International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)

Impact Factor: 5.85 (SJIF-2019), e-ISSN: 2455-2585

Volume 6, Issue 6, June-2020

SPATIAL DISTRIBUTION AND TIME SERIES MAPPING OF CORONAVIRUS DISEASE (COVID-19) IN NAGPUR DIVISION, MAHARASHTRA

Miss. Katkar Sneha Satyapal [1], Dr. Kinthada Nooka Ratnam [2], Dr. Ashtekar Avinash S. [3], Mr. Chatke Rajesh Devrao [4]

[1]*Department of Geology, Adikavi Nannaya University.*
[2]*Department of Geology, Adikavi Nannaya University.*
[3]*Department of Geography, Central University of Karnataka.*
[4] *Department of Geography, Central University of Karnataka.*

Abstract

Now-a-days, Coronavirus disease (COVID-19) is one of the most dangerous, transmissible, and infectious diseases spread all over the world. Few years ago, SARS-2003 and MERS-2012 diseases out broke in Asia which was caused by the Coronavirus. At the end of December 2019, a new type of Coronavirus disease was found in the Wuhan city of China, which was later named as COVID -19. This disease is more dangerous than the previously occurred viral infections because there is no precise antidote or treatment available for COVID -19 as of now. World Health Organization (WHO) has declared the COVID-19 outbreak as a global pandemic. The first positive case and the first death were reported in Nagpur division during 13 March 2020 and 6 April 2020 respectively. This research aimed at mapping the spatial distribution of COVID -19 and time-series analysis of COVID -19 affected people in Nagpur division from 13 March 2020 to 18 May 2020 with the aid of Geographic Information System (GIS). Based on the findings of this research, it was suggested to facilitate the affected areas with more medical services.

Keywords: - COVID-19, GIS, spatial distribution, time series analysis.

1. Introduction

Coronavirus disease is one of the most serious health issues faced by the whole world at present. Coronaviruses are a group of viruses that cause mild to lethal respiratory tract infections. Several Acute Respiratory Syndrome (SARS or SARS -CoV) and the Middle East Respiratory Syndrome (MERS or MERS- CoV) is also a viral disease caused by coronavirus. SARS and MERS were responsible for the sickness and death of nearly 813 people and 858 people in 2003 and 2012 respectively. On 31 December 2019, the WHO was informed of a cluster of cases of pneumonia of unknown cause detected in Wuhan City, Hubei Province of China. The coronavirus disease (COVID-2019) was identified as the causative virus by Chinese authorities on 7 January [1].

The motivation for this research and its importance stem from several existing studies. Firstly, [2] provided a detailed relationship between GIS and health, in which author described the GIS and spatial analysis as a potential tool for knowledge, prevention, and treatment of diseases. GIS technology can be used as a visualization help to map the geographical distribution of the disease and establish a connection between the resources available for treatment and prevention. Concerning the spatial analysis of certain information, it is possible to evaluate the risks of disease, trends in outbreaks over time and space, and hotspots of pandemic [2]. In the journal of Geography and Suitability , the author demonstrated that spatial phenomenon of the COVID-19 disease, material, population and social psychology at three scales: individual, group and regional and provided causal relationship between population density and spatial distribution COVID-19 cases which identified the highly affected areas with spatial mismatching of medical resources promptly, to bring out a rapid suggestion for preventing the pandemic spread [3]. In addition to this, coronavirus pandemic research [4] highlighted IDW spatial analysis to reveal the strength and effectiveness of the proposed method for detecting and predicting the potential for disease risk assessment in India. Due to no specific vaccines or treatments COVID -19, has also spread in the Eastern Maharashtra. The first case was reported in Nagpur division on 18 March 2020 that belonged to Nagpur district and infection kept increasing daily. This research aimed at measuring the distribution of COVI-19 cases in Nagpur Division by thematic dot density mapping and also to track the change in distribution using time series analysis and come up with bands of decisions for local public health authorities and policymakers to control pandemic in Nagpur division.

2. Study area

Nagpur division was created in 1861 which is part of Maharashtra state of India. Maharashtra is divided into six administrative divisions; Nagpur is the easternmost division including six districts i.e. Nagpur, Bhandara, Gondiya, Garchiroli, Chandrapur, and Wardha. It covers nearly 51336 Km^2 (16.68% of Maharashtra area). The area falls under 18.694806 N to 21.711704 N latitudes and 78.052519 E to 80.889961 E longitudes [5].

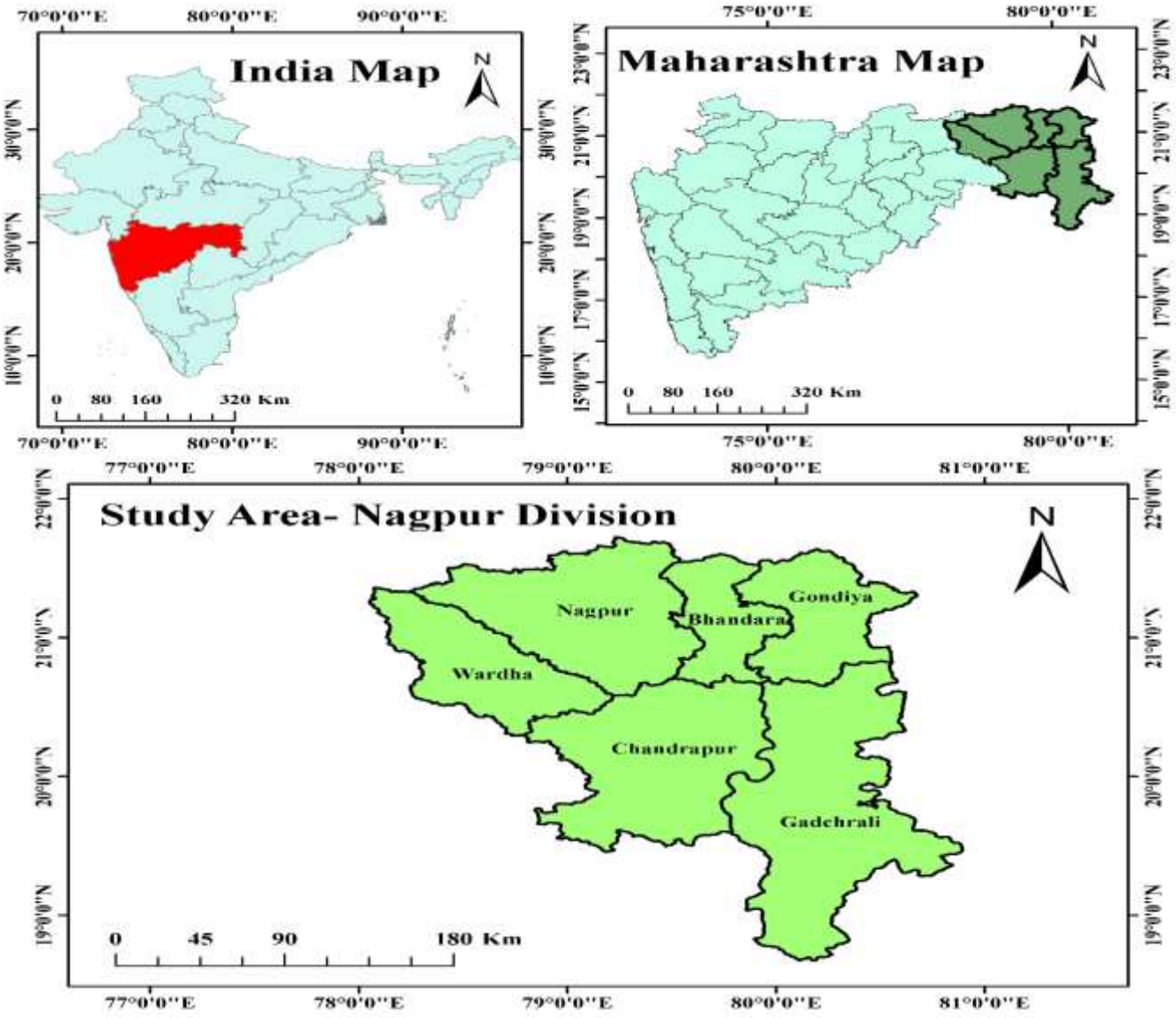

Figure 1:- Study area map of Nagpur Division.

3. Data collection and methodology

The study area for this paper was the whole Nagpur division, which includes 6 districts. This study mainly collected geographical, demographical, COVID-19 cases data, and medical resource data like number of hospitals present in Nagpur division. The procedure was as follows:

1. The basic spatial data or administrative boundary shapefile of Nagpur division was obtained from DIVA-GIS through Arc -GIS Desktop 10.5. [6].

2. Demographic data i.e. population statistics of six districts in Nagpur division was gathered from [5].

3. Data of COVID-19 cases from 13 March 2020 to 18 May 2020 were collected from the Public Health department of Maharashtra [7]

4. Medical facility data: - It included a number of hospitals in Nagpur division provided for COVID-19 treatment from [8]

In this cross-section study *Figure 2*, first, the spatial data (shapefile) was downloaded from DIVA GIS data portal. Then, it was extracted and exported based on the area of interest utilizing ArcGIS 10.5 software. The area of interest was projected to UTM 44 Zone on WGS 1984 datum via Projected Co-ordinate System. Further, a population density map of Nagpur division was prepared and all the attribute data was added to it. This density map was in the form of dot density which showed the spatial distribution of people affected by COVID-19 in the Nagpur division (Government of Maharashtra, 2019). The severely affected areas were classified as 'Red Zones' while least affected areas were classified as 'Orange Zones' and unaffected areas were classified as 'Green Zones' using GIS operations. Time series mapping was also carried out to determine the spread of the pandemic in Nagpur division between 13 March and 18 May 2020.All the data pertaining to health care facilities at the district level was retrieved and correlated with the spatial distribution of disease spread, and a suggestions were given to manage the pandemic.

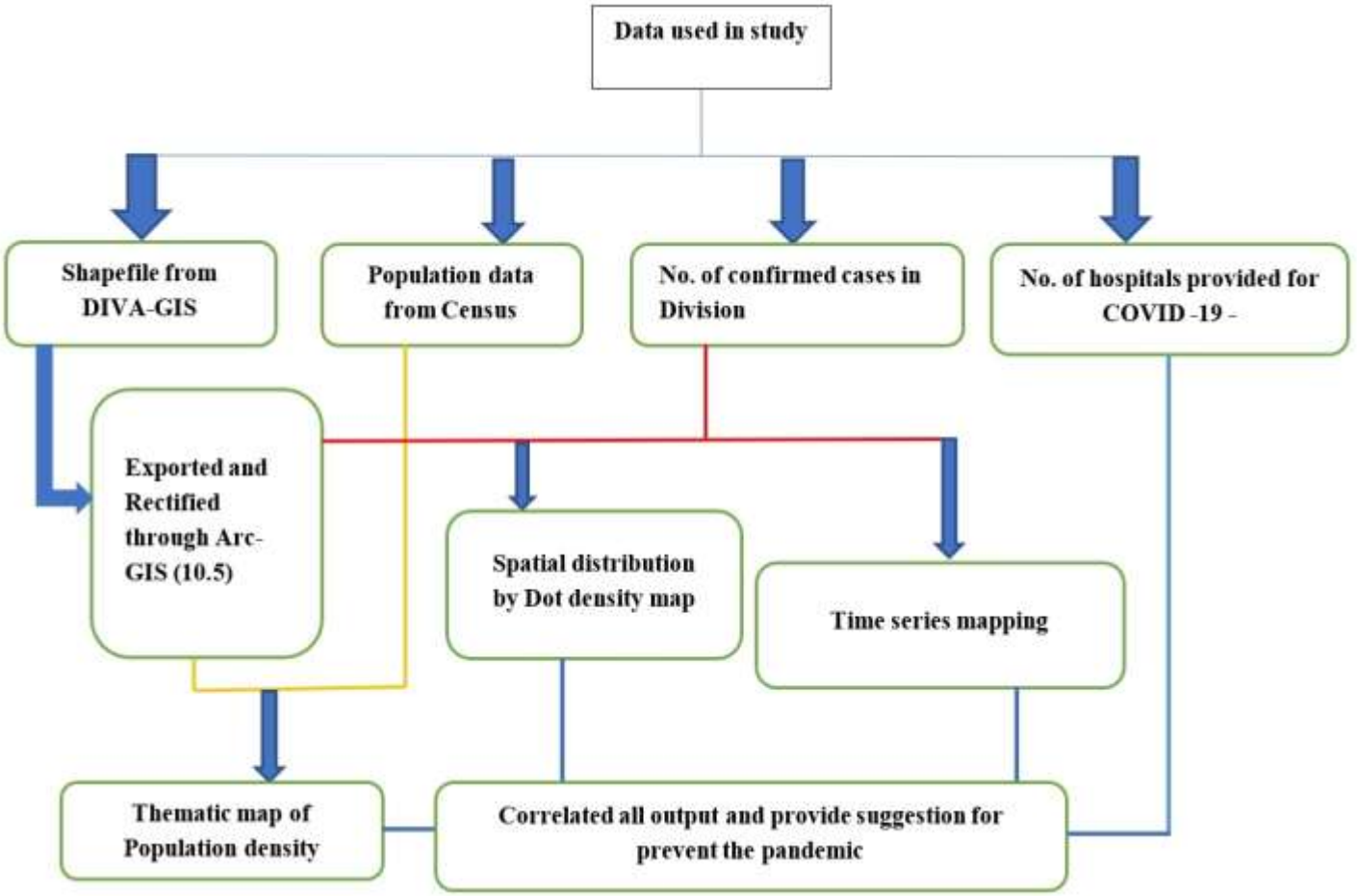

Figure 2:- Methodology

4. Results and discussion

On 13 March 2020, at first two people reported positive with COVID-19 in Nagpur and cases reached over 368 by 18 May 2020. Nearly 7 deaths were reported in Nagpur division. The most populous district in Nagpur division is Nagpur with density (i.e. 468.71) and least populous district is Garchiroli with density (i.e. 74.24). And left-over districts have population density (194 - 285) Figure 3. To obtain the profile of distribution of the cases, the spatial distribution of COVID -19 confirmed cases in Nagpur division were mapped by dot density method Figure 4. During 18 May 2020, Nagpur district had the highest number of cases (i.e. 357), followed by Chandrapur (i.e. 5), Bhandara (i.e. 3), Wardha (i.e. 2) and Gondiya (i.e. 1) districts. Red zone was identified in the Nagpur city, green zone in Garchiroli district, and remaining districts of Nagpur division fell under the Orange zone Figure 5. As first case of COVID -19 was reported on 13 March 2020 in Nagpur division, for time-series mapping a data from 13 March to 18 May 2020 was used. The location of each case was extracted from official reports and mapped at the district level using ArcGIS. Figure *6* showed the fluctuation and gently inclined trend of confirmed cases only in Nagpur District while Figure 7 gave information about COVID-19 health centres in Nagpur division.

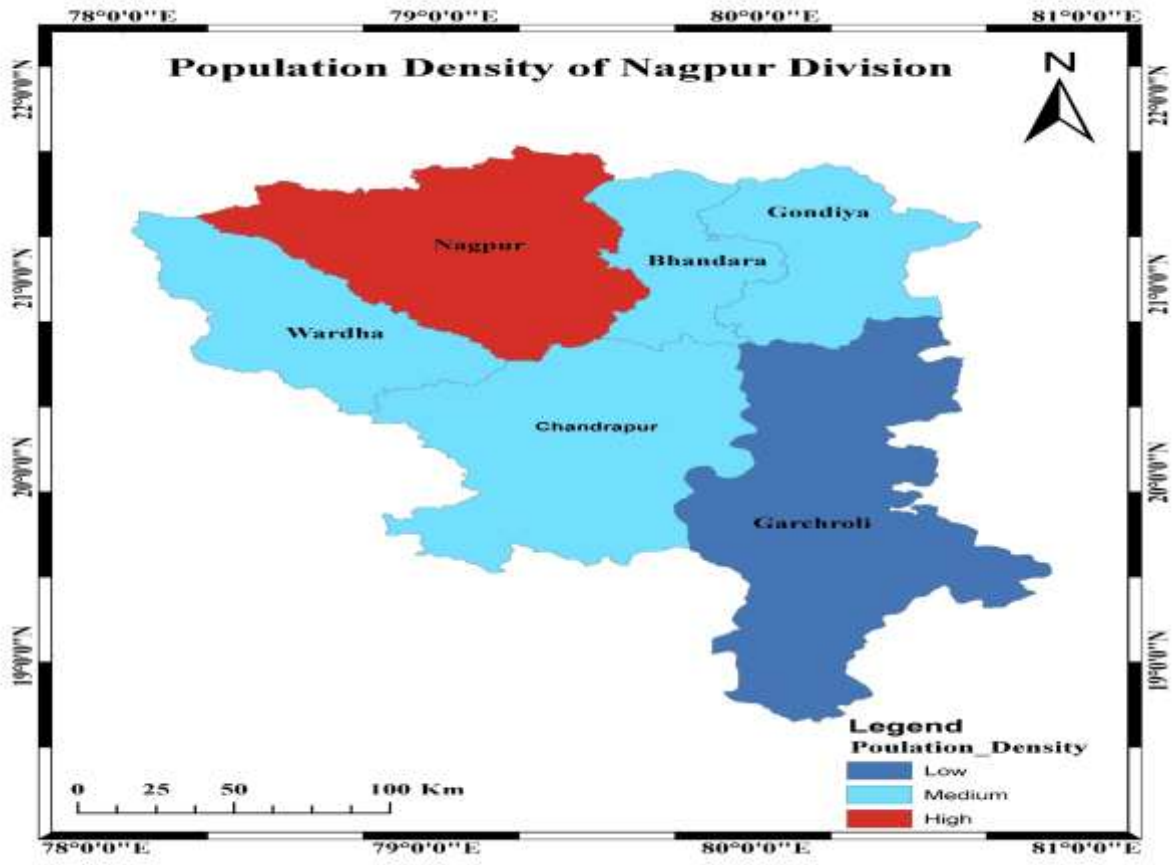

Figure 3:- Distribution of Population

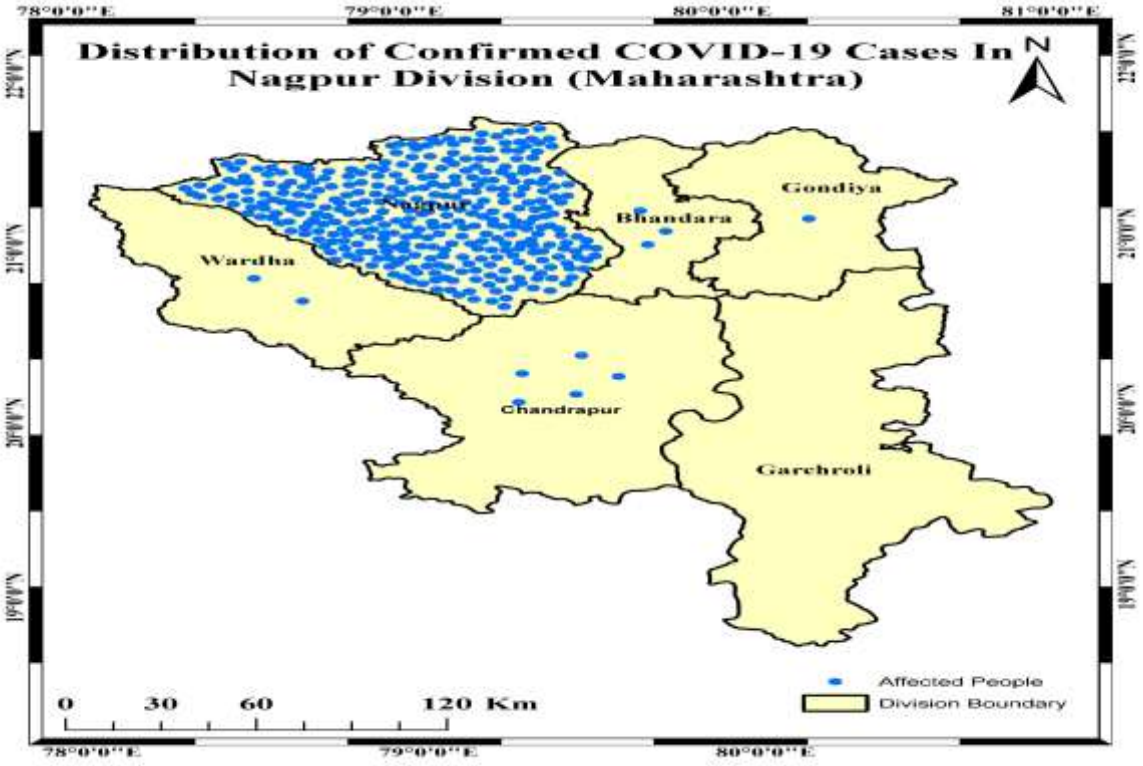

Figure 4:- Distribution of estimated confirmed patients (As on 18 th May 2020).

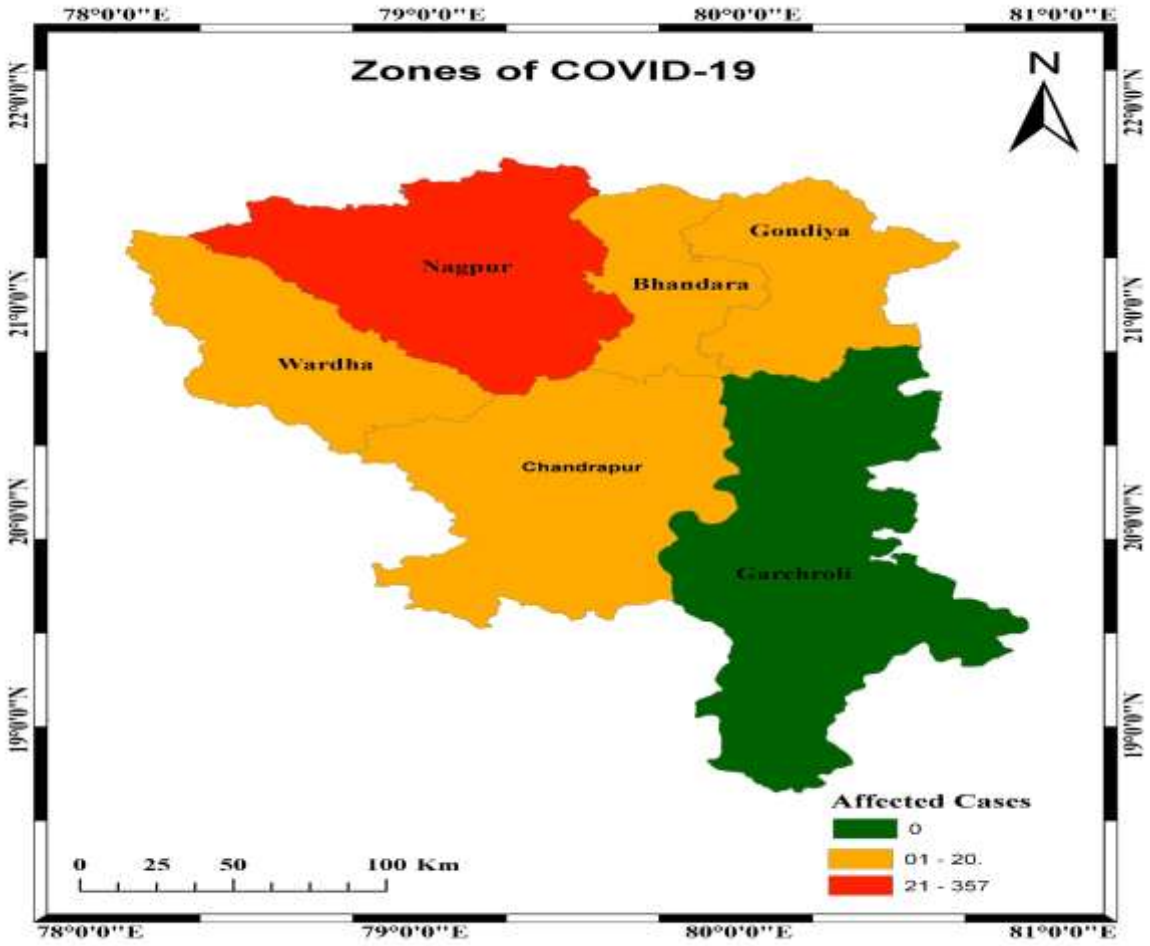

Figure 5:- Zones of COVID-19.

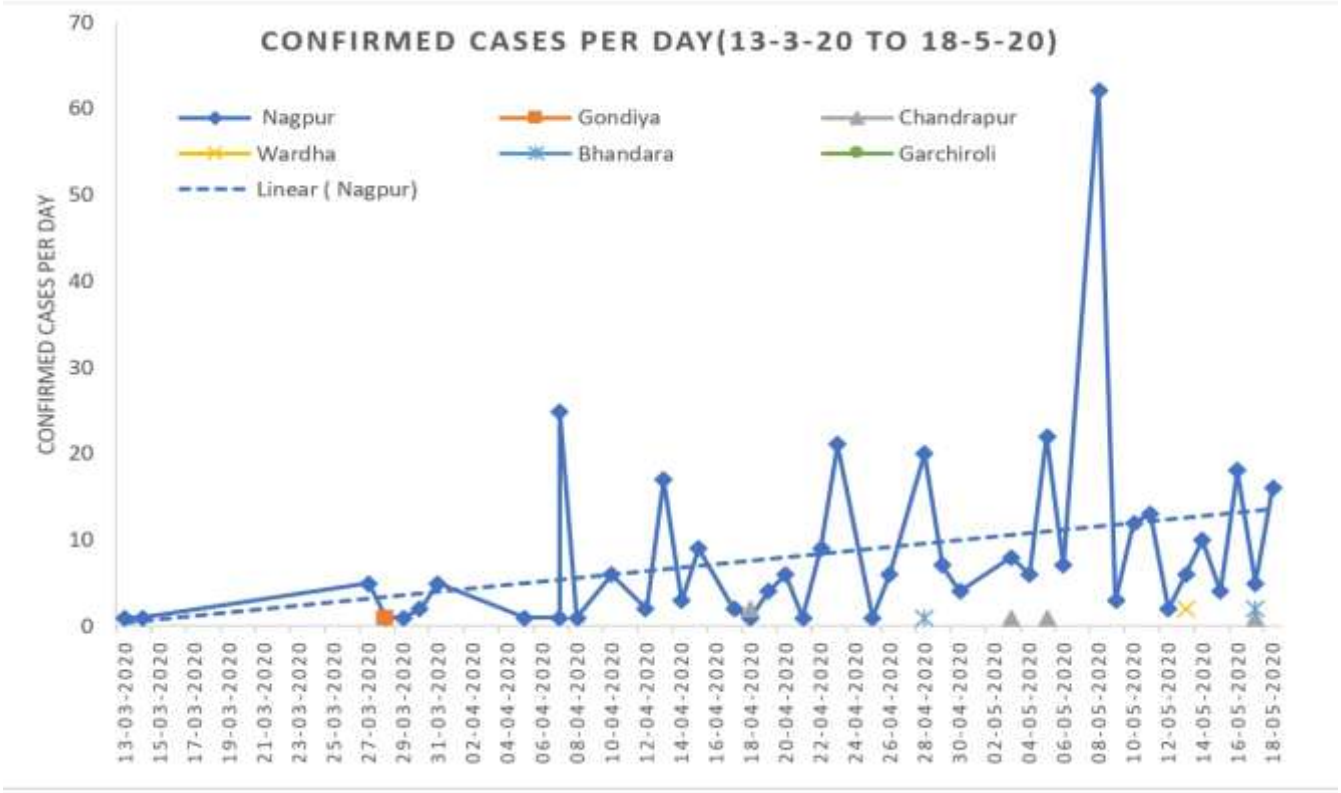

Figure 6:- Trend of confirmed cases

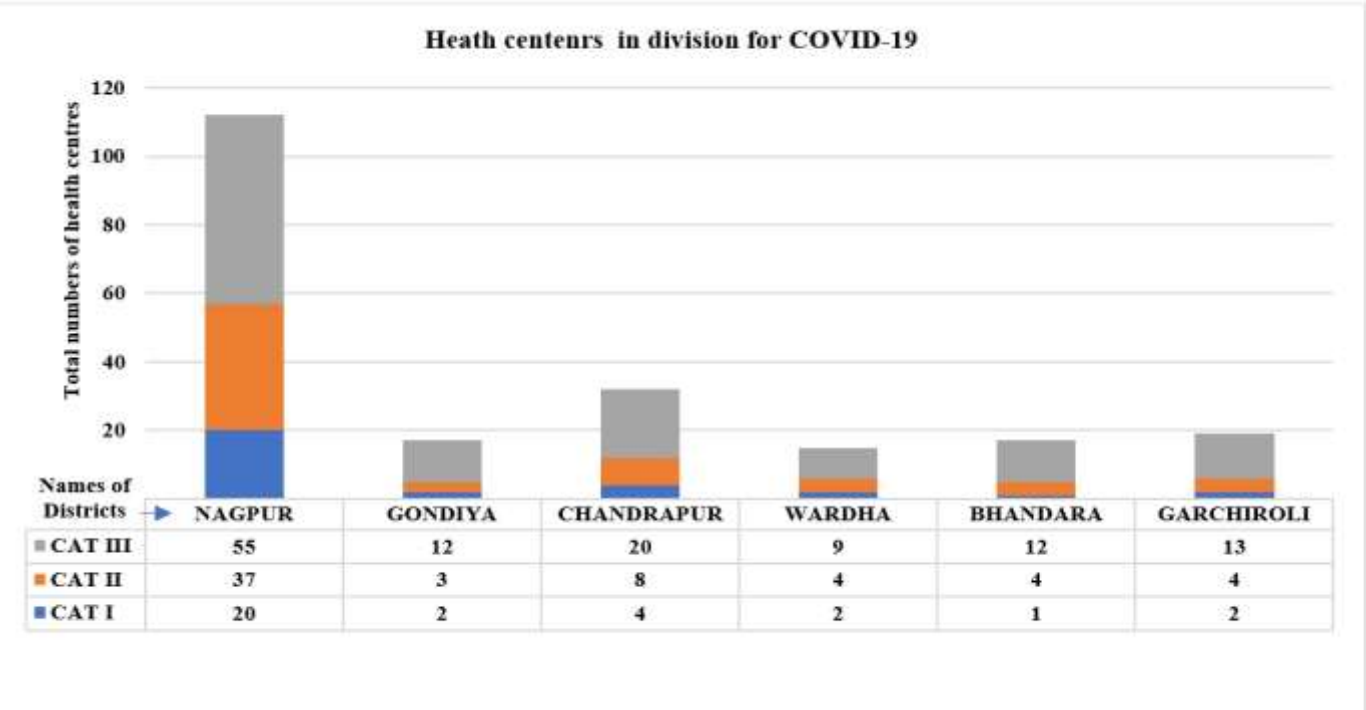

Figure 7:- Dedicated COVID-19 medical facilities

5. Conclusion

As of 18 May, spatial distribution affected cases of COVID-19 in Nagpur division showed that Nagpur district had highest population density(i.e. 468.71) with most affected area marked as Red zone, Garchiroli district had lowest population density (i.e. 74.24) with unaffected area considered as Green zone and left over districts fells under(~ 250) population density with least affected areas represented as Orange zone. Time series analysis of COVID- 19 from 13 March to 18 April 2020 represented that cases were increasing at high rate in Nagpur district compared to other districts of Nagpur division. According to the result, Nagpur district requires more facilities compared to other districts of Nagpur division. Medical services should be manoeuvred from less affected areas to the Nagpur district temporarily in the need of time. Though lockdown is not a complete solution for pandemic, it should be made strict in Nagpur district to control and manage the outbreak of the pandemic, while at the same time relaxation can be given to the less affected areas with a controlled state of market operations. Considering the possible economic loss, local authorities should lockdown only affected areas instead of whole district in coming days.

References

[1] World Health Organization, "World Health Organization," 2020. [Online]. Available: https://www.who.int/. [Accessed 18 May 2020].

[2] A. K. Lyseen, C. Nohr , E. M. Sorensen, O. Gudes, E. M. Geraghty, N. T. Shaw and C. Bivona-Tellez, "A Review and Framework for Categorizing Current Research and Development in Health Related Geographical Information Systems (GIS) Studies," *Yearbook Medical Informatics*, vol. IX, pp. 110-124, 15 August 2014.

[3] C. Zhou, F. Su, T. Pai, A. Zhang, Y. Du, B. Lao, Z. Cao, J. Wang, W. Yuan, Y. Zhu, C. Song, J. Chen, J. Xu, F. Li, T. Ma, L. Jiang, F. Yan, J. Yi, Y. Hu, Y. Liao and H. Xiao, "COVID-19: Challenges to GIS with Big Data," *Geography and Sustainability*, vol. I, pp. 77-88, March 2020.

[4] B. Murugesan, S. Karuppannan, A. Mengistie, M. r. Ranganathan and G. Gopalakrishnan, "Distribution and Trend Analysis of COVID-19 in India: Geospatial Approach," *Geographical Studies*, pp. 1-9, April 2020.

[5] Census, "District list," 2011. [Online]. Available: https://census2011.co.in/district.php. [Accessed 18 May 2020].

[6] DIVA-GIS, "Free spatial data," [Online]. Available: http://www.diva-gis.org/gdata. [Accessed 18 May 2020].

[7] Government of Maharashtra, "Arogya maharashtra," 18 May 2020. [Online]. Available: https://arogya.maharashtra.gov.in/1175/Novel--Corona-Virus. [Accessed 18 May 2020].

[8] Government of Maharashtra, "Dedicated COVID facility status," 20 May 2020. [Online]. Available: https://arogya.maharashtra.gov.in/1177/Dedicated-COVID-Facilities-Status. [Accessed 18 May 2020].