0 → Decreasing trend, If b = 0 → No trend

R^2 = Coefficient of determination; it measures how well linear trend fits the actual data.
R^2 = 1 (Perfectly fit)
R^2 = 0 (no linear relationship)
Values in between:
0.7 - 0.9 = strong linear trend, 2.4 - 0.7 = moderate trend, < 0.4 = weak trend

I. Annual Average AQI Trend:
$Y_{AQI} = -10.086 \cdot Year + 20528$
Slope (b) = -10.086 (AQI decreases by 10 unit per year on average)
Intercept (a) = 20528 (starting value)
R^2 = 0.146 (explain only 14.6% of the variation and high fluctuation in AQI)
II. Count of PM2.5 Trend:
$Y_{PM2.5} = 19.528 \cdot Year – 39233$
Slope (b) = 19.582 (PM2.5 count increases by 20 units per year)
Intercept (a) = 39233 (theoretical starting value)
R^2 = 0.352 (reflect 35.2% of the variation shows constant increasing pattern but not perfect).

From year 2014 to 2024, Varanasi city's Annual Average AQI shows a slight decreasing trend, while PM2.5 counts are moderately increasing. Despite the small decline in AQI, recent values (82-86) remain in the moderate to unhealthy range, and PM2.5 are well above WHO limits. Overall city's air quality is still poor, highlighting the need for continued monitoring and pollution control.

5.2.3 Water Pollution

Water pollution poses several challenges to the process of urbanization. When city's water resources like rivers and lakes gets polluted, people face a shortage of clean water for drinking, domestic, and industrial use. Which leads to serious public health concerns, include water borne diseases. Maximum waste coming out from Varanasi city including sewage inflow, industrial chemical waste discharge, carcasses of animals, unclaimed dead bodies of human beings, Temple Waste that is thrown into the river and almost every other type of biodegradable as well as non-biodegradable waste is being thrown into the Ganga River. The Ganga River, along the bank of which the city grew, is constantly at a risk of reaching a dangerous level of pollution due to sewage or due to cremation. In Varanasi, the total sewage generated is significantly higher than the volume that is treated, despite recent expansions in sewage treatment capacity. The latest data from year 2024-2025 indicates the following estimates:

Table 9 Sewage Generation and Treatment Status in Varanasi City (2024-25)

Category	Value (MLD)
Total sewage generated	450–522
Treated (STP capacity)	412–422
Actually Treated	250–422
Untreated discharged	28–200

Source: (Mission, 2025)

Total sewage generated (discharge) estimates for 2024–2025 report a range of 450 to 522 million litres per day (MLD) produced across Varanasi municipal area. The total sewage treatment plant (STP) capacity as of 2025 is about 412 MLD, but actual sewage being fully treated is less, often ranging between 250 and 422 MLD due to underutilization, operational inefficiencies, and ongoing commissioning of new

plants. Between 28 and 200 MLD of untreated sewage is currently reported to reach the Ganga or local rivers (Varuna, Assi) on a regular basis. This untreated part mainly comes from overflow, non-connected households, or inefficiencies in the sewer network. The major Sewage Treatment Plant (STP) units in Varanasi, along with their capacities and brief details (according to 2024) are follows:

Table 10 List of STP Units in Varanasi (2024)

Name/Location	Capacity (MLD)	Technology	Remark
Dinapur STP (old)	80	Trickling Filter/Activated Sludge Process (TF/ASP)	Major, oldest unit
Dinapur STP (new)	140	Activated Sludge Process (ASP)	Large, commissioned in recent years
Ramana STP	50	Sequencing Batch Reactor (SBR)	Handles Assi Nala discharge
Goithaha STP	120	Sequencing Batch Reactor (SBR)	One of the largest, modern plant
BLW (former DLW) STP	12	Activated Sludge Process (ASP)	Covers railway and adjacent colonies
Bhagwanpur STP	9.8	Activated Sludge Process (ASP)	Compact plant
Ramnagar STP	10	Anaerobic-Anoxic-Oxic (A2O)	Covers Ramnagar area

Source: ((CPCB), 2023), ((VSCL), 2025)

Varanasi still faces a big sewage problem despite heavy spending on treatment plants. Out of 450–522 MLD of sewage produced daily, only 250–422 MLD is actually treated. This leaves 28–200 MLD of dirty water flowing into the Ganga and other rivers.

5.2.4 Status of Ganga River

The Ganga River in Varanasi is still heavily polluted, mainly because of untreated sewage, industrial waste, and religious practices. Regular monitoring shows that in 2024, faecal coliform levels upstream were about 490 MPN/100 ml, near the safe bathing limit of 500, but downstream levels rose sharply to around 4,900 MPN/100 ml, which is unsafe (though improved from earlier 23,000). Biological Oxygen Demand (BOD) ranged between 3-6 mg/l, higher than the safe standard of below 3 mg/l, showing organic pollution is still high.

The Namami Gange project has increased sewage treatment capacity in Varanasi from 100 MLD in 2017 to about 420 MLD in 2024, leading to some improvements in water quality, with the CPCB reclassifying the river stretch from Priority Segment-4 to Segment-5. However, pollution at the ghats remains above safe bathing levels because of ritual waste, open defecation, mass bathing, and untreated sewage. This continues to threaten public health, making stronger sewage management, pollution control, and public awareness necessary.

Table 11 Water Quality Data of the Ganga River in Varanasi (2024)

Parameter	Range/Value at Sampling Sites (Varanasi, 2024)	Standard/Limit (WHO, CPCB)	Comments
pH	7.0 to 8.6	6.5 to 8.5	within safe range
Temperature (°C)	10.8 to 15.4	Not specified	Seasonal variation observed
Total Dissolved Solids (TDS) (mg/l)	218 to 283	<500 (WHO guideline)	Within acceptable limits

Total Suspended Solids (TSS) (mg/l)	38 to 67	No fixed standard	Moderate turbidity
Dissolved Oxygen (DO) (mg/l)	5.3 to 6.5	>5 mg/l (min for healthy water)	Adequate oxygen for aquatic life
Biological Oxygen Demand (BOD) (mg/l)	3.5 to 6.0	<3 mg/l (for bathing water)	Exceeds safe bathing standards
Chemical Oxygen Demand (COD) (mg/l)	5.4 to 8.5	Not fixed	Indicates organic pollution
Hardness (mg/l)	127 to 265	-	Within typical freshwater range
Alkalinity (mg/l)	121 to 194	-	Normal range
Turbidity (NTU)	4.96 to 13.45	<5 NTU (ideal)	Slightly high turbidity at some sites
Chloride (mg/l)	114 to 142	<250 mg/l (WHO guideline)	Within safe limits
Faecal Coliform Count (MPN/100ml)	Approx. 490 (Upstream) to 4,900 (Downstream)	<500 MPN/100 ml (CPCB bathing limit)	Upstream near limit, downstream exceeds

Source: ((NMCG), 2025), (The Times Of India, 2024)

The pH and dissolved oxygen in Ganga River values mostly fall in the acceptable range for bathing and aquatic ecosystem health. BOD values are still higher than recommended limits at many bath ghats, indicating organic pollution. Faecal coliform counts are very high downstream at Varanasi, showing contamination that poses health risks. Total dissolved solids and other physical-chemical parameters indicate moderate pollution but are within expected ranges for a river flowing through a populated urban area. Water Quality of Ganga River have been seen improved due to enhanced sewage treatment capacity under the Namami Gange Project, yet water at bathing ghats remains polluted above safe limits.

VI. DISCUSSION

The study shows that urbanization in Varanasi city is influenced by social and economic changes as well as environmental pressures. The rapid growth in population put more strain on land, resources, and infrastructure which caused congestion, the growth of slums, and obstacle in mobility. In city Literacy levels have improved over time, but gender inequality in education and job opportunities still a major issue. The road network in city has been expanded, but it is heavily deformed by increasing vehicle numbers, which leads to traffic jams and pollution. A large part of the population still lives in slums without accessing to basic amenities, which reflect the unequal distribution of urban facilities. In terms of environmental challenges, solid waste management is inefficient because of poor sorting and rising waste volumes generated by city. Air pollution emitted from vehicles and industries is still a major health concern. PM2.5 levels are consistently above safe limits. While water quality of the Ganga River, despite improvements under the Namami Gange project, it is still not safe for bathing due to untreated sewage discharge and ritual practices. These issues emphasize that socio-economic development and environmental sustainability in Varanasi city are closely connected. The discussion highlights the requirement of better planning, citizen involvement, and strict implementation of policies to balance growth with ecological health.

VII. CONCLUSION

Urbanization in Varanasi is a complex process which brings both opportunities and challenges. The city has become a centre for trade, tourism, culture, and education. However, rapid population growth puts heavy pressure on resources. The rising population, with a low sex ratio, questioning to social imbalance and the need for inclusive development. Literacy ratio has improved significantly, but the gender gap in education and employment still a major concern. Maximum number of jobs are occupied by men, and many workers are in marginal positions, which point

to unstable livelihoods and economic risk. The growth of slums, which are nearly one-third of the population, highlights issues of poverty, poor policy planning, and unequal access to basic services. The road network is extensive, but it struggles with the increasing number of vehicles which leads to congestion, pollution, and reduced mobility. In context of environmental challenges, waste generation is increasing at a concerning rate. Separation of wastes and disposal remain a challenge for the municipal corporation. Air quality of the city is getting worse continuously, with PM2.5 levels exceeding safe limits, which poses long-term health risks for residents. Water pollution in the Ganga River is still a major issue. Despite significant investments under Namami Gange Project, untreated sewage, industrial waste, and ritual practices continue to contaminate in the river. However, sewage treatment capacity has grown, operational inefficiencies still lead to untreated waste flowing into rivers. This undermines the efforts made. The integrated impact of these issues shows in declining environmental quality, rising social problems, and worsening urban inequality. Programs like Smart Cities Mission and Clean Ganga have started new initiatives, but their success depends on the effective implementation, accountability, and community involvement. Sustainable urban planning, good governance, and eco-friendly practices are important to balance development with conservation. It is equally crucial to address literacy gaps, gender inequality, and job instability along with environmental management. The future of Varanasi as a liveable and sustainable city depends on connecting social equity with environmental responsibility. Without these comprehensive measures, the city's heritage and liveability will face greater risks from unplanned urban growth.

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