GIS approach for mapping novel coronavirus in northern state of India, Jammu and Kashmir

Mohammad Suhail Meer¹ · Anoop Kumar Mishra²

Received: 26 February 2021 / Accepted: 30 July 2021 / Published online: 14 August 2021
© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2021

Abstract

Novel coronavirus “COVID-19” has affected worldwide. At initial stage, the way out to curb the deadly virus was lockdown, isolating the symptomatic people, quarantining travellers and educating the people about the coronavirus infection so that precautionary measures are followed by people. The present research focuses on the application of Geographic Information System on mapping the coronavirus cases in Jammu and Kashmir. The research attributes the role of dense population and urbanization responsible for increasing the coronavirus cases in the study area. The districts like Srinagar and Jammu with high population and urbanization (census 2011) attribute high number of corona cases in year 2020. This high population experiences the highest number of corona cases (Jammu 23,339, Srinagar 24,996), deaths (Jammu 350, Srinagar 444) and COVID-19 recoveries (Jammu 22,141, Srinagar 23,957). The highly urbanized and populated area are much exposed towards infection. The high number of corona case experiences heart-related issues. The number of heart-related deaths are increased to 29.6% during winter in study area by extreme weather conditions limiting regular exercising and outdoor activities. But, due to COVID-19 the amount of heart-related deaths has significantly increased, which is crucial for the study area. This study will serve as replica study for managing COVID-19 in Jammu and Kashmir and help the medical fraternity by giving the priority for vaccinating the people and managing the facility related to COVID-19. The GIS was used to mitigate the infection of COVID-19 on life.

Keywords COVID-19 · GIS · Urbanization · Remote sensing and GIS

Introduction

At the end of year 2019, the world experiences COVID-19 infection. The infection believed to have originated in the city of Wuhan, China, in December 2019 (Wu et al. 2020; Shereen et al. 2020). After research on the infection, later pathogen was identified as novel coronavirus (COVID-19), which was later named as SARS-CoV-2 (severe acute respiratory syndrome coronavirus). The virus is very prone to those who are having low immunity like pregnant women and elderly people. The affected person shows symptoms like fever, fatigue, cough and loss of smell and taste. The

efficient human-to-human transmission of the disease will result in huge disaster. To stop this infection, government should implement strict measures in order to break the infection chain (Nussbaumer-Streit et al. 2020). The ability of high human-to-human transmission of the virus affected the thousands of people in China. These infected people travel other parts of the world like USA, Japan, India, Germany, Singapore, Iran, etc. After that, the infection travelled every corner of the world. Millions of people got infected and died. In order to stop this infection, the whole world was under lockdown. The lockdown due to COVID-19 has confined the human activities in India that resulted in the significant decrease in pollutant released from the industries (Pal et al. 2020). The abrupt lockdown affected daily earning of migrant workers, which resulted in loss of life to migrant workers and increase in the rate of COVID-19 infection (Pal et al. 2021). The lockdown by COVID-19 indirectly reduced the lightning activity over the Indian state, Kolkata (Chowdhuri et al. 2020). The world was new to this infection by COVID-19. So, it was very different to combat this

✉ Mohammad Suhail Meer
mohdsuhailrs@gmail.com

¹ Centre for Remote Sensing and Geoinformatics, Sathyabama Institute of Science and Technology, Chennai, India

² Satmet Division, Office of Director General of Meteorology, India Meteorological Department, Ministry of Earth Sciences, Mausam Bhavan, New Delhi 110003, India

Fig. 1 Study area Jammu and Kashmir

Fig. 2 Total number of COVID-19 cases in Jammu and Kashmir in Year 2020

Fig. 3 Number of recoveries from COVID-19 in Jammu and Kashmir

infection. The coronavirus world meter (<https://www.worldometers.info/coronavirus/>; <https://www.jkpi.org/rising-heart-attacks-among-young-people-in-jammu-and-kashmir>), as of January 10, 2021, 11:45 IST, reported that confirmed cases stood at 90,086,549 with total global deaths 1,934,939 and recoveries standing at 64,482,717 current active cases 23,668,893. The rate of infection in India was so fast and unparallel. At the peak, one lakh people experience the effect in 24 years. There are different sectors which were affected by the COVID-19. The unexpected lockdown has serious consequences on the meat sector. The analysis was prepared after specific recommendations from the meat companies (Grinberga-Zalite et al. 2021). The study area Jammu and Kashmir faces huge loss of life by COVID-19 by low medical facility. The study area faces huge heart-related deaths by COVID-19. The study area faces 29% deaths during cold season by heart attack. Out of these, 32.8% deaths occur in the urban areas and 22.9% in rural areas. These things like cold weather ease the way to increase the heart attack by COVID-19 (<https://www.jkpi.org/rising-heart-attacks>). The research experiences that the Srinagar and Jammu attribute

high population (1,236,830 and 1,529,958) and urbanization attributes highest number of COVID-19 cases and deaths than other districts of Jammu and Kashmir.

Application of geographic information system in fighting COVID-19

Geographic Information System has significant application in tracking and combating the viral infection since 1964. In old time, conventional method in GIS was used to combat, track and understand the spread of many infectious diseases including cholera, fever and even the 1981 influenza pandemic. Computerization of systems for geographic information in the 1960s contributed to the possibilities to analyse, visualize and detect patterns of diseases. Its usage focused on mapping infectious diseases in a review conducted in 2014 (Lyseen et al. 2014). With the passage of time, using web-based GIS brings advancement in health sector (Boulos et al. 2010; Gong et al. 2015; Tanser 2000). During this

Fig. 4 Total number of COVID-19 deaths in Jammu and Kashmir

pandemic, web GIS plays a significant role for investigating data from sources and displaying of results in interactive and real or near real-time dashboards, which have become very useful means by which many government departments display spatial specific information on the COVID-19. The use of GIS for COVID-19 can be significant for decision making, social mobilization and community responses. The huge application of GIS in health geography cannot be ignored in regard of political decision making accountable to all sectors of society (Franch et al. 2020). There are many good outcomes by using the geospatial technology. More analyses can be put in place to present the COVID-19 pandemic spatially and picture its distribution in the determination of future outcomes. The present research will be useful for planning, policy making accelerating vaccination drives in order to mitigate the impact of COVID-19 infection on the life.

Study area

The case study for the present study is Jammu and Kashmir located on the northern area of India attributing area 101,387 km². It lies between latitude 32° 17' and 37° 05' N and longitude 72° 31' and 80° 20' E (Fig. 1). The region is dominated with different Himalayan mountain series which adds the beauty of the region. The climate of the Jammu and Kashmir changes with space and time. The Jammu region has subtropical hot climate during summer. In this area, temperature starts soaring in the month of March and experiences its peak in the month of May. The temperature during summer can go higher than 45 degree Celsius, where Kashmir has pleasant weather during summer, but in winter due to snowfall the temperature goes to minus 10 degree

Fig. 5 Total number of cases during year 2020 in Jammu and Kashmir

Celsius. The Jammu and Kashmir has 21 districts. Among all the districts, Srinagar and Jammu district are most urbanized.

Materials and methodology

Jammu and Kashmir is one of the most affected states in the northern India by COVID-19. Jammu and Srinagar are the mostly affected districts in different categories of COVID-19. District-wise COVID-19 data of year 2020 for Jammu and Kashmir were downloaded from (<https://covidindia.org/jammu-and-kashmir>); after statistical analysis, the data were exported to GIS environment. In GIS environment, different thematic maps of COVID-19 are prepared. District-wise population data for year 2011 were downloaded from (www.jkcensus.com). After statistical analysis, the data were exported in GIS environment where the data were linked with COVID-19 data of the Jammu and Kashmir. Finally, those districts are analysed where more COVID-19-related

deaths and positive cases are found and the reason behind them is analysed.

Results and discussion

The novel coronavirus (COVID-19) was originated from Wuhan, China, in December 2019. During the month of March, India starts receiving cases in the state of Kerala. The students from the Wuhan travelled their homes to Kerala. The infected students interact with other people by which infection of COVID-19 transmitted in India. In northern state of India, Jammu and Kashmir, the first COVID-19 case was identified in a 63-year-old women travelled from Iran. Then, gradually the cases of COVID-19 were increased. The present research focuses on different categories of COVID-19 cases in the year 2020 of Jammu and Kashmir. After statistical analysis, the COVID-19 data were exported in GIS environment where different classes are generated. The thematic maps

Fig. 6 COVID-19 cases and total population of Jammu and Kashmir

were generated in the form of total number of COVID-19 cases: number of recoveries from COVID-19, total number of deaths by COVID-19 and total number of COVID-19 cases in year 2020 of Jammu and Kashmir. The result attributes that districts like Jammu and Srinagar received the highest number of COVID-19 cases in year 2020 in all the formats like total number of COVID-19 cases (Jammu 23,339, Srinagar 24,996), number of deaths by COVID-19 (Jammu 350, Srinagar 444), number of recoveries from COVID-19 (Jammu 22,141, Srinagar 23,957) and presently number of active cases of COVID-19 (Jammu 848, Srinagar 595) in year 2020 shown in Figs. 2, 3, 4 and 5. Baramulla and Budgam received 7896 and 7525 COVID-19 cases, respectively.

As districts Srinagar and Jammu attribute the highest number of cases and recoveries from COVID-19, we have experienced the highest number of deaths in these two districts (Fig. 3). The Srinagar and Jammu are densely populated and urbanized districts of Jammu and Kashmir (Fig. 4). People of the area are more exposed to other states of the country. These are the reasons the districts experience high COVID-19-related cases in different formats. Figure 6 clearly highlights the role of population attributing the COVID-19-related cases in different formats.

Conclusion

The importance of the study highlights the role of dense population and urbanization for increasing COVID-19 infection. The districts like Srinagar and Jammu are having high population and urbanization resulting in the highest number of COVID-19 cases in different formats. The urbanized and high population districts are highly exposed to outsiders that are infected by COVID-19. The COVID-19 has increased the rate of heart-related deaths in the study area mostly under the age of 20–50 years. The research will be useful for planning the COVID-19 facility and vaccine parity drives. The research will be useful for planners and policy makers to mitigate the impact of COVID-19 infection on population. The research will help to understand the transmit rate. The research has also highlighted the role of GIS for mapping, planning and analysing the COVID-19 viral infection and modeling vaccination drive.

References

- Boulos M, Warren J, Gong J, Yue P (2010) Web GIS in practice VIII: HTML5 and the canvas element for interactive online mapping. *Int J Health Geogr* 9(1):14. <https://doi.org/10.1186/1476-072X-9-14>

- Chowdhuri I, Pal SC, Saha A, Chakraborty R, Ghosh M, Roy P (2020) Significant decrease of lightning activities during COVID-19 lockdown period over Kolkata megacity in India. *Sci Total Environ* 747:141321
- Franch-Pardo I, Napoletano BM, Rosete-Verges F, Billa L (2020) Spatial analysis and GIS in the study of COVID-19. A review. *Sci Total Environ* 739:140033
- Gong J, Geng J, Chen Z (2015) Real-time GIS data model and sensor web service platform for environmental data management. *Int J Health Geogr* 14(1):2. <https://doi.org/10.1186/1476-072X-14-2>
- Grinberga-Zalite G, Pilvere I, Muska A, Kruzmetra Z (2021) Resilience of meat supply chains during and after COVID-19 crisis. *Emerg Sci J* 5:57–66
- Lyseen AK, Nøhr C, Sørensen EM, Gudes O, Geraghty EM, Shaw NT, Bivona-Tellez C, IMIA Health GIS Working Group (2014) A review and framework for categorizing current research and development in health related geographical information systems (GIS) studies. *Yearb Med Inform* 23(01):110–124
- Nussbaumer-Streit B, Mayr V, Dobrescu AI, Chapman A, Persad E, Klerings I, Wagner G, Siebert U, Ledinger D, Zachariah C, Gartlehner G (2020) Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review. *Cochrane Database Syst Rev* 4(4):CD013574
- Pal SC, Chowdhuri I, Saha A, Chakraborty R, Roy P, Ghosh M, Shit M (2020) Improvement in ambient-air-quality reduced temperature during the COVID-19 lockdown period in India. *Environ Dev Sustain* 23(6):9581–9608
- Pal SC, Saha A, Chowdhuri I, Roy P, Chakraborty R, Shit M (2021) Threats of unplanned movement of migrant workers for sudden spurt of COVID-19 pandemic in India. *Cities* 109:103035
- Shereen MA, Khan S, Kazmi A, Bashir N, Siddique R (2020) COVID-19 infection: origin, transmission, and characteristics of human coronaviruses. *J Adv Res*. <https://doi.org/10.1016/j.jare.2020.03.005>
- Tanser FC (2000) The application of geographical information systems to infectious diseases and health systems in Africa. Doctoral dissertation
- Wu Y-C, Chen C-S, Chan Y-J (2020) The outbreak of COVID-19. *J Chin Med Assoc* 83(3):217–220. <https://doi.org/10.1097/JCMA.0000000000000270>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.