

A Geo-Spatial Perspective for the Analysis of Problems of Chiplun Town and the Adjoining Region

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Abstract: *The rate of urbanisation is increasing all over the world. India ranks second globally in terms of total urban population. In India, 36.36% of the total population resides in urban areas, whereas in Maharashtra, the figure is 45.22%. The urbanisation process refers to the growth of urban centres and the corresponding increase in urban population. Currently, many cities and towns are facing issues related to overpopulation, transportation, sanitation, water supply, housing scarcity, essential facility shortages, pollution, upward social mobility, squatter settlements, and slums. Ratnagiri district in Maharashtra is situated in the Konkan region, with a 16.33% urban population. Chiplun town has been selected as a study region for micro-level analysis. Chiplun town is one of the significant urban centres and the second most populous town in Ratnagiri district. The latitudinal extent of the town is 17° 30' 41.63" north to 17° 33' 05.54" north, and the longitudinal extension is 73° 28' 40.82" east to 73° 32' 31.99" east. The primary objective of this research paper is to analyse the problems associated with urbanisation in Chiplun town and its surrounding region. The research is based on observations, as well as primary and secondary data. The study highlights the problems associated with rapid, unplanned development in Chiplun town, including waterlogging, flooding, traffic congestion, narrow roads, parking issues, pollution, inadequate solid waste management, drainage-related problems, and the presence of stray cattle and crocodiles. For the region's optimistic growth, proper management and urban planning are essential.*

Keywords: Urbanisation challenges, Chiplun town, unplanned development, micro-level urban study, urban infrastructure issues

1. Introduction

The city environment is the composite effect of city terrain, drainage (including water bodies), modes of transport, and movement within and out of the city. The population of residential areas, the density of buildings, industries, and commercial regions, as well as the alignment of roads and streets, workplaces, and institutions related to the economy, health, education, and culture, all contribute to forming a typical urban environment. (Verma, 2006) Outcomes of Rural push factors, poor quality of urbanisation, massive growth in slums, poverty, and a product of demographic explosion and rural-urban migration are some unique features of Indian urbanisation. Housing, slums, water supply, sanitation, air and water pollution, lack of basic infrastructure, poverty, transport and traffic congestion, increasing socio-economic inequalities, and poor management of garbage and sewerage are some of the notable problems and effects of urbanisation in India. (Jaysawal & Saha, 2014)

Urbanisation is the process of population growth in urban areas. The concept has two sides of the same coin: the growth rate of the urban population and the shift of population from rural to urban areas. (Verma, 2006) In towns and adjoining regions where land is scarce, there is a tendency to build upwards to accommodate the maximum number of dwellings or offices. (Yglesias & Beaver, 1967) The expansion of government services, migration following partition, the Industrial Revolution, economic opportunities, infrastructure development, and the growth of the private sector are crucial factors in India's urbanisation. In contrast, urban sprawl, overcrowding, shortage of housing and sanitation facilities,

poverty, unemployment, transport-related problems, i.e., traffic congestion, decreasing efficiency of public transport, etc, water shortage, increasing squatter and slums, crimes, waste management, environmental concern, heat islands, etc., are some significant problems of urbanisation. (Venkatesham, 2015) Maharashtra is the most urbanised state, while Assam has the lowest urbanisation rate. Due to increasing urbanisation, Indian cities are facing problems related to urban poverty, unemployment, housing shortages, environmental pollution, congestion, and transportation issues. (Das, 2012) Every urban system faces various problems, some familiar and others unique to the locality.

The level of urbanisation, trends of urbanisation in India, and Maharashtra have been studied by various researchers, including the studies conducted by Khadke & Waghmare, 2017; Salunkhe, 2019; Chaudhari, 2021; Jaysawal & Saha, 2014; Chandaneshwari Punyamurthy & Ram Shepherd Bheenaveni, 2023; Pagar, 2015; etc. While a few researchers have studied problems and urbanisation in towns and cities of India, particularly in Maharashtra and the Konkan region. (Sonawane & Jadhav, 2021) (Shrikrishna G., 2017; Vartak et al., 2019) It is well known that the problems of any town or urban system grow as that system develops. Some issues arise earlier, while others are added to it over time. The researchers' primary observation is that Chiplun town and the adjoining region are not an exception to this. Hence, the researchers have attempted to analyse the problems of the study region using facts and figures, which is the core of the research topic.

2. Study Region

For the present research work, Chiplun town and its adjoining villages in Chiplun Tehsil, Ratnagiri District, Maharashtra, have been selected as the study region. The latitudinal extent

of the town is 17° 30' 41.63" north to 17° 33' 05.54" north, and the longitudinal extension is 73° 28' 40.82" east to 73° 32' 31.99" east. An average elevation of the study region from MSL is around 80 meters. Fig. 1 specifies the location of the study region.

CHIPLUN TOWN AND ADJOINING REGION
LOCATION MAP

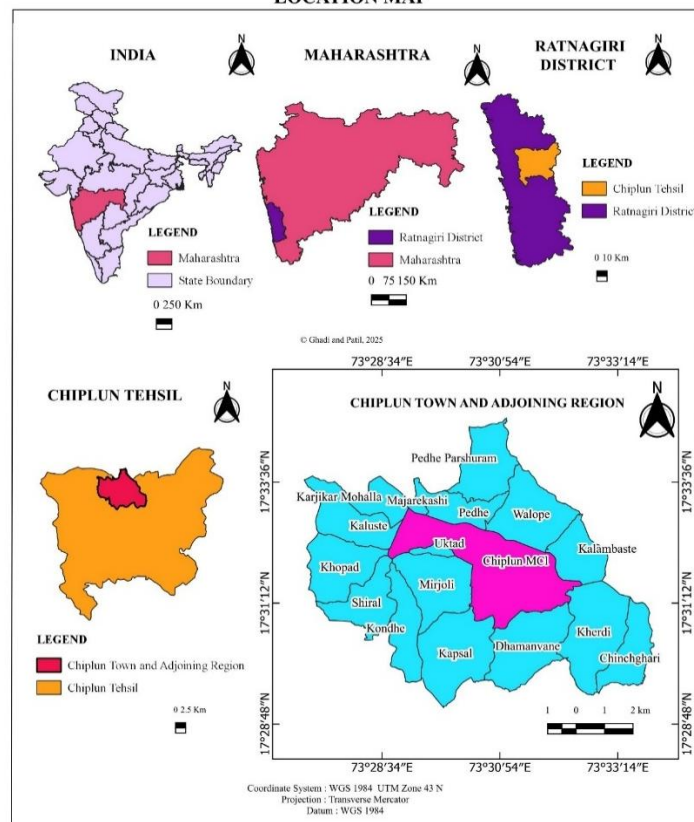


Figure 1

Objectives:

The primary objective of the present research paper is to analyse the problems of Chiplun town and the adjoining region and to suggest the remedial measures to tackle the issues sustainably.

Brief Review of Research Work Related to the Topic:

Problems in towns and cities, such as traffic congestion, wastewater management, housing shortages, slums, poverty, illegal construction, transportation issues, environmental degradation, and inadequate drainage, have been extensively studied by various researchers. The noteworthy studies include research by Vartak et al., Venkatesham, Das, Shrikrishna, Kadi et al., Jhavar et al., and Goswami et al. (Sonawane & Jadhav, 2021) (Dr. Venkatesham, 2015) (Das, 2012) (Shrikrishna G., 2017) (Kadi, Halingali, & Ravishankar, 2012) (Jhavar, Tyagi, & Dasgupta, 2012) (Dr. Goswami & Manna, 2013)

3. Methodology

The present research focuses on the problems of urbanisation in the study region. Quantitative and qualitative primary data were collected through intensive fieldwork in the study region, using a well-designed schedule. Additionally, the Google Earth Pro 2024 database has been utilised to analyse patterns of specific issues in the study region. Additionally,

secondary data from various websites, journals, Government reports, books, and newspapers have been utilised to gain a deeper understanding of the problems in the study region. With the help of photographs, observations, and analysis, the narrative is presented. *Taguette*, a Free and Open-Source Software, has been used to analyse the qualitative data, whereas an advanced Excel technique has been used for the quantitative data analysis. Additionally, the spatial representation was generated using the QGIS software.

4. Results and Discussions

Poor Land Use and Land Cover Planning and Management:

The sustainable planning and management of land use and land cover are helpful for the sustainable development of any urban system. Whereas improper or unplanned LULC changes generally affect ecological processes, soil degradation, water resource depletion and pollution, infrastructure stress due to urban sprawl, local climate change, and increased vulnerability to natural hazards. (Foley et al., 2005; IPCC, 2019; Lambin & Geist, 2006; Seto et al., 2011; Turner et al., 2007; Vörösmarty et al., 2000) It is worth noting that Chiplun town and its adjoining region are not an exception to this. The LULC analysis suggests that the unplanned development of Chiplun town and its adjacent region has occurred without considering the physical aspects

that determine various aspects of urbanisation. The LULC analysis conducted by Patil and Ghadi reveals that the agricultural land decreased by 8%, 7%, and 0.74% between 2010 & 2015, 2015 & 2020, and 2020 & 2024, respectively. This change is primarily focused on converting settlements and improving road infrastructure to facilitate access to them. Being an agricultural area, the land is situated in a low-lying region, and as a result, the newly developed settlements are more susceptible to flooding. This is evident in the devastating 2021 flood on the River Vashishti, which affected many areas in Chiplun and surrounding regions.

The increased proportion of open/scrub land, along with the decrease in vegetation cover, highlights the potential for ecological imbalance in the study region. Additionally, some land in Chiplun town, particularly along the Vashishti shoreline, is becoming fallow due to excessive water and capillary action. It also indicates deforestation and the conversion of agricultural land to fallow land to obtain more construction sites. Overall, the LULC indicates that unplanned development is occurring in the study region, likely to impact future urbanisation and exacerbate existing problems.

Locational Disadvantage

The site and the town's situation significantly influence its development. The study region is situated in a saucer-like topography that creates hurdles to its development. The topographic characteristics control the free and natural movement of water. This low-lying area is always vulnerable to flooding. The proximity of the River Vashishti intensifies flooding and waterlogging during the rainy season. Most of Chiplun is low-lying. The drainage line in Chiplun is also clogged during the summer months. The reason is that the drainage line is at a very low level due to the area's low relative elevation. The drainage line gets to the Vashishti and other streams. However, the river is perennial, and the drainage lines' heights are very low; in some parts, they are even lower than the river's water level. This creates a critical situation. Even during high tide in the Vashishti River, the water flows backwards from the drainage channels.

Another locational disadvantage is the study region's absolute location. The study region is approximately 330 km from Mumbai and Goa. Although the study area is connected to the rest of Maharashtra by rail and roads, its connectivity and accessibility indices are lower than those of other towns in Maharashtra, limiting urbanisation and development.

Crocodile Encroachment in the Human Habitat:

The Vashishti River is one of the major dwelling sites for Crocodiles in the Konkan region of Maharashtra. The poor drainage system in the study region allows crocodiles to encroach on residential areas in search of food. It occurs mainly during the rainy season due to increased water levels and the encroachment of the river water into the town through drainage. Sometimes crocodiles come onto roads, especially during the rainy season.

In the study region, 21.12% of Chiplun town residents and 45.57% of people in Karjekar Mohalla, Kaluste, and Uktad villages reported incidents of crocodiles emerging from the drainage into human habitats during the survey. In Chiplun

town, such incidents primarily occur in the following areas: Chiplun Bajarpeth, Fish Market, Govalkot, Juna Stand, Bahadurshekh, Bapat Aali, Bhogale, Muradpur, Khend, Kavitali, Markandi, Pethmap, and Vадnaka.

In 2021, during the flood, it was reported that crocodiles emerged from the drainage and wandered the streets. (The Times of India, 2024) (Lokmat Times, 2021)(The Times of India the Weather Channel, 2021) (NDTV, 2024) The primary survey and informal interactions with locals confirmed the presence of crocodiles in the human habitat.

Waterlogging And Flooding:

The waterlogging and flooding in the study region are associated with the physiography, elevation, and the very low relative height difference between the topography and the river Vashishti. The study region is located at an elevation of 15 to 16 meters above the WGS84 datum, and the average height above the River Vashishti water level is only 3 to 5 meters. The study region is situated in a low-lying area. As a result, most parts of Chiplun town and some areas of adjoining villages are consistently affected by waterlogging during the rainy season. Markandi, Bajarpeth, and Kherdi are the most waterlogging-prone areas. Even continuous heavy rainfall for three or four hours can cause severe waterlogging. Shiv River, a tributary of Vashishti, flows near Bajarpeth, exacerbating waterlogging during the rainy season. The shopkeepers in Bajarpeth face these problems every year during heavy rainfall. They have to relocate their goods and materials to a safer location away from the water.

People living in low-lying areas of Chiplun town and the adjoining region face flooding during heavy rainfall. The people living in Chiplun town and the surrounding region experienced severe flooding on July 22-23, 2021. Heavy rain, water discharge from the Kolkewadi dam, and the Vashishti river overflowing increased the severity of the flood. Several ground and first-floor flats were flooded. Traffic on the Mumbai-Goa Road and the Konkan Railway service were severely affected. (Deccan Herald, 2021b).

Local people claimed that the discharge from the Kolkewadi dam during heavy rain was one of the significant reasons, along with encroachments on the Vashishti riverbank, construction in flood-prone areas, and the narrowing of the stream due to debris dumping. (Times of India, 2022).

Problems Pertaining to Industrialisation

Lote Parshuram MIDC, one of the leading industrial areas in the Konkan region, is situated near the Chiplun town. The Lote Parshuram Industrial Area is a hub of chemical industries and severely affects the environment in the vicinity. According to Down To Earth, chemical discharges from the Lote Parshuram industrial area have a severe impact on water quality and other environmental components in the Khed area. (Menon Rajil, 2010). Considering the topographic characteristics and as confirmed by locals in the study region, there is a high likelihood of the said problems. The researcher was unable to provide detailed information due to time constraints and the geographical boundaries of the study region.

Generally, industries are the economic backbone of any urban system. The development of any town and the sustainability of economic development mainly depend on industrial growth. In the study region, there is very low industrial development within its administrative boundary, which severely affects its development.

The Kherdi MIDC provides various job opportunities to residents in the study area. However, contrary to this, the industries also increase pollution. It is also worth mentioning that most of the workers at construction sites are non-natives, especially non-Maharashtrians. It creates problems and sometimes tension. Additionally, unplanned development in the study region negatively impacts the processes of industrialisation and urbanisation.

Problems Related to Transportation and Traffic Congestion and the Quality Of Roads:

There are various problems regarding transportation in Chiplun town and the surrounding region, including traffic congestion, heavy traffic, accidents, a lack of a proper traffic signal system, poor road maintenance, potholes, and inadequate parking facilities. Most of the settlements in Chiplun town and the Kherdi area have existed for a long time, as Chiplun and Gowalkot have been commercial centres since ancient times. After the advent of the Konkan railway, settlements, apartments, and bungalows were constructed in other areas. Settlements were formed haphazardly, without a particular or planned design. Due to unplanned development, the roads remain narrow and winding, with minimal scope for widening to meet present-day needs. The primary survey of the study region shows that the major roads are very narrow. Traffic congestion appears severe during peak hours in the morning and in the evening, especially in the area from Bajarpeth to Bahadurshekh and towards the S.T. stand. The narrowness of the roads in the Bajarpeth area is a significant problem that leads to parking issues and traffic congestion.

Continuous heavy traffic during peak hours on highways makes it difficult for older adults to cross the road. **Accidents** are prevalent and are a significant issue in the study area. Accident frequency is high in Kherdi Bajarpeth, located on the Mumbai-Goa highway, particularly at Parshuram Ghat, as well as on some internal, narrow roads, including junctions and turns. (Dainik Pudhari, 2025) (Maharashtra Times, 2024b) (Dainik Lokmat, 2024a) (Maharashtra Times, 2022). Figure 2 depicts accident-prone areas. The zig-zag roads on NH66, particularly those at the Parshuram Ghat region, make

it highly accident-prone. The stretch from Bahadurshekh Naka to Guhagar Bypass Road on NH 66 has also seen a notable number of accidents due to heavy traffic, inadequate signal systems, and rash driving. The area from Bahadur Shekh Naka to Chinchnaka, including the ST stand and Guhagar Bypass on NH 66, has a low to medium accident frequency. Stray cattle, donkeys, and narrow roads are significant factors contributing to accidents. The fatality rate is high at Pedhe Parshuram Ghat, Guhagar Bypass, and the Kherdi Region on the Chiplun-Karad State Highway, as well as on NH 66 from Bahadurshekh to Guhagar Bypass.

The lack of a **proper signal system** is observed in the town. Holes, road patches, stray cattle, stray dogs, donkeys, and narrow roads increase the risk of accidents. The problem of traffic congestion is evident, particularly in the vicinity of the new river bridge in the market, as vehicles travel from the market towards Pethmap, Gowalkot, Kaluste, and Walope. In contrast, others come from Chiplun and the market area. During Ganeshotsav, Traffic congestion is excessive at Chiplun Bajarpeth. (Dainik Lokmat, 2023). Nowadays, people often park their vehicles on the side of newly constructed highway flyovers. (TV 9 Marathi, 2023). Figure 3 indicates traffic congestion during peak hours in the study region.

During peak hours, traffic congestion is moderate at Pedhe Parshuram New Visava Point, especially in the evening, when people visit the point to enjoy the scenic and fascinating view of the sunset and the River Vashishti. On Kalambaste Road, Farshi (both on NH 66), and at the Guhagar to Chiplun Bypass, traffic is medium during peak hours. Between Bahadurshekh Naka and Chinch Naka, as well as between Bahadurshekh and Kherdi, and Chinch Naka and S.T. Stand, traffic is moderate during peak hours. Chinch Naka, Bahadurshekh Naka, Power House, and Chiplun Municipal Council are highly congested areas due to heavy traffic. In the Kherdi region, particularly at the Kherdi Gram Panchayat, traffic congestion is a persistent issue during peak hours. The condition becomes severe on Wednesday due to the weekly market. From Chinchnaka to the Municipal Council, the Municipal Council to Pan Galli, and the areas around the Fish market, Gandhi Chouk, and Vad Naka, traffic is medium to high during peak hours. The area around the Municipal Council, particularly Gandhi Chuak, is a significant market in Chiplun; hence, it is crowded in the evening. It also affects the traffic congestion.

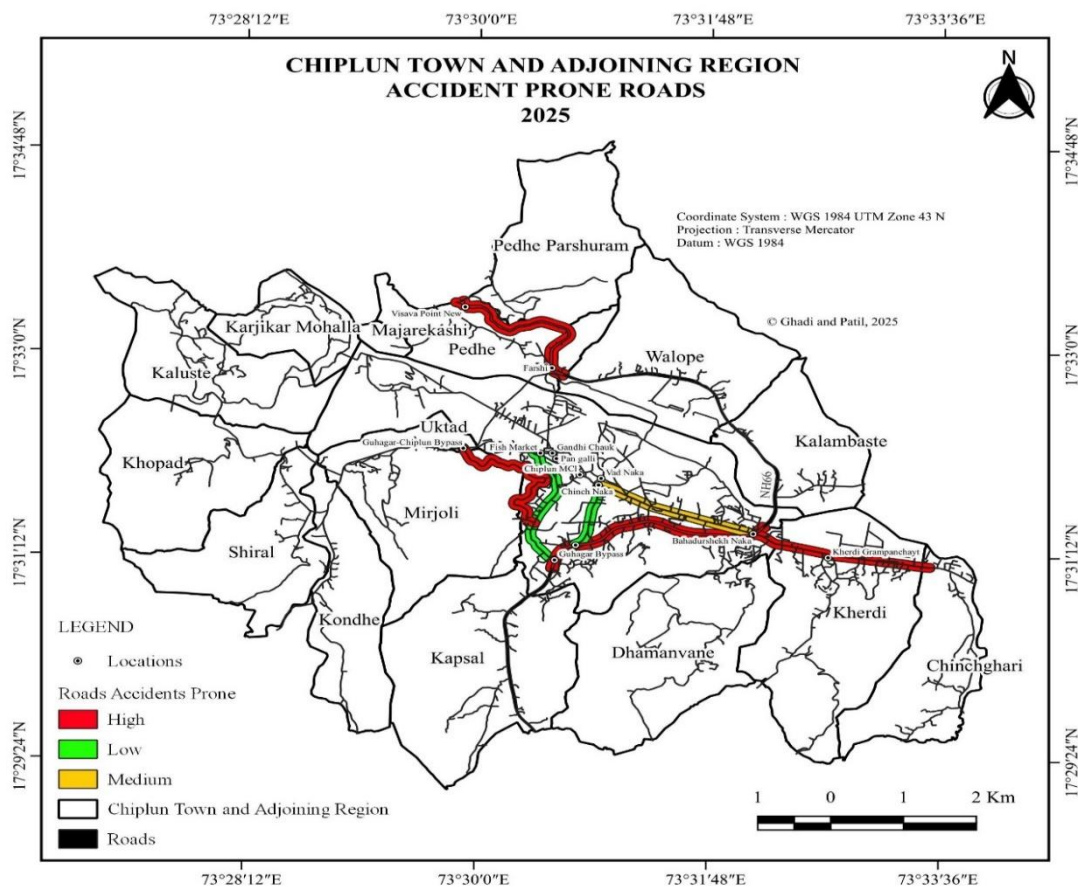
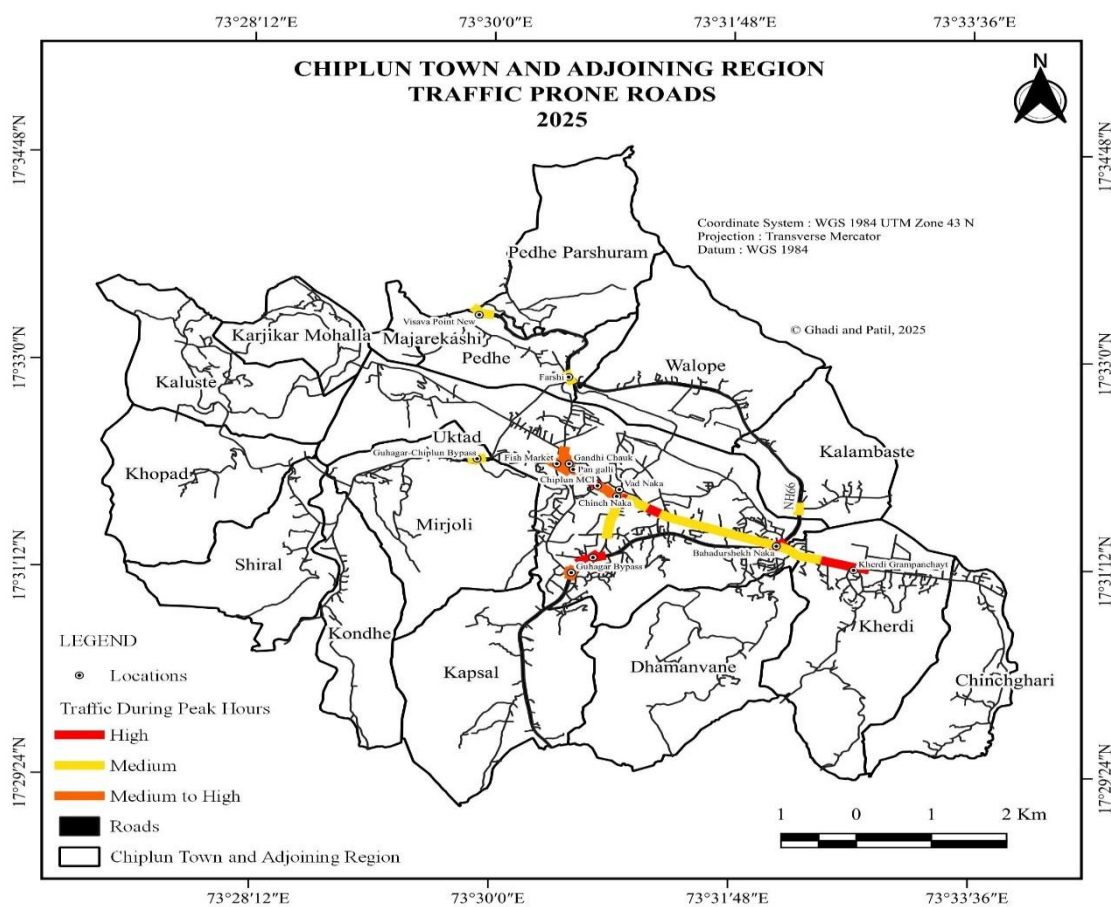


Figure 2: (Source: (NOAA, 2024))

Figure 3
(Source: (NOAA, 2024))

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Dhamnavane, Kapsal village, does not have a state transport bus facility. While bus frequency is lower in the afternoon, it is more pronounced in some adjoining regions of Chiplun. The hilly terrain, narrow roads, and sharp turns are the reasons behind the challenges in Dhamnavane. Roads in Chiplun town are of tar and grit, and in the rainy season, the tar and grit are plucked out. The road transforms into a network of potholes during the rainy season. Sometimes, avoiding these potholes comes at the cost of accidents. The Chiplun market area is always busy. However, in this area, there are no special parking facilities. Due to the lack of designated parking areas during peak hours, traffic congestion occurs on the market road and in nearby areas.

Problems of Residential Areas

Since ancient times, the town of Chiplun and the surrounding villages have experienced significant population growth. Though limited, due to its location and historical commercial activities, Chiplun is a centre of attraction to outsiders. Migrant people prefer Kherdi, Sati Chinchghari, and Kalambaste for their proximity to economic activities and infrastructure. This process of rapid urbanisation led to a significant increase in residential and commercial construction in the study region. This unplanned, unexpected growth in residential and commercial buildings created several problems. It includes choked drainage, stray animals, water supply-related problems, pollution, and other issues, which lead to unsustainable development.

Due to the low-lying area, the drainage in Chiplun town becomes clogged even during the summer months. Water and sewerage remain at a standstill. In most places, the drainage line goes closer to houses and apartments. Spraying chemicals into sewers is not a common practice. The foul odours of drainage water and mosquitoes are a significant nuisance for residents.

Stray animals are always seen in Chiplun town and the Kherdi area. In the area of Chiplun town, stray donkeys are always seen on the road. Much development is ongoing in Chiplun town. Various sites are under construction. Donkeys are used to carry construction materials in internal areas where road transport is unavailable and on congested roads. Accident cases are increasing due to the nuisance of stray donkeys. 2.6% of % surveyed people from Chiplun town stated that they had already fallen prey to accidents due to stray donkeys and were severely injured. During Diwali 2024, the municipal administration caught eight donkeys and tied them up in the Annasaheb Khedekar Sports Complex. However, the donkey owners did not come forward due to fear of action. (Dainik Sakal, 2024). While in the Kherdi area, stray cattle are often seen in the market. Sometimes, they even harm pedestrians and vendors. In nearby villages, the stray cattle are also a problem.

In some areas of Chiplun, residents occasionally experience an insufficient, low-pressure water supply. (Konkan Today

Marathi E Newspaper, 2022). Occasionally, due to water pipeline leaks, citizens in Chiplun town experience a water shortage. Still, in some places, cement pipes are used for main water pipelines, which is a significant reason for water leakage. (Dainik Sakal (Ratnagiri), 2024).

In addition to the notable problems mentioned above, 78% of respondents living near the main road, market, and highway reported issues such as air pollution, vehicle noise, and traffic congestion. Additionally, people from Kherdi are facing the same problem, partly due to the proximity of the industrial area. In Chiplun, even sometimes social discord, debate, quarrel, murder, burglary, prostitution, and crime are some other issues. (Dainik Lokmat, 2021a; Konkan Today Marathi E-Newspaper, 2019; Loksatta, 2024; Maharashtra Times, 2024a; Tarun Bharat, 2024).

Administrative Problems

The study region encompasses Chiplun town and its surrounding villages. The majority of the study region falls under the *Grampanchayat*, and Chiplun town has a municipal council. Figure 4 displays the area under the Municipal Council and the Gram Panchayats. This variation in the administration has given rise to some administrative problems, which may be very common in other parts of the Konkan and Maharashtra.

In all of the adjoining villages, there are gram panchayats. However, there are still administrative problems, especially in Chiplun town. Unplanned land-use and land-cover changes lead to haphazard urban expansion, a common occurrence in Chinchghari, Dhamnavane, Kalambaste, Kaluste, Kapsal, Karjekar Mohalla, Kherdi, Khopad, Kondhe, Majarekashi, Mirjoli, Shiral, Pedhe, Pedhe Parshuram, Uktad, and Walope. This unplanned development has placed a burden on the local governments of these villages, resulting in a lower standard of living in the area. Inadequate infrastructure development, including water supply, sanitation, roads, and waste management, was observed in the adjoining villages during the primary survey of the study region. It is worth noting that the enforcement of rules and regulations concerning building construction is essentially nonexistent. The migration towards adjoining villages created social strain in the surrounding region.

Encroachment and illegal constructions are increasing in Chiplun town and its surrounding areas. Even after the declaration of the flood line, illegal construction is still in full swing in some areas. In 2021, blue and red flood lines were implemented. Some parameters and criteria for construction were changed in accordance with the new flood line implementation. However, some builders in Chiplun are violating the law and continuing their illegal construction work despite receiving notices from the authority. (Pragati Times, 2022).

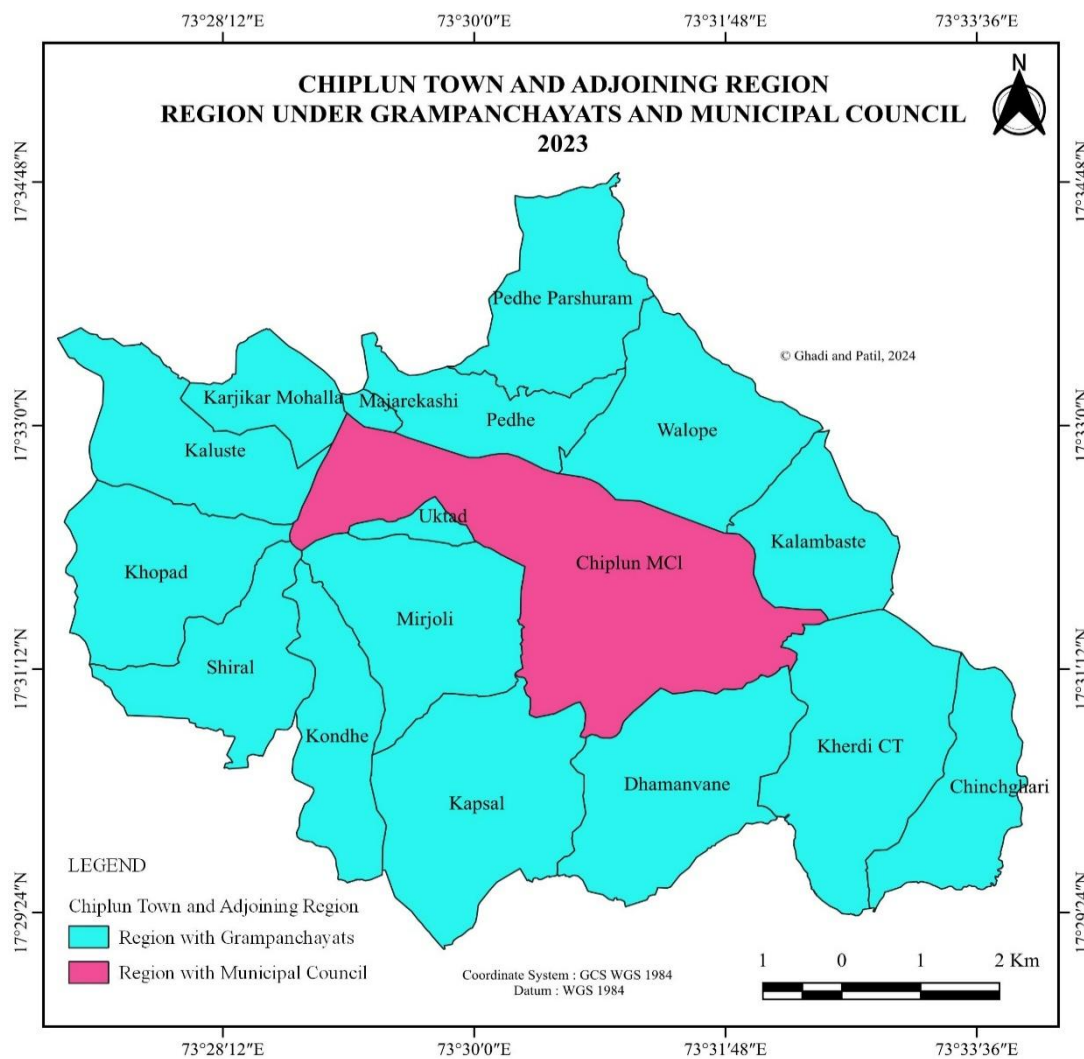


Figure 4
(Source: (NOAA, 2024))

Environmental Problems

Chiplun is located on the bank of the Vashishti River. Due to the low-lying area and saucer-type topography, the Municipal Corporation is unable to establish a proper drainage system, either by improving the existing one or by creating an underground drainage system. There are greater chances of percolation of domestic waste and contamination of secondary water sources due to the typical geographical location of Chiplun town, highly porous soil strata, and an insufficient and improper municipal drainage system (Raje et al., 2016).

There are 74 public toilets in Chiplun town, located in various areas, with more than 50 of them being out of order. Public toilets in Govalkot, Pethmap, Muradpur, Shankarwadi, Bajarpeth, and Wadar Colony are out of order. These locations are the sources of pollution and environmental degradation. (Dainik Lokmat, 2021b)

Solid Waste Management Related Problems

In Chiplun town, solid waste is collected through a door-to-door visit by a van. The collected waste is disposed of at the designated dumping site. The dumping site is located at the top of the hill in Shivajinagar. Solid waste collection is conducted daily in Chiplun town using a solid waste

collection van. Settlements in Chiplun town are increasing. An increasing population and settlements also lead to an increase in solid waste. However, the dumping site is only one of many. Additionally, it is not suitable or ideal because it falls within 500 m of settlements, 200 m of vegetation/forest, and 100 m of roads.

In the Kherdi, Mirjoli area, solid waste is collected using a *Ghantagadi*, a specialised vehicle for collecting solid waste. The dumped solid waste probably burns for its disposal. It creates pollution. The governing body lacks an effective method for disposing of solid waste. Plate 10 displays a dumping ground and waste disposal site.

While in adjoining villages, there is no waste collection van or waste bin. People need to dispose of their daily waste themselves. They prefer to burn the collected waste. Given the continuously increasing population of Chiplun town, Nagar Parishad needs to expand its waste management system and introduce new collection vans.

Society composting, individual composting, plastic waste collection, milk bag collection, and other initiatives related to plastic waste management are underway through Sahyadri Nisarga Mitra, along with awareness efforts. However, the

response from citizens has been unsatisfactory. (Sahyadri Nisarga Mitra, 2024)

5. Other Problems

Most villages depend on the gram panchayat's water service. Some villages, such as Dhamanavane and Kapsal, do not have any state transport bus service. Kapsal, Dhamnavane, Khopad, and Kaluste do not have a bank, hospital, clinic, post office, petrol pump, etc, within a 1 km range. Apart from that, in some adjoining villages, significant problems include soil erosion, deforestation, increased fallow land, and the absence of street lights on roads and sub-roads. The lack of job opportunities also compels the youth in the study area to migrate to big cities like Mumbai and Pune.

6. Conclusion and Suggestions

There are various problems in the Chiplun town and adjoining region, including poor land-use and land-cover planning and management, locational disadvantage, waterlogging and flooding, crocodile encroachment into human habitats, and industrialisation-related issues. Due to haphazard development, the study region faces problems including transportation and parking issues, unplanned development, inadequate drainage systems, and traffic congestion. The town of Chiplun is an outgrown market village, and with the march of time, urbanisation has affected the surrounding villages. It created administrative problems and struggled to achieve the Sustainable Development Goals (SDGs). The difficulty in achieving the SDGs aggravated issues in waste management, environmental degradation, and other areas.

There is a need for proper land use and land cover planning and management in the region. Also, an advanced flood forecasting and warning system is required. A sustainable drainage system should be used. It includes permeable pavement, sidewalks and gardens, green roof and wall, French drains, Embankment of the river Vashishti, use of flood dykes, time-to-time dredging and desilting of the river and its tributaries etc., that reduce the intensity of waterlogging in the study region, especially in the low-lying area in the vicinity of Vashishti and the Shiv River. Flood wall barriers/ flood barriers, flood insurance are other measures. Micro-level water shade management is necessary to utilise water better and reduce the intensity of floods. Additionally, proper cleaning and maintenance of drainage systems are essential to ensure the free flow of drainage water. Proper signal systems, effective parking management, and road maintenance will help reduce traffic and accidents. Additionally, sustainable practices for solid waste management and the adoption of the 3R principle (Reduce, Reuse, Recycle) are essential, as they not only enhance sustainability but also promote citizen participation in the management process.

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