

Three Decades of Urban Dynamics in India: Exemplifying Haora Sadar Subdivision



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1 Introduction

Urbanization can be defined as the conversion of rural lands to urban or other built-up uses, representing an important type of land transformation (Chen et al. 2020). Economic development of a society and a progressive division of labours has led to the formation and expansion of towns and cities around the globe (Mandal 1998). Worldwide urbanization is steadily rising over the years and cannot be reflected by a linear curve. In 2019, 55.71% of the global population were urban residents, which was only 30% in the 1960s (Ritchie and Roser 2018). It is projected that by 2050 the percentage of urban population will be 56% and 64%, respectively, in Africa and Asia only. Between 2014 and 2050, India, China and Nigeria together are expected to have 37% of the projected growth in urban population. India is projected to contribute to around 404 million urban dwellers followed by China (292 million) and Nigeria (212 million) (UNICEF 2012).

The definition of urban varies from country to country. The criteria of defining urban area ranges from administrative criteria (e.g. area within the jurisdiction of a municipality or town committee), a threshold population size (where the minimum

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for an urban settlement is typically in the region of 2000 people, although this varies globally between 200 and 50,000), population density, economic function (e.g. where a significant majority of the population is not primarily engaged in agriculture, or where there is surplus employment) to the presence of urban characteristics (e.g. paved streets, electric lighting, sewerage) (Goldstein 1990). Every country has chosen its own standard for delimiting urban areas. In India, urban areas are defined by the census using administrative and demographic benchmarks. In 2011, the definition of urban area was divided into two parts. The administrative criteria were used to define all places with a municipality, corporation, cantonment board or notified town area committee as Statutory Towns. All other places which satisfy the demographic threshold such as a minimum population of 5000, at least 75% of the male main working population engaged in non-agricultural pursuits and a density of population of at least 400 persons per sq. km. was known as Census Towns (Census 2011). Different study reports also focus on social aspects of urban areas, i.e. urbaneness as a criteria for definition (UNICEF 2012).

Urban growth patterns can be of several types depending on the nature of the urbanization. It can be infilling, i.e. the shape inside the city can change, edge expansion, i.e. the extension takes place along the fringes and also spontaneous unplanned widening. In the developed world, cities mostly encounter edge expansion, whereas spontaneous growth is more prolific in the developing and underdeveloped countries (Cheng and Masser 2003). Government policy changes sometimes play a significant role in the nature of urbanization and which, in due course, results in the transformation in the form of the city. In Wuhan city in Central China, the urban growth pattern has mostly followed the transport lines and economic activities (Chen et al. 2020). Urban growth patterns are also dependent on the physical terrain in which a city is situated, where built-up areas are rarely found on high terrains and slopes (Herold et al. 2003). There are some stages of urban growth. When industrialization and urban economic activity start booming in a certain place, urban areas start expanding. It slowly reaches a stagnant point and the growth stops (Xiao et al. 2006). It is also seen in some of the global cities that not only economic activities but also the economic condition of the people of a city plays an important role in the pattern of growth of a city (Dociu and Dunarintu 2012).

Traditionally, urban settlements have been classified as compact and dispersed. The former defines very closely spaced houses and the latter means sparsely spaced ones. The conceptual ambiguity of sprawl is seen in most literature as “lost in semantic wilderness” (Angel 2007, Barnes 2015, Sudhira et al. 2004). It is observed that sprawl can alternatively or simultaneously consist of changes in land use, land development along with the land-use behaviours and their consequences (Bhatta et al. 2010). Accurate definition of sprawl is very much debated among the scholars and urban planners. However, unifying the available explanations, it can be observed that urban sprawl is an uneven and unplanned growth due to multifarious reasons ultimately leading towards inefficient utilization of resources, but the nature of sprawl and the population characteristics of sprawl varies over space and time (Bhatta 2009). Sometimes urban sprawl is defined as the uncontrolled and

misappropriate expansion of an urban area into the surrounding countryside forming low density poorly planned patterns of development, and it is common in both high- and low-income countries (UNICEF 2012). Urban expansion has become unique characteristics of cities. Factors such as migration (Haregeweyn et al. 2012), decentralization of economic activities, population explosion (Bhatta 2009), topography, socio-cultural and psychology of the inhabitants determine the nature of urban sprawl.

It is evident that land covers in urban and peri-urban areas are rapidly changing with the change in economic activities. The environmental degradation, increasing population, growing land prices on one hand and expanding transport network and developing economic activity, decentralization of the public sectors lead towards the increasing built-up density of the suburban or urban fringe areas. Hence, analysis of the pattern of city growth needs attention for the planners and geographers. Measuring urban built-up area with the help census or surveyed data is generally biased because the data are mostly residential. The pattern of uses of lands is not taken into consideration, whereas remote sensing data offers a way of generating reasonable proxy variables of the built environment. Mapping built-up area using remotely sensed data is a useful tool for planners to analyse the temporal changes in the urban land-cover change with the nature of urban built-up area (Zha et al. 2003). The modification of physical environment, i.e. characteristics of urban places can be inferred from the classification of multispectral satellite images. A place that is distinctly urban can be determined from the imagery regardless of the characteristics of the residents (Weeks 2010). Temporal remote sensing data analysis can easily depict the growth pattern of any city. The historical imagery analysis gives a temporal dimension upon the growth of the cities. However, remote sensing data does not provide the perception and the reasons behind the rapid pace of urbanization. The uniqueness of the spatial dimension and perception of urban built-up area has been ignored in the research arena of urban study (Herold et al. 2005).

The current research uses satellite images for temporally mapping the growth of urban built-up areas. The classified areas have been analysed using statistical indices. Finally, a questionnaire survey has been conducted using a stratified random sampling to introspect into the causes behind the change in urban land use, which gives the uniqueness to this work. Therefore, the objectives of the study include:

- Analysing the nature of urban sprawl in Haora Sadar subdivision, Haora district of West Bengal in India from 1990 to 2016
- Assessing the factors affecting the nature of urban expansion in Haora Sadar subdivision, Haora district West Bengal, India

The two objectives of this study have provided a systematic pathway for conducting both quantitative and qualitative researches.

2 Study Area

In this research, Haora Sadar subdivision of Haora district in West Bengal, India, has been chosen as the study area (Fig. 1). Haora district is located between $22^{\circ} 48' N$ and $22^{\circ} 12' N$ latitudes and $88^{\circ} 23' E$ and $87^{\circ} 50' E$ longitudes and bounded by Hooghly river, North and South 24 Parganas on east, Hooghly district in the south, Midnapur in east and west Midnapur in the west. Haora district has a prolonged history which dates back much before the initiation of the colonial rules of Bengal. The ancient texts of Bengal such as “Mansamangal” written by Bipradas Pipilai (1495) has a mention of this place and the petition sent to the Mughal emperor Aurangzeb by the British East India Company has an inclusion of some places of Haora district such as Salkia, Ramkrishnapur, Kasundia, etc. Haora was initially under the zamindari of Burdwan and Muhammad Aminpur, but after the Battle of Plassey, the fate of Bengal altered and a treaty was signed between the then Nawab of Bengal, Mir Quasim and British East India Company and by 1760 Haora came under the sphere of British East India Company. In 1787, Hooghly district was formed and also the entire Haora district. In 1843, Haora appeared as a separate district. Looking at the large historical lineage indicating an interesting urban dynamic, Haora district has been chosen as the study region of the urban dynamics. Haora is also important in demographic terms as it is the second most densely populated district of West Bengal after Kolkata, and its expanding nature provided the opportunity to be chosen as an area of research.

Haora is the second smallest district after Kolkata, the capital of West Bengal, but in spite of its small size, it has a great importance in the map of West Bengal throughout its journey. Haora and Kolkata are adjacent and linked by four bridges, namely Haora bridge, Vidyasagar Setu, Nivedita Setu and Vivekananda Setu, and these have almost blurred the distance between Haora and Kolkata and developed a symbiotic relationship between the two twin cities. The census conducted in the British India in 1896 reported that Haora had a population record of 84,069 and which was reported to have grown up to 157,594 in 1901 and further reached a sum of population of 4,273,099 in 2001 and the last census of 2011 reported a sum of 4,850,029 as total population of the district.

Haora, which is sometimes known as the “Sheffield of East” and the hub of light engineering industries, is the house of many industries such as Burn Standard Company (since 1781) which is now a part of Bharat Bhari Udyog Nigam Limited (BBUNL), Shalimar Plants (since 1902), Jute Industries and several Iron and Steel Industries comprising both scrap iron industries and light manufacturing industries. These industrial belts have played a significant role in the increasing population as it has provided an abundant employment opportunity which attracted migrating population from the neighbouring areas. The increasing population has made a passage for the enhancement of urban built-up areas.

Haora district has two subdivisions, namely Uluberia and Haora Sadar Subdivision. Haora Sadar subdivision is composed of Haora municipal corporation

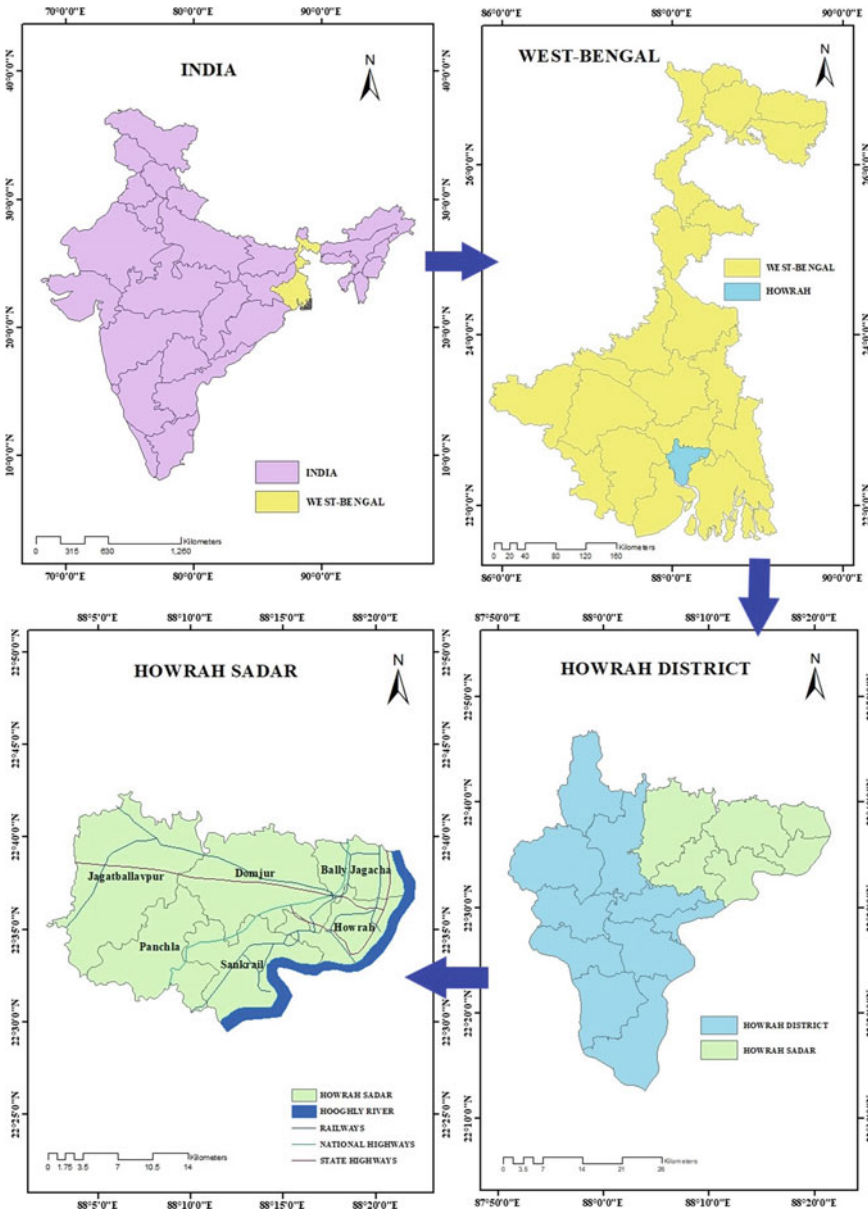


Fig. 1 Location map of Haora Sadar subdivision, Haora district, West Bengal. *Source* Authors

and five community development blocks, namely Bally Jagacha, Domjur, Panchla, Sankrail and Jagatballavpur.

3 Methods

The study has been conducted in Haora district from 1990 to 2016. Data was obtained for the years 1990, 2000, 2010 and 2016. Figure 2 shows the sequence of the methods involved in this work.

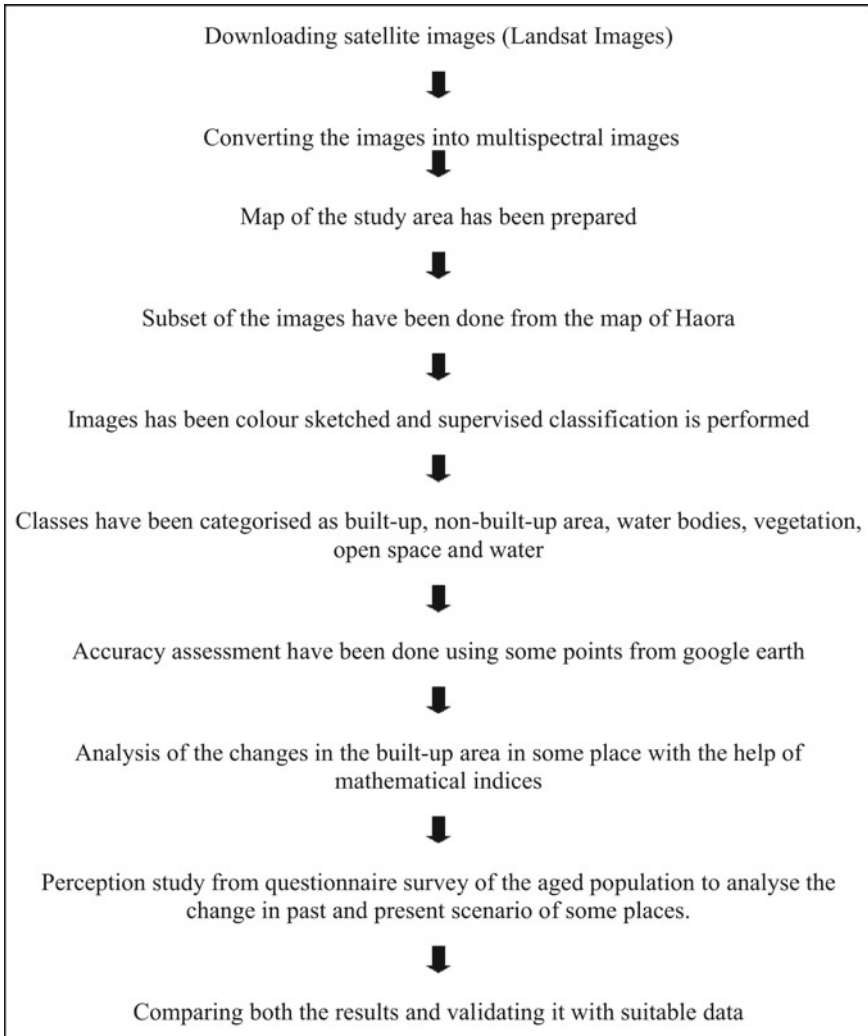


Fig. 2 Flow chart showing the sequence of methods involved in the work. *Source* Authors

4 Analysis of the Remote Sensing Images and Statistical Analysis

The gradual growth of the urban built-up area of Haora Sadar subdivision showed that there is hardly any space left for urban expansion in 2016. There is also a massive compaction of the city. The nature of the built-up area was calculated using indices like patch density, largest patch index and Shannon's entropy. Figure 4a–c shows the result of urban expansion. The comparative study of the results derived from the indices has shown a significant trend of growth from the year 1990 to 2016. It is evident from the classified maps of Haora Sadar subdivision (Fig. 3) that the built-up area is expanding and tending towards a compact kind of settlement.

The first mathematical index that has been chosen is the patch density (PD) index. The entire landscape has been chosen as the base of calculation of the built-up area. Patch density is the number of built-up patches divided by total landscape area. It has been measured as numbers per thousand hectares. The value of PD is >0 and has no upper limit. This measures landscape patterns. By measuring the PD Index of the landscape in all the years a temporal change in the landscape pattern has been measured (Fig. 4a). In 1990, the value of patch density was 15.464. In 2000, it reached up to 17.3417, and it has further increased to 22.1773 in 2010, and in 2016, it became 24.1346. The trend of this increasing density of patches leads towards compact kinds of settlement.

Largest patch index (LPI) was also calculated. Largest patch index is the percentage of total built-up area occupied by the largest built-up patch. The value ranges between 0 and 100. The temporal change in the largest patch (Fig. 4b) shows an increasing trend from 41.6251% in 1990 to 80.3146% in 2016. This is an indicator of the dominance of built-up area over the non-built-up area. The value of LPI ranges between $0 < \text{LPI} < 100$. Here in this study, the LPI value has increased significantly which is an indicator of the dominance of built-up area over non-built-up area in Haora Sadar subdivision.

Relative entropy is a globally accepted measure for analysing urban sprawl. The entropy method is widely appreciated in the field of urban study because of its simplicity and range. As determining the threshold value is considered to be a challenge that is faced by urban geographers, Shannon's entropy index which has a very clear range and threshold value is considered as one of the most reliable indices. The value of Shannon's entropy varies between 0 and 1 where the threshold value is 0.5. The value greater than 0.5 indicates a sprawled or dispersed settlement, whereas below the threshold indicates a compact type of built-up area. In Haora Sadar subdivision, the value of SEI in 1990 was 0.7716 indicating a dispersed kind of growth. In the year 2016, the value of SEI was 0.467 showing a perfect compact kind of settlement (Fig. 4c).

There is a low gradient in the change in the SEI value between 1990 and 2000 & 2000 and 2010. The change, however, steepens between 2010 and 2016. Thus, it is observed that the urban change in Haora district is gradual but rapid.

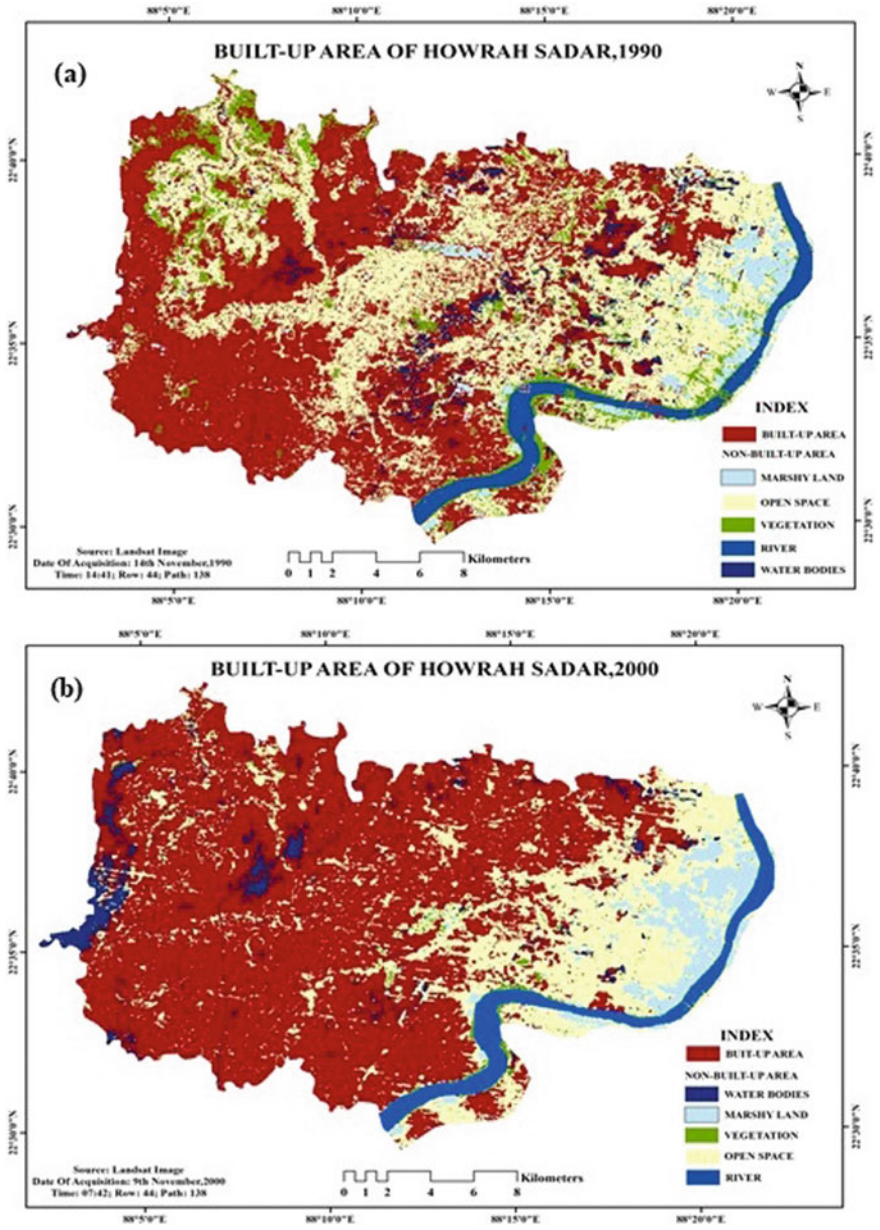


Fig. 3 Gradual expansion of built-up area of Haora district in a 1990, b 2000, c 2010 and d 2016. Source Landsat Data classified by Authors

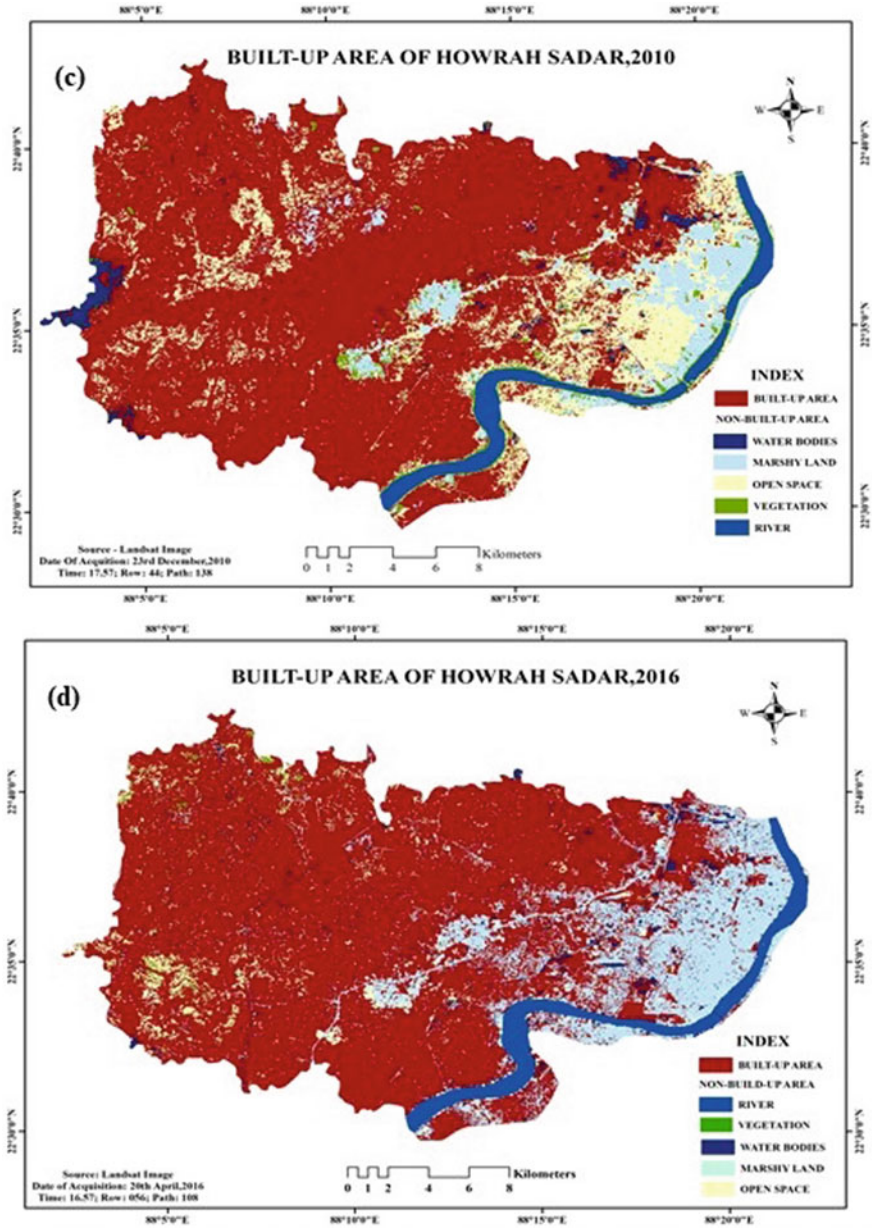
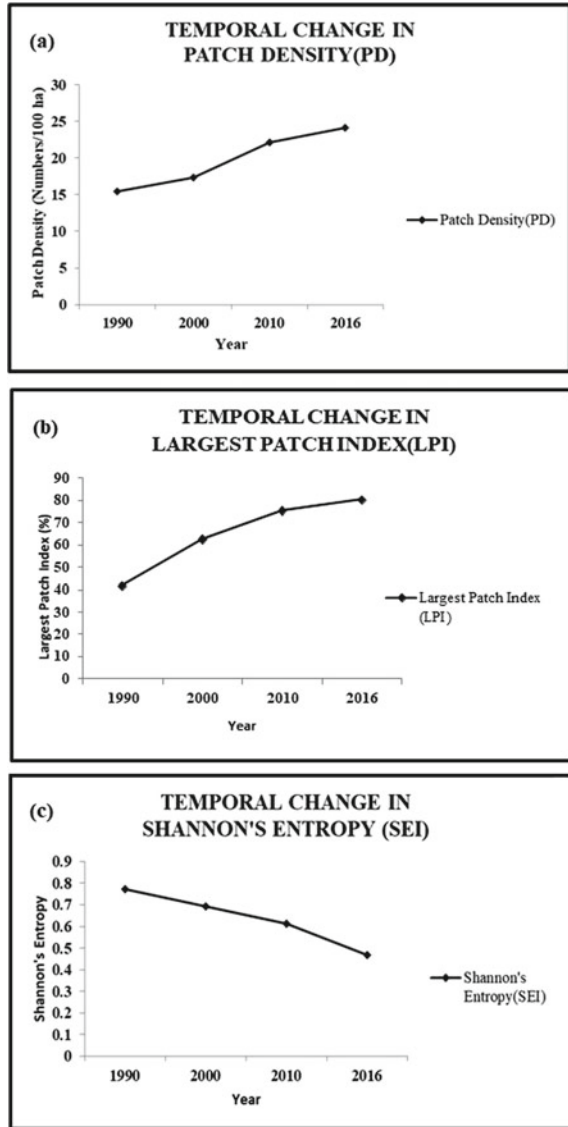


Fig. 3 (continued)

Fig. 4 Line graph showing temporal changes in **a** patch density, **b** largest patch index and **c** Shannon's entropy.

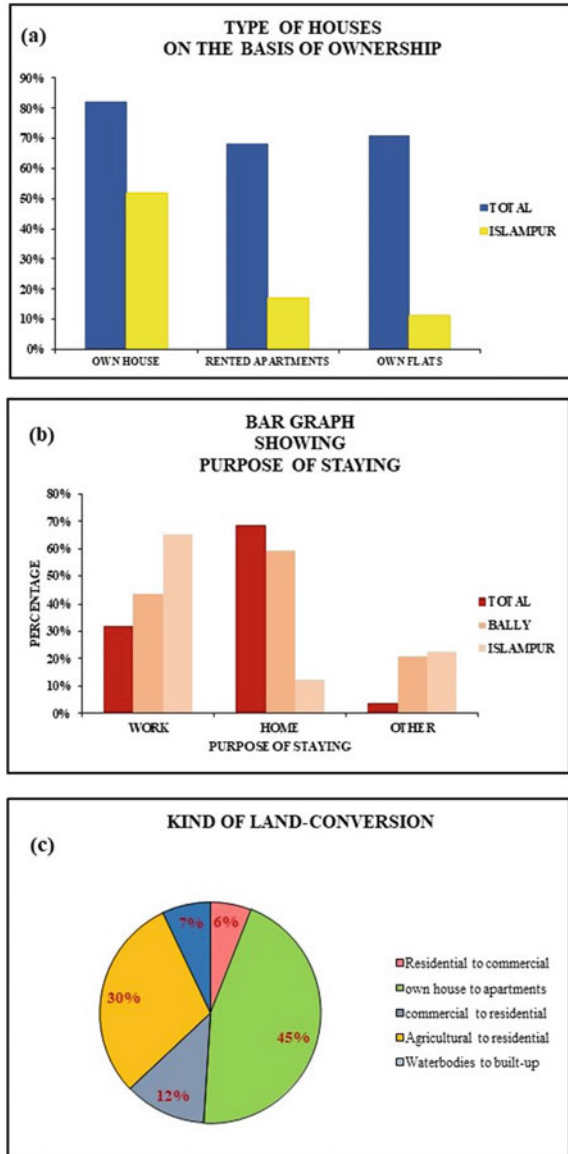
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5 Perception Study of Bally and Islampur of Haora District

Every city has its own history. Looking at the indices and the expansion of built-up areas from classified satellite images, it is not possible to understand the entire story of urban dynamics. Keeping that in mind a questionnaire survey was conducted to analyse the urban amenities in the study area and introspecting the causes behind

Fig. 5 Graphs showing **a** types of houses on the basis of ownership, **b** purpose of staying and **c** kind of land conversions. *Source* Authors



such rapid urbanization. The target group was chosen by a stratified random sampling method including only a population of 60 years and above. The survey was carried out in the cities of Bally and Islampur. Bally was already a built-up area in 1990, while Islampur converted to an urban centre between 2010 and 2016. As per census 2011, the percentage population above 60 years is 5% to the total population in Haora Sadar subdivision. The sample size was, therefore, chosen as

the 5% of the total population of these two places. As a result, 138 people in Bally and 83 persons in Islampur were surveyed. The results have been compared with the census data of West Bengal, India, to locate the position of Haora district with respect to the entire country and the state.

Nature of houses is one of the most important indicators of urban expansion. Most of the respondents surveyed lived in self-owned houses. Around 70% of the respondents live in Islampur because of the employment of either their son or daughter in the area. The same is around 48% for Bally. The respondents being dependants to the working kins; they are often bound to live in these areas (Fig. 5a, b). Some of the people surveyed also preferred to live in these areas because of the available urban amenities. Most of them, however, were already accustomed to the area because of their previous employment in the Haora industrial belt.

The nature of urbanization was also found to be different between Bally and Islampur. As the former is a newly converted urban centre, land conversion from agricultural uses is more prominent. Bally, being an old town, is now changing to a high-rise apartment city. Most of the old houses in Bally are getting promoted to modern buildings by brokers. Most of the people said that young generations prefer to stay in apartments compared to own houses because of the huge cost of maintenance and security issues, and some of the respondents have indicated that big land brokers offer lucrative amounts to the landlord and that also sometimes play a key role in the land conversion. The conversion of residential area to commercial area, own house to apartments, water bodies to built-up indicates a strong shift from the non-built-up to the irreversible built-up.

From the survey, it is evident that there is a sharp increase in the percentage of people availing banking services (Fig. 6a). The use of banking services has shown a sharp increase, whereas the percentage of people using the post offices for financial activities has declined significantly. The use of Automated Teller Machine (ATM) has been increased because using ATM cards give people a benefit of carrying less liquid money, which is travel handy for the busy urban life. Financial services are a part and parcel of urban life, and the available banks, post offices and ATMs play a very significant role in understanding the urban way of life. Haora district consists of more than 200 branches of different banks and around 500 ATM outlets in several areas. The respondents who have been surveyed have shown a trend of using more banks and ATMs as the lifestyle of the area is changing. People use ATM cards for shopping purposes, and after the policy of demonetization, even the smallest shop also accepts ATM cards. Both the nationalized and private banks are operating as financial service providers. The respondents have mentioned that post offices were in use for the financial activities initially, but now the banks have taken the place and almost every respondent has a bank account in which they operate regularly.

Haora Municipality was established in 1862. From 1896, it started supplying filter water across the city. During 1882–83, Bally Municipality was formed separating it out from Haora. As per the Haora Municipal Corporation Act of 1980, Haora became a municipal corporation, in 1984. The corporation area is divided into fifty wards, each of which elects a councillor. The Haora Police

Commissionerate is responsible for law enforcement in the city. Water supply is one of the basic amenities provided in the urban lifestyle. A five-point Likert scale has been constructed to measure the satisfaction of the respondents temporally about the water availability (Fig. 6c) When people were asked about the scenario of water supply, they said they were quite dissatisfied with the water supply at that time, but gradually the situation has improved with the intervention of the Municipal Corporation. The people's perception regarding the availability of water has changed from 55% dissatisfaction to 70% satisfaction between 1990 and 2016.

Like water supply, electricity is also one of the basic requirements in the city. It has been reported that nowadays not only the non-renewable source of energy but also the renewable sources of energy are being used as the source of electricity. Here also the five-point Likert scales have been used to measure the people's satisfaction with the electricity available in Haora district, and it has been found that Haora Municipal Corporation has been able to make people quite satisfied with electric supply. Very less incidents of power cuts are seen in this area compared to the time of 1990s. The respondents told some stories about frequent power cut breaks while they were students, and at the time of survey, they said there are very few power cuts and the available electricity is quite satisfactory and the people have experienced a journey from unsatisfied urban amenities to quite satisfactory urban amenities. Almost 78% people are very satisfied with electricity which is a significant change compared to only 11% rate of satisfaction with electricity in the year 1990 (Fig. 6b).

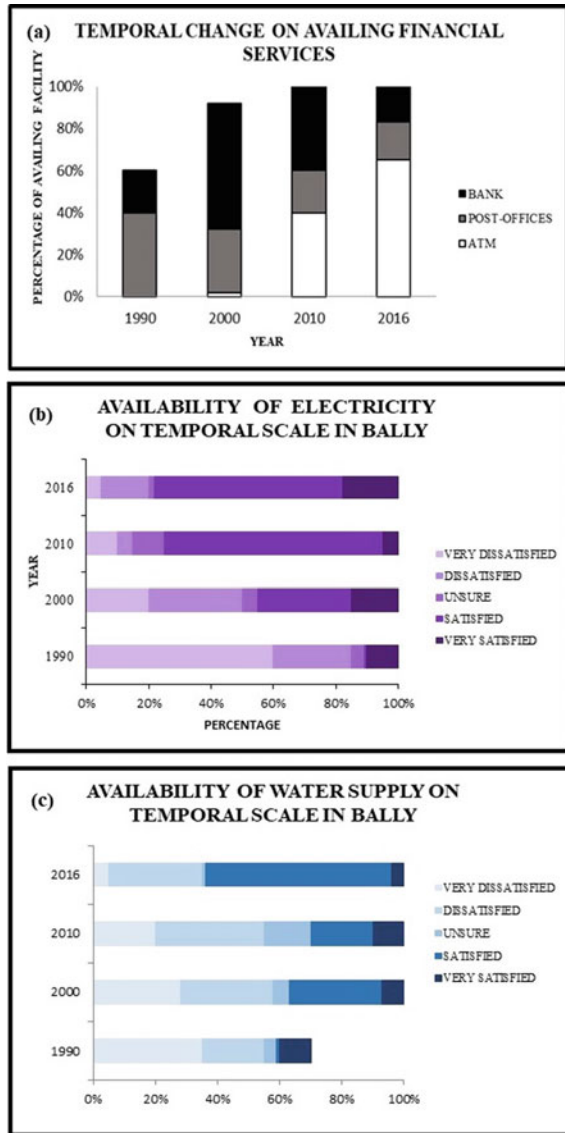
Availability of street light is not only an indicator of development, but it is taken as a safety measure for the residents as well. Though there are plenty of street lights Fig. 7a, the crime rate has not declined in this area. According to a Report provided by NCRB, Haora has a highest crime rate of 240.25 compared to the national crime rate of 218.67. However, some residents were of the opinion that the shifting of the government headquarters to the district has significantly reduced the incidents of crime.

The total road length in Haora is approximately 300 km. Road connectivity has played a major role in the process of urbanization of Haora district. Important highways like Grand Tank Road, Kona Expressway pass through Haora and connect it with neighbouring districts. Haora station, established in 1854, connects with most of the major cities of India and is considered a lifeline for both Haora and Kolkata. Though the respondents are quite satisfied with the roadways (Fig. 7b), the survey revealed that problems like congestion, pollution and ill maintenance of roads often lead to water logging. Thus, sometimes they are quite dissatisfied with the road conditions.

Haora always was a strong base for education in India and West Bengal (Fig. 8a).

As far as the health facilities are concerned, the respondents complained about the state of the government hospitals. Therefore, they prefer private healthcare facilities. The private nursing homes provide high-end facilities to the patients, and the basic cleanliness of the nursing homes are much more than the government

Fig. 6 Graphs showing **a** temporal change in available financial services, **b** temporal change in availability of electricity and **c** kind of land conversions. *Source* Authors



hospitals. However, the difference in the charges makes it difficult to avail the facilities by all the economic classes, and the respondents have pointed out that the medical charges are increasing by leaps and bounds and because of that sometimes they have to rely upon the government hospitals and the health centres. The dismal conditions of the OPDs and the pressure upon the hospitals have reduced the patient to bed ratio and patient doctor ratio. Hence, the above diagram shows the upsurge in the nursing homes, and they are giving tough competition to the government

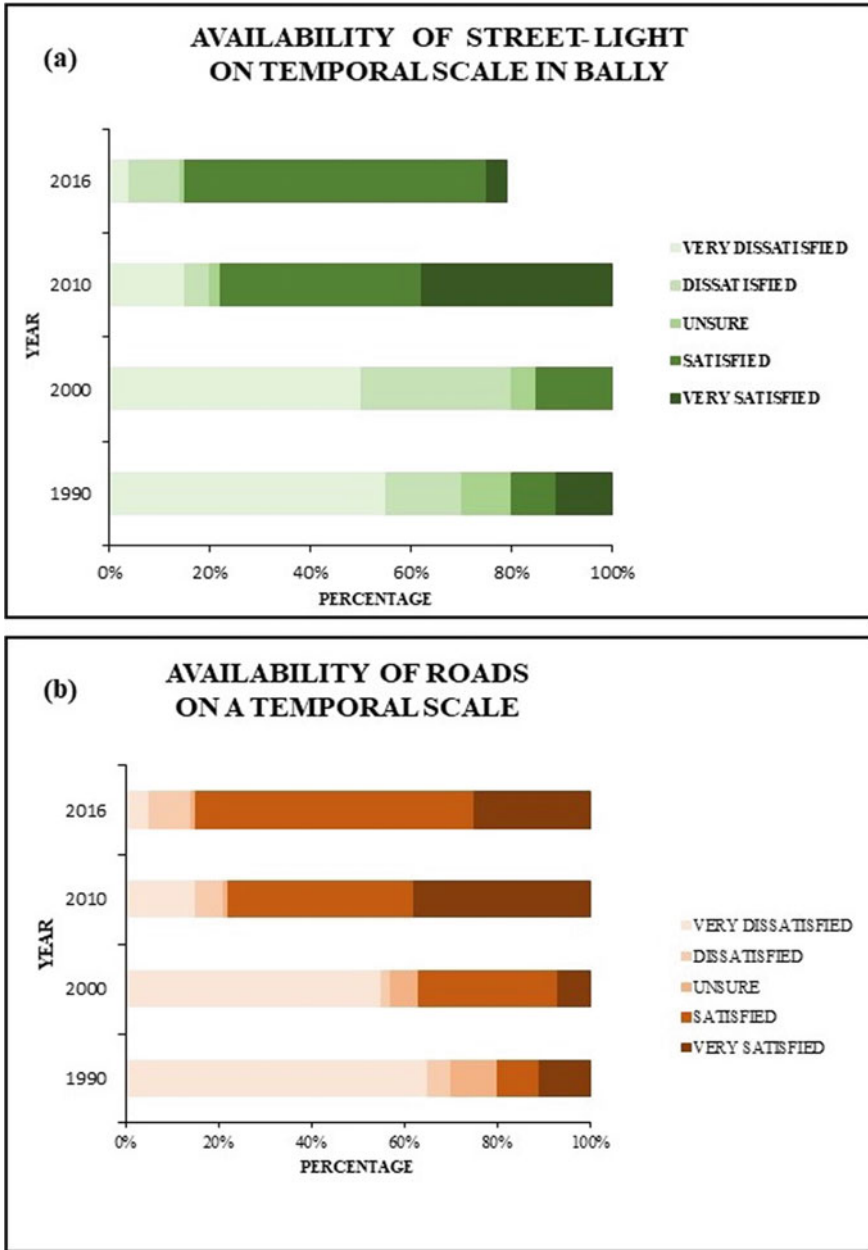


Fig. 7 Graphs showing **a** availability of street lights on a temporal scale, **b** availability of roads on a temporal scale. *Source* Authors

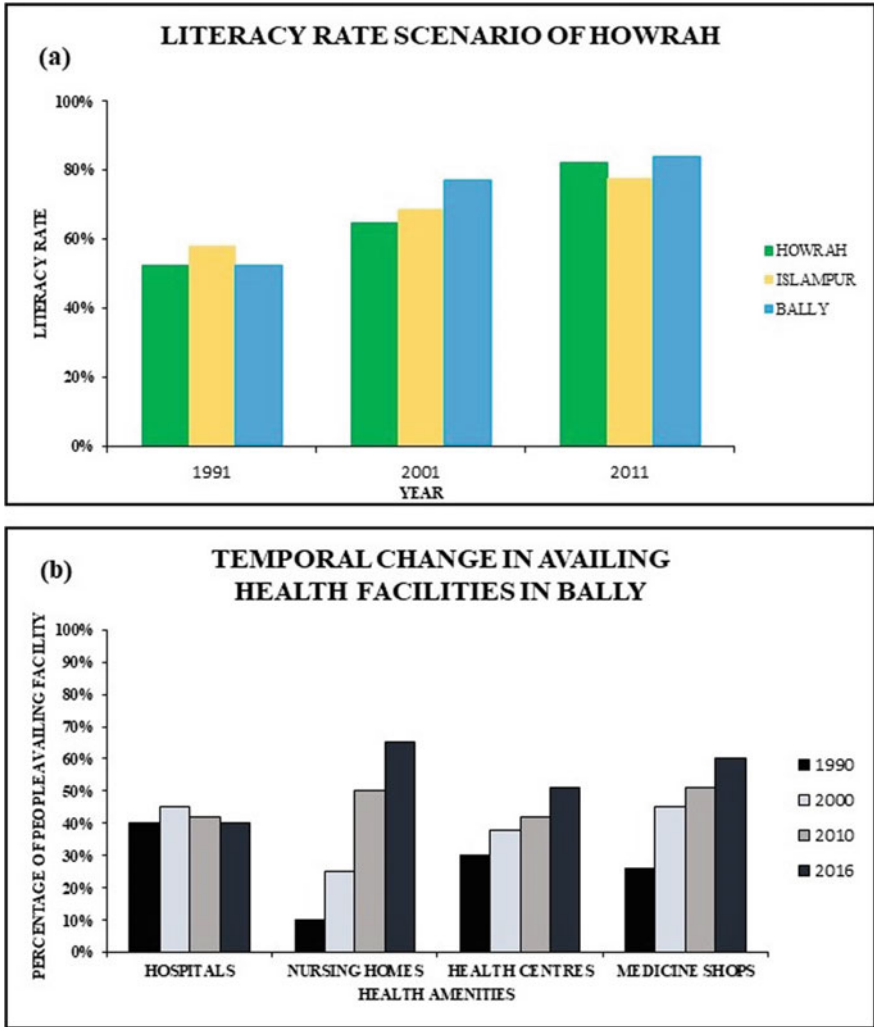


Fig. 8 Graphs showing **a** literacy rate scenario of Haora, **b** temporal change in available health facilities in Bally. *Source* Authors

hospitals. Hence, most of the people who are economically competent are moving towards private nursing homes, and medicine shops are also very much frequent in every nook and corner of Haora compared to that of 1990.

6 Conclusion

From the perception study, it is very clear that Haora's infrastructural development and employment opportunities have accelerated the urban growth of Haora. The population rise in Haora district is a combination of both natural cause and migration. The industrial belt of Haora has pulled people to this district throughout history. The railway junction and the Haora Bridge have acted as catalysts. Slums and squatters are the initial mode of residences for the migrants, which in due time have reduced the open spaces of the area. Excessive population pressure led to the dispersal of the settlements mostly along transport lines followed by the conversion of available non-built-up areas.

Repeated visits to Haora Sadar subdivision during this study have given an impression that urban land-use changes are very rampant in this area. The study has been conducted using both the primary and secondary data, and the results found are significant. It has been observed that over the period of thirty years, the urban landscape has changed from a dispersed kind of settlement in 1990 to compact settlement in 2016. The urban way of living has been infused in this area where people are getting accustomed with urban amenities available, and it is increasing regularly. The increasing value of the largest patch index and patch density of Haora Sadar Subdivision has proved the fact that built-up density is leading towards compaction. Open spaces are reducing as built-up area is increasing, and it has been noticed from the questionnaire survey of the respondents that water bodies, parks and open spaces are converting into built-up areas. India being among the top populous countries (second comprising of 1.311 billion population immediate next to China comprising of 1.371 billion population) of the world and projected to be most populous country of the world by 2022 has provided a great passage for studying urban built-up areas as the urban area of India is about 32% of the total land area, and it is increasing by leaps and bounds. Overall, it can be concluded that in micro-scale also rapid urbanization process is evident indicating India as the projected largest urban agglomeration in the coming century. Urban built-up measurement is still under a research domain of urban geographers because mathematical indices are not always sufficient because of the spatial dimension of urban growth. It is quite evident that there is a huge scope of research in urban built-up measurement.

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