

# Analysis of Land Use Land Cover Change and Relative Growth in Social Amenities: Panvel Tahsil, Maharashtra

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**Abstract** - Panvel is a fast-growing locality adjacent to Navi Mumbai, and a growth hub in the Mumbai Metropolitan Region. Due to its proximity to Mumbai and Navi Mumbai, it is one of the few urban areas of Raigad district, and attracts migrants due to work opportunities and low cost of living, which has led to incredibly high speed to urbanization post-2000s.

Through a series of land use and mapping studies utilizing aerial imagery and historical maps, this study aims to understand the pattern of Panvel's rapid urbanization over the last 30 years, while also comparing the rate of growth of its social amenities, to compare the lag or the delay with which urban amenities are provided in rapidly growing cities. Lastly, the actual mapped amenities are compared with the relevant census populations and the recommended URDPFI standards to understand the degree of pressure on amenities due to this urbanization, and the gap between recommended standards and real-life cases.

**Keywords:** Urbanization, Panvel, Urban amenities, Planning standards, social amenities

## 1. INTRODUCTION

Remote sensing (RS) and GIS are recognized as primarily essential and powerful tools in determining LULC changes at various spatial scales (Dewan & Corner, 2013). Land Use and Land Cover change detection has become a fundamentally important component to understand the extent of urbanization in rapidly growing cities. LULC generated information is utilized by researchers, city professionals and planners to determine changes in natural resources and evaluate the growth patterns (Adeel, 2010).

It has been recognized that the growth and development of larger cities and its interaction with the neighboring areas is influenced by economic development, the intensity of trade growth, and motivation on the part of the administration aimed at bringing about development of the cities (Tabuchi,

2013). Nevertheless, Panvel tahsil, located on the periphery of Mumbai Metropolitan Region has been extensively influenced by the growth and development of its surrounding urban areas. The integration of Mumbai and its surrounding region into the global economy, is bringing radical changes in the socioeconomic and environments of this surrounding region (Phadke, 2013). Such areas that are in proximity to the urban as well rural centres act as transitional economic and social spaces where changes in the land use result in several other dynamics that result in transition to a great extent (Varkey, 2019) The main objective of the paper is to identify the extent to which the changes in land use land cover have affected the development of social infrastructure in the selected study area.

## 2. STUDY AREA

Panvel tahsil is a part of Raigad district falling within the peripheral limits of the Mumbai Metropolitan Region. It lies approximately 30kms to the southeast of central Mumbai. Located to the south of Thane District, Panvel Tahsil is surrounded by Uran Tahsil on the east, Pen Tahsil on the south and Khalapur Tahsil on the west. Panvel City located in the tahsil is the first Municipal Corporation of Raigad district. The tahsil has close proximity to Mumbai as well Pune district. According to the census report of 2011, Panvel Tahsil has recorded highest growth rate in the urban areas of the district. MMR Regional Plan 2036 has recognized the area around Panvel as an emerging growth centre.



**Fig -1:** Location of Panvel Tahsil in context to MMR, Maharashtra.

For analyzing land use land cover change, Landsat imagery has been acquired from the USGS portal. After undergoing the required corrections and referencing, the images were analyzed and 100-400 identification points were selected per land use category per decade. Using MLE classification, the images were classified, and the extracted image was verified using historical Google Earth imagery and census maps.

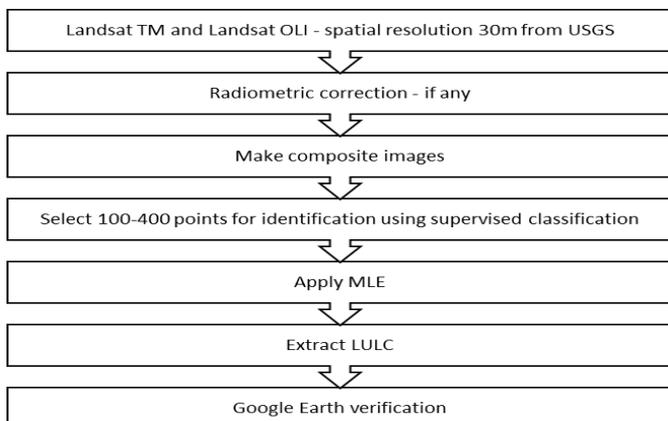
### 3. METHODOLOGY

To assess the pattern of LULC change, Landsat 05 image of 1991, Landsat 07 image of 2001 and 2011 and Landsat 08 image of 2021 was used from USGS portal. The selection of the land sat images was based on the image quality considering low cloud cover Different band combinations were used to proceed with the image classification of Landsat imagery.

**Table -1:** Land Sat Imagery acquired and analyzed as per decade

S. No.	Year	Landsat type
1	1991	5
2	2001	7
3	2011	5
4	2021	8+ OLI

After undergoing the required corrections and referencing, the images were analyzed and 100-400 identification points were selected per land use category per decade. In order to facilitate the change in land use land cover of the study area, supervised classification (Maximum Likelihood Classification) was conducted in ArcGIS. Four classes viz. Built Up, Water Body, Vegetation (includes dense vegetation like forest cover, sparsely vegetated areas, agriculture area) and Barren land were used.



**Fig -2:** Methodology of LULC extraction using Landsat Imagery

### 4. LAND USE LAND COVER CHANGE DETECTION

The results from the classification suggest that there is change in the pattern of land use over the four decades. The table below indicates land use changes in Panvel Tahsil from 1991 to 2021.

The total area under Panvel Tahsil is 642.90 sq. kms. A significant increase in the built-up land is seen from 1991 to 2021. The year 2001 and 2021 have seen more increase in the built-up percentage. Area under built up land has increased from 44.18 sq. kms to 105.76 sq. kms in 2001 and 117.01 sq. kms to 311.03 sq. kms respectively, covering up to 48.46% of the total area. This increasing trend in the built up is indicative of the rapid urban growth occurring in areas under Panvel tahsil. The area under water body has shown a gradual decrease over a span of these four decades with a total decrease in the area under water body by 45.36%.

The area under vegetation has also reduced from 1991 to 2021. The area under vegetation in the year 1991 was 331.31 sq. kms comprising of 51.5% of the tahsil area which has further decreased to 113.50 sq. kms accounting to 17.655 of land area. Hence, it is inferred that the area under agriculture in the tahsil has also subsequently reduced.

The classification as seen from the maps indicate that most of the area under vegetation cover has changed to barren land over the years. Thus, the percentage of barren land has increased over the period of three decades. The area under barren land has increased from 251.65 sq. kms to 378.08 sq. kms from 1991 to 2011. There is decrease in the area under barren land from 2011 (378.08 sq. kms) to 2021 (208.95 sq. kms). The trend in the classification map indicates that the barren land is further being converted to built up area in the tahsil. The land use land cover analysis suggests that the tahsil is undergoing rapid urban growth.

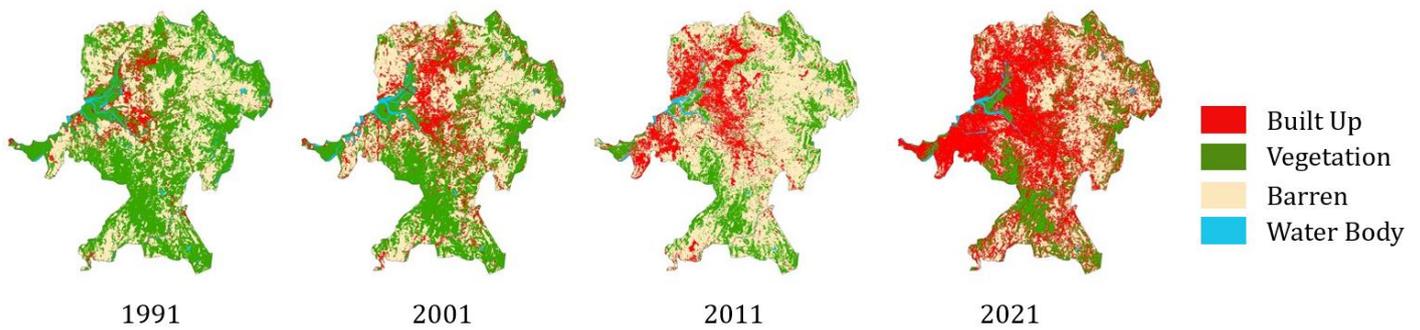


Fig -3: Maps indicating LULC Change in Panvel Tahsil

Table 2: Land Use Land Cover Change Detection

Land Use Land Cover	Year							
	1991		2001		2011		2021	
	Area (sq. km)	%						
Built Up	44.18	6.87%	105.76	16.45%	117.01	18.20%	311.03	48.46%
Water Body	15.76	2.45%	12.09	1.88%	7.14	1.11%	8.61	1.34%
Vegetation	331.31	51.53%	258.96	40.28%	140.67	21.88%	113.30	17.65%
Barren	251.65	39.14%	266.09	41.39%	378.08	58.81%	208.95	32.55%

### 5. PROVISION OF SOCIAL AMENITIES

Civic and social amenities and facilities provided to the citizens at taxpayer’s cost. These encompass educational, medical, communication facilities and more. In the Indian scenario, URDPFI guidelines lists down the hierarchy of social infrastructure development in Appendix N of Volume of 2 of URDPFI Guidelines 2014.

For the purpose of this study, the given standards of education, medical and communication facilities like Post and Telegraph office and banks are compared with the recorded numbers of social infrastructure as extracted from District Census Handbook records of Panvel C.D. Block, Raigad district. In total, within the three main categories, there are a total of 14 subcategories, dependent on available information from various government related secondary sources.

Table 3: URDPFI recommended values of amenities for a given population of CD Block

	URDPFI social amenity		1991	2001	2011	2021
	Population		172217	218186	252477	304764
	Recommended values	1 per				
	<b>EDUCATION</b>					
1	Primary school	5000	34	44	50	61
2	Senior Secondary School	10000	17	22	25	30
3	Bank	15000	11	15	17	20
4	Dispensary	15000	11	15	17	20
5	College	100000	2	2	3	3

6	Nursing home/polyclinic	100000	2	2	3	3
7	Hospital	100000	2	2	3	3
8	Engineering college/Technical college	1000000	0	0	0	0
<b>MEDICAL</b>						
9	Dispensary	10000	17	22	25	30
10	Child and maternity welfare	100000	2	2	3	3
11	Polyclinic	100000	2	2	3	3
12	Intermediate Hospital	100000	2	2	3	3
13	Multi-specialty Hospital	100000	2	2	3	3
14	Family welfare center	50000	3	4	5	6
15	Diagnostic center	50000	3	4	5	6
<b>COMMUNICATION</b>						
16	Sub post office	10000	17	22	25	30
17	Bank	10000	17	22	25	30
18	Telegraph booking counter	100000	2	2	3	3
19	Post office	250000	1	1	1	1

The values of population are taken from the District Census Handbooks and the population of 2021 is estimated based on previous years' growth rates.

For comparing year-wise data of available statistics from the DHCB.

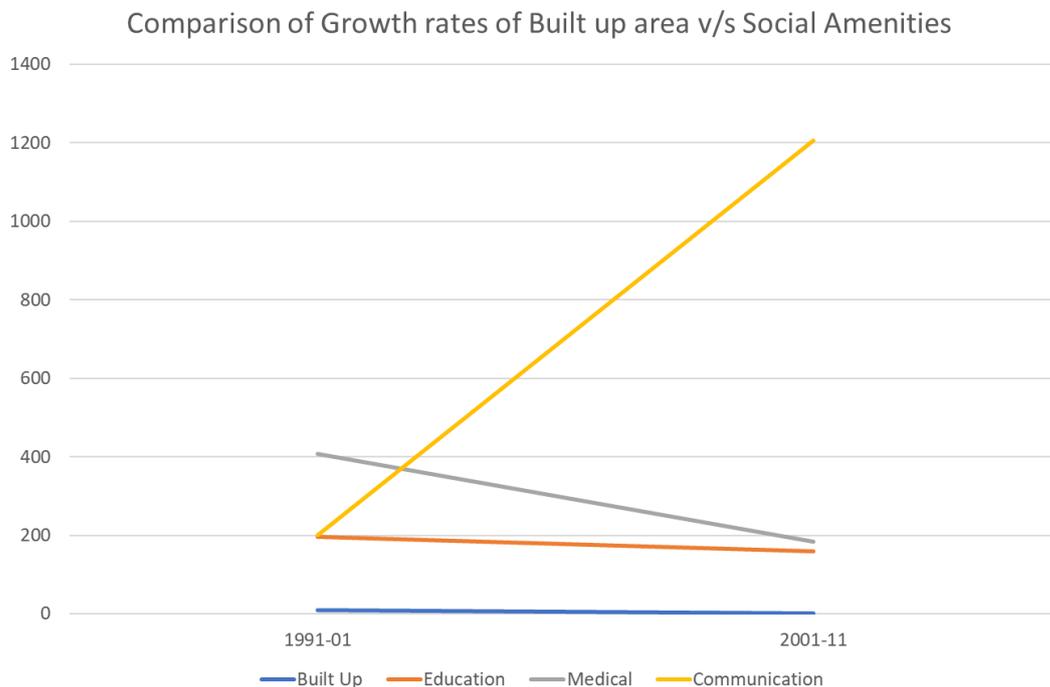
**Table 4:** Comparison of social amenities – recommended vs real values to show deficit in factors

S.no.	Amenity	1991		2001			2011		
		URDPFI recommendation	Real Value	URDPFI recommendation	Real Value	Growth %	URDPFI recommendation	Real Value	Growth %
<b>Education</b>									
1	Primary School	34	139	44	179	28.78	50	288	60.89
2	Middle School	NA	15	NA	55	266.67	NA	113	105.45
3	Secondary School	NA	11	NA	21	90.91	NA	49	133.33
4	S. Secondary School	17	1	22	5	400	25	22	340
<b>Medical facilities</b>									
5	PHC	2	0	2	5	500	3	5	0
6	Primary health subcenter	NA	4	NA	22	450	NA	26	18.18
7	Maternity/child welfare	2	0	2	0	0	3	5	500
8	Polyclinic	2	0	2	0	0	3	5	500
9	Hospital	2	0	2	2	200	3	5	150
10	Dispensary	17	0	22	13	1300	25	5	-61.54
<b>Communication</b>									
11	Post office	1	25	1	26	4	1	25	-3.85

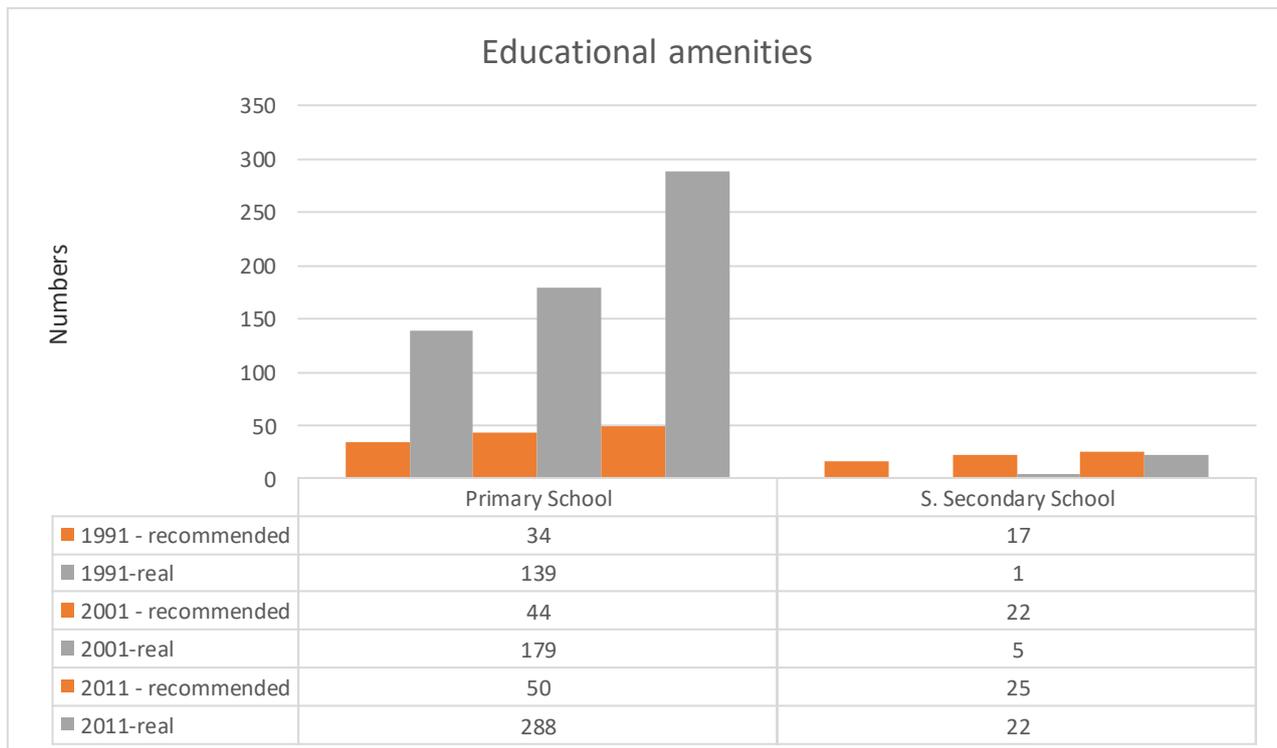
12	Sub Post office	17	0	22	0	0	25	22	2200
13	Post and telegraph	2	0	2	0	0	3	25	2500
14	Commercial and coop banks	17	NA	22	8	800	25	18	125
<b>Net Deficit (number of factors)</b>			<b>9</b>		<b>7</b>			<b>4</b>	

In comparison to the urbanization growth rates on 9.58% between 1991 and 2001, and 1.75% between 2001 and 2011, social amenities in total have grown on an average of 288% and 447% respectively. This shows

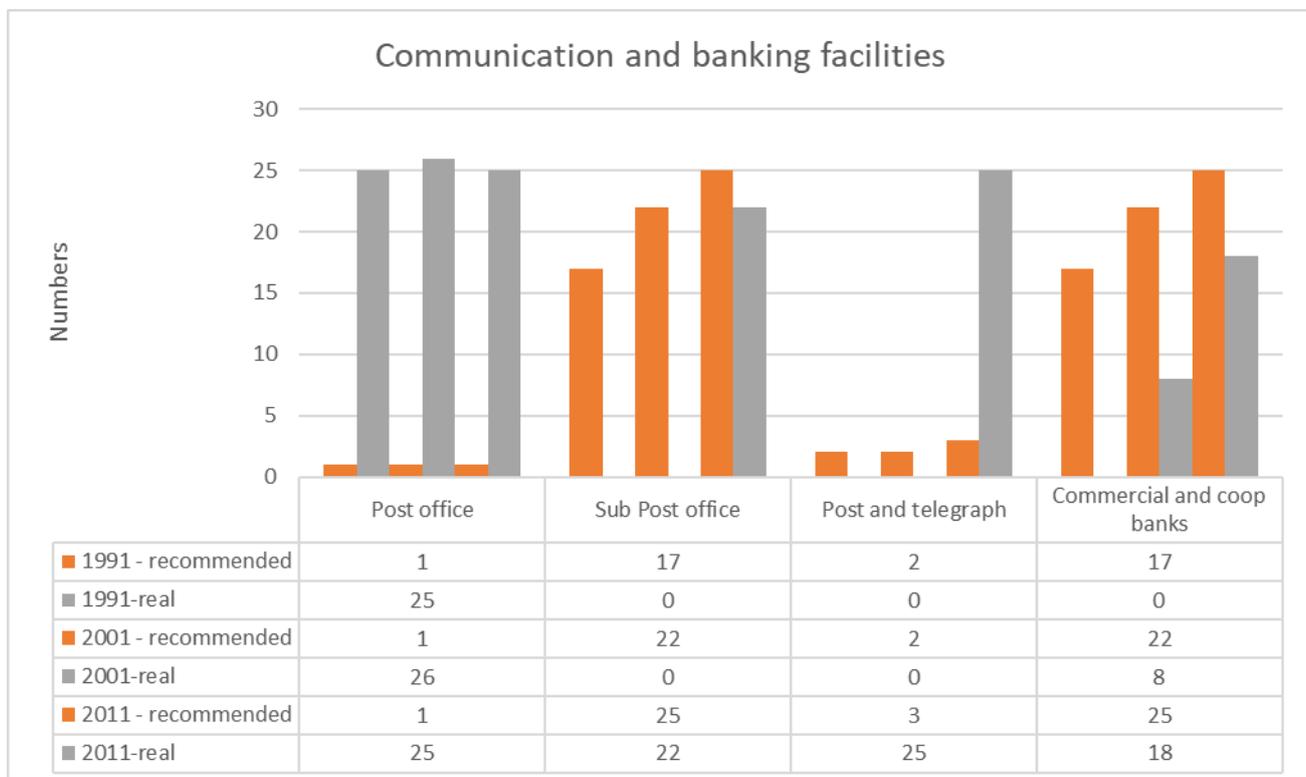
that the rate of provision of amenities has far exceeded the land conversion rates to built-up land in these decades, though it has still not reached the recommended levels.



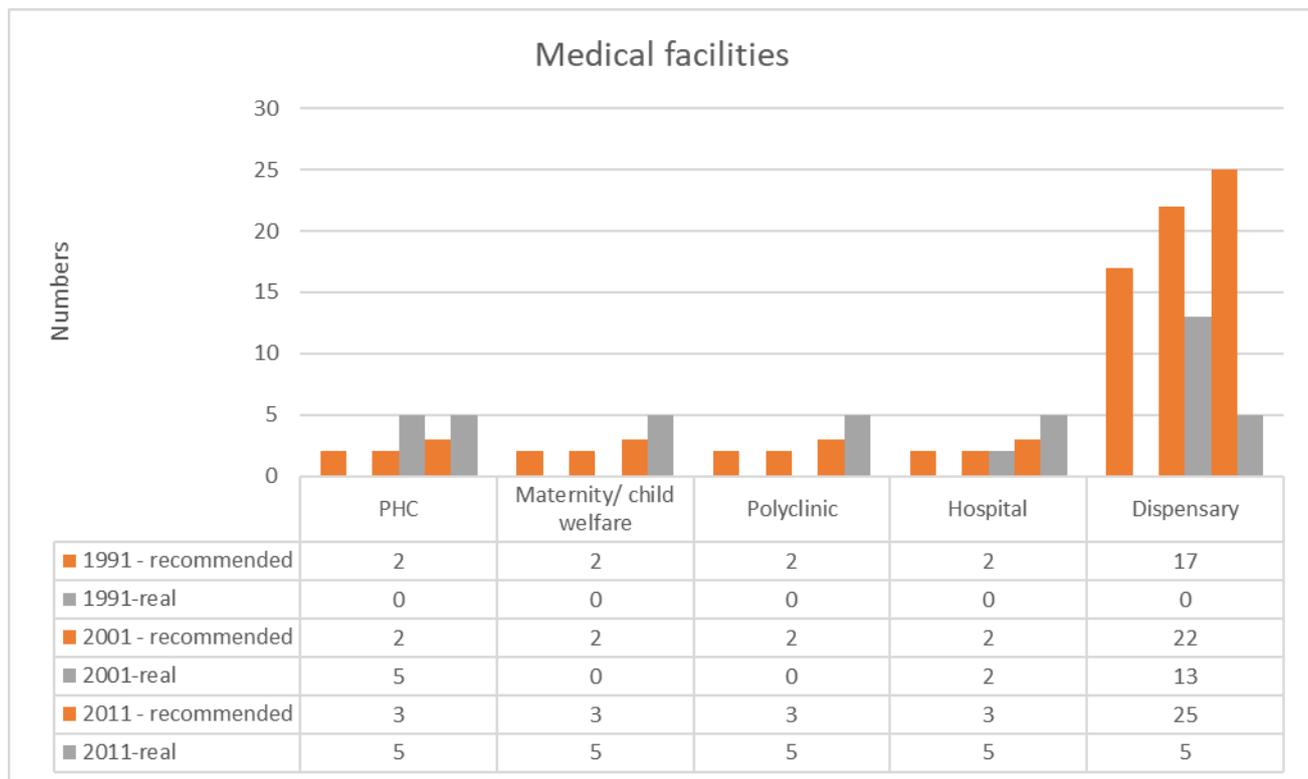
**Chart 1:** Comparing rate of growth of built-up area v/s social amenities in Panvel (1991-2011)



**Chart 2:** Comparing recommended and actual numbers of educational facilities in Panvel (1991-2011)



**Chart 3:** Comparing recommended and actual numbers of communication and banking facilities in Panvel (1991-2011)



**Chart 4:** Comparing recommended and actual numbers of medical facilities in Panvel (1991-2011)

As can be seen from comparative trends over the last 3 decades (1991-2011), the gap of social amenity provision has been reducing. The 2021 DCHB is delayed due to the pandemic and hence its statistics could not be included in this comparison. However, it is expected that the gap will close further when the new statistics are out.

As can be seen from Table 4, Higher schooling has lagged behind provision of primary schooling. Medical facilities, which were lagging behind strongly, have caught up and exceeded recommended levels as Panvel transforms into an education and medical hub for its neighboring rural and semi-rural zones.

## 6. CONCLUSION

As Panvel urbanizes at a rapid rate, it is heartening to see the social amenities too have been growing at a rapid rate. While it still hasn't reached the recommended levels, and will need more funding and execution to match a projected population in the future, it is well on track to achieve the recommended

rates. Most parameters see a robust rate of growth exceeding the rate of urbanization for the decade.

## 7. REFERENCES

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