# PANDEMIC AND URBAN SUSTAINABILITY: ANALYZING THE COVID-19 SCENARIO IN MUMBAI, INDIA

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**ABSTRACT.** The present study analyses the case of urban sustainability in Mumbai in the context of the COVID-19 pandemic and aims to identify the relationship between the existing sustainability issues and the spread of the pandemic across the administrative wards of the Municipal Corporation of Greater Mumbai. It also tries to delve into the reasons behind the observed relationships to establish the patterns created by the COVID-19 pandemic in Mumbai by the end of August 2020. The study relies on secondary sources of data, that include reports published by government agencies, news articles, journals and websites. The study comprises a large amount of quantitative data that were analyzed using ArcGIS 10.4.1 and SPSS 23. The qualitative data collected through an extensive literature review was used alongside the quantitative data to support the study. The findings reveal that the COVID-19 pandemic had a varied impact across the wards of Mumbai, which was found to be associated with the unequal socio-economic conditions that prevail across the city. This inequality has contributed to Mumbai's reduced resilience, for building which the Sustainable Development Goals (SDGs) have to be achieved.

KEY WORDS: COVID-19, Density, Pandemic, Poverty, Sustainability, Urban

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### INTRODUCTION

The need for sustainable development in cities has been recognized in the Sustainable Development Goals (SDGs) formulated by the United Nations, where SDG 11 is dedicated to making cities and communities sustainable<sup>1</sup>. Large population and diverse activities in urban areas have resulted in the emergence of several socio-economic and environmental challenges rendering a multi-dimensional character to the sustainability debate (Kwivani 2010). Furthermore, sustainable development in the cities of the Global South poses several challenges due to the existence of various problems such as high population density, urban informality, poverty, housing crisis and growing unemployment. Therefore, sustainable development in the cities of the Global South would require accomplishing certain other SDGs in conjunction with Goal 11. These goals include Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 3 (Good Health and Well-Being), Goal 8 (Decent Work and Economic Growth) and Goal 17 (Partnerships)<sup>2</sup>. On top of all the existing challenges, the emergence of the COVID-19 pandemic has crippled the urban areas raising more concerns about the future of sustainability. Black et al., (2020) note that, «In dense, internationally connected

<sup>1</sup> United Nations, n.d.

<sup>2</sup> Sustainable Development Goals | Partnerships platform, n.d.
<sup>3</sup> Guterres, n.d.

<sup>4</sup> Praharaj and Vaidya, n.d.

⁵ Jha 2020

cities, risk of transfer of infectious disease is exacerbated through rapid population flows, and lack of quality public space». By bringing the issue of urban vulnerability to the forefront, the pandemic has reinstated interest in the subject (Sharifi et al. 2020). It has also provided an opportunity to examine how pandemics affect urban areas and what can be done to increase the urban resilience to pandemics (Sharifi et al. 2020). With 90% of the reported cases, the urban areas across the world have emerged as ground zero of the pandemic<sup>3&4</sup>. This has not been an exception for India, where the progress of the pandemic has made it evident that the urban areas of the country are bearing the brunt of the crisis. According to Jha, «With an ever-larger shift of populations to urban areas in conjunction with a shift of a very large percentage of national economies to large urban centers, the concentration of a succession of epidemics and pandemics in cities has become stronger»<sup>5</sup>.

The city of Mumbai is one of the worst affected areas by the COVID-19 pandemic. It is one of the most densely populated cities of India and the density in its ghettos of the urban poor is strikingly high, for instance, in Mumbai's 'Dharavi', which is one of the most densely populated slum areas of the world, the population density is 277,136/ km<sup>2</sup> (Golechha 2020). Unlike the affluent sections of the society, the urban poor are facing far greater challenges under the lockdown. 'People living in urban slums are exposed to greater risks than those residing in wealthy neighborhoods'1 (Neiderud 2015), especially in times of a pandemic. Prevalence of co-morbid conditions, malnutrition and insufficient diets weakens the immune system, which alongside factors such as lack of clean drinking water and improper sanitation facilities make people susceptible to disease transmission and deaths (Toole and Waldman 1990). Paul et al. (2020) note that high population density and a large concentration of the population in slums with high household density and low per-capita income drive the spread of infectious diseases, as people living under such circumstances are compelled to violate social distancing norms for their basic needs. In the slums of Mumbai, maintaining social distancing for stopping the spread of the virus is a luxury, which the slum dwellers cannot afford for the sake of their survival. Along with this, homelessness is another major challenge confronting Mumbai. The COVID-19 pandemic has posed a severe challenge to this less recognized section of Mumbai's population as well. The present study aims at examining the scenario emerging from the pandemic in the Indian city of Mumbai from the perspective of urban sustainability. The paper attempts to explore the relationship existing between the spatial distribution of the pandemic, urban density and urban poverty in the city.

### MATERIALS AND METHODS

### The Study area

The study area chosen for the study is the coastal city of Mumbai located in the western part of India, in the state of Maharashtra. Mumbai is administered by the Municipal Corporation of Greater Mumbai (MCGM). Greater Mumbai is a city spread over two districts, Mumbai City District and Mumbai Suburban District. It is divided by the MCGM into 24 administrative wards, of which 9 are in Mumbai City District and 15 are in Mumbai Suburban District<sup>2</sup> (Fig. 1). The wards located in the Mumbai City District are A Ward (Colaba), B Ward (Sandhurst Road), C Ward (Marine Lines), D Ward (Grant Road), E Ward (Byculla), F/S Ward (Parel), F/N Ward (Matunga), G/N Ward (Dadar/Plaza) and G/S Ward (Elphinstone)<sup>2</sup>. The wards located in the Mumbai Suburban District are H/W Ward (Bandra), H/E Ward (Khar/Santacruz), K/E Ward (Andheri East), K/W Ward (Andheri West), P/S Ward (Goregaon), P/N Ward (Malad), R/S Ward (Kandivali), R/C Ward (Borivali), R/N Ward (Dahisar), L Ward (Kurla), M/E Ward (Chembur), M/W Ward (Chembur West), N Ward (Ghatkopar), S Ward (Bhandup) and T Ward (Mulund)<sup>2</sup>.

### Data collection and processing

To meet the objectives of the research, two major sets of data were used in this study. The first set of data is on the scenario of the COVID-19 pandemic in Mumbai, which is collected from the key updates and trends published by the Municipal Corporation of Greater Mumbai, dated 30<sup>th</sup> of August 2020<sup>3</sup>. This set comprises the ward-wise data on COVID-19 positive cases, active cases, cases discharged and cases resulting in deaths as well as containment zones and sealed buildings in Mumbai. The second set comprises demographic data on gross population density, slum population and homeless population in the wards of Mumbai as per the estimates of the Census of 2011. The ward-wise data on gross population density and slum population were collected from the District Disaster Management Plans of Mumbai City District and Mumbai Suburban District<sup>3</sup>&<sup>4</sup>; whereas the ward-wise data on homeless population was derived from the FAQ document of the Public Health Department of the MCGM<sup>5</sup>. In addition to this, data from other sources such as journals, websites and news articles were also used to support the study.



Fig. 1. Wards and Districts comprising Mumbai

<sup>1</sup> Choudhry and Avinandan 2020 <sup>2</sup> District Census Handbook: Mumbai Suburban District, 2011 <sup>3</sup> MCGM 2020b <sup>4</sup> MCGM 2019a <sup>5</sup> MCGM 2020a The collected data were processed and analyzed using ArcGIS 10.4.1 and SPSS 23. Using ArcGIS 10.4.1, the wardwise distribution of the total number of positive COVID-19 cases, number of active cases, patients discharged, patient deaths, containment zones and sealed buildings as well as population density, slum and homeless population in Mumbai were mapped to reveal the emerging spatial patterns. Thereafter, the correlation between these variables was analyzed in SPSS 23 to analyse the existence of any significant associations. In addition to these, the map showing the wards and districts of Mumbai was also prepared in ArcGIS 10.4.1.

### **RESULTS AND DISCUSSION**

### The COVID-19 scenario of Mumbai

The COVID-19 pandemic has affected Mumbai tremendously. With Dharavi emerging as a COVID-19 hotspot in April<sup>1</sup>, Mumbai's fate in terms of the pandemic seemed extremely gloomy. However, since then Dharavi went a long way, going from being a hub of SARS-CoV-2 infections to becoming a success story. In the wake of the growing number of cases in Mumbai, the success of Dharavi in controlling the spread of the SARS-CoV-2 virus has altered the dynamics of the pandemic in the city. In this study, the COVID-19 situation that emerged in Mumbai at the end of August 2020 was considered. Analyzing the ward-wise distribution of the positive COVID-19 cases in Mumbai revealed the existence of significant differences throughout the city (Fig. 2). Some wards such as P/N, K/W, K/E and G/N were marked by a high number of COVID-19 positive cases, ranging from 7670 to 8727, while the wards H/W, C, B and A had a very low number of positive cases, ranging from



Variation among the wards of Mumbai also exists in terms of the number of active cases, people discharged and cases resulting in deaths (Fig. 3). The highest number of active cases was recorded in the R/C ward (1641), followed by the R/S (1327) and K/W (1229) wards, whereas the lowest number of active cases was recorded in the B ward (129), followed by the C (241) and L (462) wards. The highest number of cases discharged was recorded in the P/N ward (7530), followed by the K/E (7413) and G/N (7102) wards, whereas the lowest number of cases discharged was recorded in the B ward (1039), followed by the C (1768) and R/N (3104) wards. With regards to the number of COVID-19 related deaths, the highest number of deaths was recorded in the K/E ward (540), followed by the G/N (506) and S (474) wards, whereas the lowest number of deaths was recorded in the A ward (72), followed by the B (93) and C (106) wards.

As a result of the growing number of cases, the municipal authorities have identified containment zones in each of these wards (Fig. 4). Containment zones refer to areas where positive cases of COVID-19 were detected and to protect everyone inside and outside from further spread of the virus, the surrounding zone covering these areas were sealed<sup>2</sup>. The restrictions on movement and interactions were the most severe in the containment zones with only basic supplies and services allowed inside<sup>3</sup>. The highest number of containment zones was in the L ward (54), followed by the R/N (53) and S (52) wards, whereas the lowest number of containment zones was in the B ward (2), followed by the H/W, G/S (6 each) and M/W (8) wards.

Along with containment zones, individual buildings were also sealed. Since apartment living is highly prevalent in





(Source: Computed based on data from MCGM's «Stop Coronavirus – With Right Information & Simple Measures: Key Updates & Trends» 2020)

<sup>1</sup> The Hindu 2020 <sup>2</sup>MCGM 2020b <sup>3</sup>The Indian Express 2020



Fig. 3. Ward-wise distribution of the number of active cases, cases discharged and cases resulting in deaths in Mumbai (Source: Computed based on data from MCGM's «Stop Coronavirus – With Right Information & Simple Measures: Key Updates & Trends» 2020)

Mumbai, the civic authorities of the city have resorted to sealing buildings upon detection of positive COVID-19 cases in them. The distribution of the sealed buildings varied across the wards of the city (Fig. 5). The highest number of sealed buildings in Mumbai was in the R/C ward (981), followed by the R/S (551) and K/W (458) wards, whereas the lowest number of sealed buildings was in the E ward (37), followed by the A (56) and C (60) wards.

# Linking the COVID-19 spread in Mumbai to urban density and poverty

High population density has been linked to the spread of the SARS-CoV-2 virus in India<sup>1</sup> (Bhadra et al. 2020). Adlakha and Sallis have however pointed towards the protective health benefits of urban density such as active lifestyle, more walkability and lower risk of chronic health diseases due to lesser use of transport, thereby refuting the notion that urban density is necessarily unhealthy<sup>2</sup>. The development of slums and shantytowns are a product of the rapid growth of urban centres with poor urban planning and lack of capacity to meet the needs of the growing population (Reyes et al. 2012). McFarlane notes that «The problem is not with high population density per se, but with the imbalance between good quality urban provisions - including housing, services and infrastructure - and the population density of an area»<sup>3</sup>. Living in impoverished slums and on streets exposes the urban poor to health issues and immunity-related challenges. People residing in the poorer neighborhoods are likely to have pre-existing health problems, as in the case of Mumbai, where in several of its slum communities tuberculosis has been found to be prevalent in large proportions<sup>3</sup>.

Before identifying the links between the COVID-19 spread in Mumbai to the population density and poverty in the city, it is important to understand the existing state of the population density and poverty in different wards. It is a well-known fact that Mumbai is a densely populated city. As per the Census of 2011, the total population of Mumbai is 12,442,373 people<sup>4</sup>. The most densely populated ward of Mumbai is the C ward with a gross density of 869 pp ha, whereas the least densely populated ward is the T ward with a gross density of 75 pp ha (Fig. 6).

The fact that the COVID-19 pandemic has affected the urban poor the most has come to be recognized worldwide<sup>3</sup> (Tampe 2020). Unequal cities bear marks of poverty on the one hand and prosperity on the other, as in the case of Mumbai, where rags and riches reside side by side. The high concentration of slums by the side of skyscrapers bears testimony to the city's unequal character. Except for the C ward, all other wards of the city have slums. Out of 24 wards, 9 wards have more than 50% of the population living in slums. The highest share of the slums population (72.3%) is found in the S ward (Fig. 7).

Along with the slum dwellers, there is also a large number of homeless people. As per the MCGM, there are 35,408 homeless people living in Mumbai, of which the highest numbers are found in the C ward (4685) and the lowest numbers are found in the M/E ward (356) (Fig. 8). It is worth mentioning that such official statistics on the homeless population are not very reliable because the official enumeration takes place during day hours when it is most difficult to track down the homeless as they are busy earning their livelihood away from their place of stay (Sattar 2014). Nonetheless, it at least provides some idea on the current situation regarding homelessness.





### s in Fig. 5. Ward-wise distribution of sealed buildings in Mumbai (Source: Computed based on data from MCGM's «Stop Coronavirus – With Right Information & Simple Measures: Key s: Key Updates & Trends» 2020)

Fig. 4.Ward-wise distribution of containment zones in Mumbai

(Source: Computed based on data from MCGM's «Stop Coronavirus – With Right Information & Simple Measures: Key Updates & Trends» 2020)

<sup>1</sup> Baggchi 2020

- <sup>2</sup> Adlakha and Sallis 2020
- <sup>3</sup> McFarlane 2020

<sup>&</sup>lt;sup>4</sup> District Census Handbook: Mumbai Suburban District 2011

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the number of containment zones and slum population can

be explained by the fact that as the slum population of Mumbai

became highly affected by COVID-19, most containment zones

came to be set up in and around these areas. Apart from living in

congested conditions, the slum dwellers are also required to use

To identify the relationship between the current state of the COVID-19 pandemic in Mumbai and urban density and poverty in the city, the correlation between relevant variables was analyzed (Table 1). From the analysis, a number of associations were observed. At a significance level of 0.05, a slightly strong positive correlation of 0.408 was found between the number of containment zones and slum population (%), whereas a slightly strong negative correlation of -0.409 was observed between the number of containment zones and homeless population. The positive correlation between



Fig. 6. Ward-wise distribution of gross population density in Mumbai

(Source: Computed based on data from MCGM's «Draft Disaster Management Plan for Mumbai City District» 2019; «Draft Disaster Management Plan for Mumbai Suburban District» 2019)



Fig. 7. Ward-wise distribution of slum population in Mumbai (Source: Computed based on data from MCGM's «Draft Disaster Management Plan for Mumbai City District» 2019; «Draft Disaster Management Plan for Mumbai Suburban District» 2019)

Kilometers

1.5 3



Fig. 8. Ward-wise distribution of homeless population in Mumbai

(Source: Computed based on data from «FAQ document of the Public Health Department of the MCGM», n.d.) *Karelia 2019* 

		Containment Zones	Sealed Buildings	Total Cases	Cases Discharged	Deaths	Active cases	Gross population density	Slum population (%)	Homeless population
Containment Zones	Pearson Correlation	1	-0.005	0.346	0.347	0.34	0.201	-0.195	0.408*	409*
	Sig. (2-tailed)		0.982	0.098	0.097	0.104	0.346	0.361	0.048	0.047
	Ν	24	24	24	24	24	24	24	24	24
Sealed Buildings	Pearson Correlation	-0.005	1	0.591**	0.547**	0.119	0.888**	-0.312	0.028	-0.202
	Sig. (2-tailed)	0.982		0.002	0.006	0.579	0	0.138	0.897	0.343
	Ν	24	24	24	24	24	24	24	24	24
Total Cases	Pearson Correlation	0.346	0.591**	1	0.998**	0.743**	0.796**	-0.296	0.299	-0.404
	Sig. (2-tailed)	0.098	0.002		0	0	0	0.16	0.156	0.05
	Ν	24	24	24	24	24	24	24	24	24
Cases Discharged	Pearson Correlation	0.347	0.547**	0.998**	1	0.757**	0.759**	-0.278	0.296	-0.389
	Sig. (2-tailed)	0.097	0.006	0		0	0	0.189	0.16	0.061
	N	24	24	24	24	24	24	24	24	24
Deaths	Pearson Correlation	0.34	0.119	0.743**	0.757**	1	0.27	0.029	0.39	-0.404*
	Sig. (2-tailed)	0.104	0.579	0	0		0.202	0.894	0.06	0.05
	Ν	24	24	24	24	24	24	24	24	24
Active	Pearson Correlation	0.201	0.888**	0.796**	0.759**	0.27	1	-0.451*	0.165	-0.361
	Sig. (2-tailed)	0.346	0	0	0	0.202		0.027	0.442	0.083
	Ν	24	24	24	24	24	24	24	24	24
Gross population density	Pearson Correlation	-0.195	-0.312	-0.296	-0.278	0.029	-0.451*	1	-0.417*	.471*
	Sig. (2-tailed)	0.361	0.138	0.16	0.189	0.894	0.027		0.042	0.02
	Ν	24	24	24	24	24	24	24	24	24
Slum population (%)	Pearson Correlation	0.408*	0.028	0.299	0.296	0.39	0.165	-0.417*	1	-0.610**
	Sig. (2-tailed)	0.048	0.897	0.156	0.16	0.06	0.442	0.042		0.002
	N	24	24	24	24	24	24	24	24	24
Homeless population	Pearson Correlation	-0.409*	-0.202	-0.404	-0.389	-0.404*	-0.361	0.471*	-0.610**	1
	Sig. (2-tailed)	0.047	0.343	0.05	0.061	0.05	0.083	0.02	0.002	
	Ν	24	24	24	24	24	24	24	24	24

### **Table 1. Correlation Matrix**

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

(Source: Computed based on data from MCGM's «Stop Coronavirus – With Right Information & Simple Measures: Key Updates & Trends», 2020; MCGM's «Draft Disaster Management Plan for Mumbai City District», 2019; «Draft Disaster Management Plan for Mumbai Suburban District», 2019; and «FAQ document of the Public Health Department of the MCGM», n.d.)

Even though Dharavi has flattened the COVID-19 curve in mid-June, four of the most densely populated pockets of slums inside Dharavi, i.e. the Matunga Labour Camp, Kumbharwada, Kala Killa and Koliwada are still on MCGM's watch list<sup>1</sup>. To understand the negative correlation between the number of containment zones and homeless population, it is first necessary to keep in mind that

the data on homeless population used in the study is in conjunction with the Census of India's definition of houseless households. It includes only those households, which do not live in buildings or census houses and rather reside in the open or near roads, places of worship, railway platforms, etc<sup>2</sup>. Such houseless households are highly scattered across the city and are also mobile, leading to

<sup>1</sup> Eshanpriya 2020

<sup>2</sup> Census of India 2011

their negative correlation to the spread of the containment zones. At the significance level of 0.05, a slightly strong negative correlation of -0.404 was observed between the homeless population and COVID-19 related deaths. The extent to which the homeless people, being the most neglected section of the society, are getting tested for COVID-19 is still an open question. Along with this, many of the homeless are found to shift from one locality to another, which makes it difficult to track and trace their health status along with their spatial distribution. Similarly, a slightly strong negative correlation of -0.451 is observed between the number of active cases and gross population density at the same significance level. This reinforces the fact that density per se is not necessarily the sole determining factor for the growing number of active cases. There are a number of other factors such as the immunity of people, their health conditions and prevalence of other ailments along with the extent of adherence to the social distancing guidelines that in conjunction with density contribute towards the growing number of COVID-19 cases. Fang and Wahba have rightly pointed out in this regard that densely populated urban areas may have door-to-door delivery services and access to high-speed internet, enabling the residents to avail all the necessary services without requiring them to step out of their homes<sup>1</sup>. Under such circumstances maintaining physical/social distance can be more convenient than otherwise. Besides these, certain other patterns were also revealed by the analysis, which are not discussed here as they are not relevant to the subject matter of the article.

### CONCLUSIONS

The above analysis revealed that at the end of August 2020, the highest number of positive COVID-19 cases was recorded in P/N, K/W, K/E and G/N wards of Mumbai. The highest numbers of active cases, cases discharged and cases resulting in deaths were recorded in the R/C, P/N and K/E wards. The highest number of containment zones was in the L ward and the highest number of sealed buildings was in the R/C ward. In terms of population density, Mumbai is known to be a densely populated city and among its wards, C has the highest density. In addition to this, inequality is rampant across Mumbai. The slum population can be found in all the wards of the city except

the C ward. The highest percentage of slums population is found in the S ward. There is also a large number of homeless people living in the city. All the wards of Mumbai have homeless population and the highest number of homeless corresponds to the C ward. The correlation analysis between the COVID-19 data, population density and poverty in Mumbai revealed a more detailed picture. A slightly strong positive correlation was observed between the number of containment zones and slums population, whereas a slightly strong negative correlation was observed between the containment zones and homeless population. A moderately strong negative correlation was observed between the homeless population and COVID-19 related deaths. Also, a slightly strong negative correlation was observed between the number of active cases and gross population density. These results summarize the conditions that emerged in Mumbai at the end of August 2020. Thus, the battle against the COVID-19 pandemic in Mumbai has been a mixed tale of success and failure. With the COVID-19 situation changing fast, it is difficult to say what will happen in the coming future. Nonetheless, the pandemic has exposed the deep-seated inequality ingrained in the urban structure of Mumbai. The prevalence of poverty, unsanitary conditions in the slums and lack of adequate housing have culminated in Mumbai's lack of resilience to pandemics and epidemics. Hence, with the amplification of the urban vulnerability during the pandemic, the need for revisiting and implementing the SDGs has become highly necessary<sup>2</sup> (Filho et al. 2020). On the positive side, the outbreak of the pandemic has stirred up the authorities and civic bodies to take necessary measures for addressing the difficulties and drawbacks that plagued the residents of Mumbai. It was realized that the successful implementation of the SDGs can save the city from such disasters. SDG 11, which aims at making cities and communities sustainable, can serve as a key in this regard. Achieving the very first target of SDG 11, i.e. 'ensuring access for all to adequate, safe and affordable housing and basic services along with upgrading of the slums', can contribute significantly to resolving the sustainability crisis in Mumbai. Along with it, ending poverty (as specified in SDG 1), making provisions for clean water and sanitation (as specified in SDG 6) and promoting decent work and economic growth (as specified in SDG 8)<sup>1</sup>, can enable Mumbai to gain resilience and become more sustainable (Fang & Wahba 2020; Mishra et al. 2020).

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