

Role of GIS in managing COVID-19

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A geographic information system (GIS) is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data.¹ Geographical Information System is an analysis tool which helps to analyze the complex data captured by the satellite imageries. In other words, GIS is a technical system that collects, stores, manages, calculates, analyzes, displays, and describes relevant geographic data in all or part of the earth's surface (including the atmosphere) with the support of computer hardware and software systems. From the perspective of the application, GIS is a tool for solving spatial problems, From the perspective of discipline, GIS included geography, cartography, surveying and computer science.

It is evident that any information is mostly inseparable from its geographic location. GIS is an emerging technology that was developed in the early 1960s². The application of GIS is prominent in urban planning, infrastructure planning, resource planning, surveying and research, image analysis, environmental assessment, power, disaster management areas. It has evolved as an important tool for policymakers.

India has been a forerunner in using modern spatial technologies. In early 90s India had launched its Indian Remote Sensing satellites and used image-based mapping for creating GIS databases and applications.³ Some major GIS initiatives taken in India are Natural Resources Information System, National Spatial Data Infrastructure, Bhuvan Image Portal of Department of Space, Delhi State Spatial Data Infrastructure, National Urban Information System, Establishing Government to Government GIS, modernization of land records under NLRMP (National Land Record Modernization Programme), Restructured Advanced Power Development & Reform Program and various City GISs among others⁴. Transport management, Land Record Management, Smart City planning, distribution of infrastructure and utilities, agriculture, India's National River Linking Project are some other GIS initiatives.

¹<https://www.esri.com/en-us/what-is-gis/overview>

²<https://www.gislounge.com/history-of-gis/>

³<https://www.irjet.net/archives/V3/i5/IRJET-V3I5582.pdf>

⁴https://ncog.gov.in/documents/2015/national_gis.pdf

AarogyaSetu App launched by Government of India is another important application of GIS technology for COVID 19 management. The app is a contact tracing app developed by National Informatics Centre. This app prompts users to take a Self-assessment Test and then uses the location of users to issue alerts about positive COVID-19 cases in the vicinity. This app also provides a list of all helpline numbers related to COVID-19 for India. There is also a feature which plots the daily and cumulative cases reported across different districts of the country. The app uses the phone's Bluetooth and GPS capabilities. It keeps a record of all other AarogyaSetu users that it detected nearby using Bluetooth. It will also use a GPS log of all the places that the device had been at 15-minute intervals. These records are stored on the phone till the time any user tests positive or declares symptoms of COVID-19 in a self-assessment survey in the app. In such cases, the records are uploaded to the servers. AarogyaSetu app has helped millions in the country to trace, track and geographically map the incidence of COVID 19 in India.

Role of GIS in COVID-19 response

GIS tools have been used to reveal the spatial propagation pattern, spatial and temporal transfer of the hotspots. It was noticed through the information maps that almost in all cases at the city level, the concentration of infected persons occurred in clusters.

One user case on the application of GIS for COVID 19 incidence mapping at ward level in Delhi was done by Integrated Research & Action for Development (IRADe). IRADe mapped the COVID 19 incidences on the ward level shapefiles for the period 08th April to 14th April, 20. Through mapping, it was identified that there were 47 COVID 19 hotspots distributed in 37 wards of Delhi. This analysis shows that containment measures should be more strictly implemented in 37 wards distributed in nine infected districts. Combining with socio-economic data of infected wards, further potential population under risk can be estimated. Such an analysis is also the starting point of modelling the future spread of the disease.

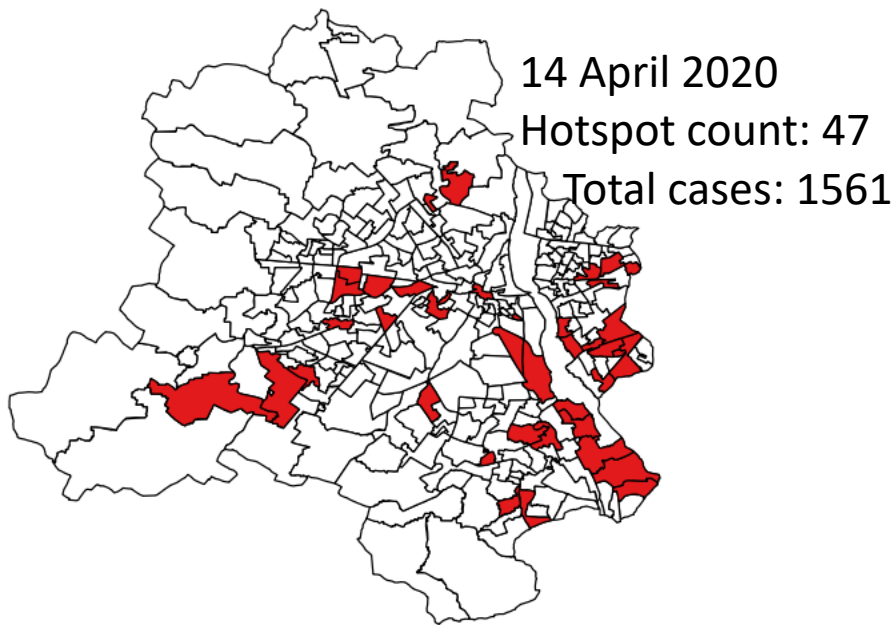


Figure 1: Wards having COVID-19 Hotspots in Delhi as on 14 April 2020

However, the spread of infectious diseases in an area is not subject to administrative boundaries, and the hotspot centre and its border should be divided according to the actual spread of infectious diseases in space. The quantitative division of the hotspots, clusters and the direction of the spread not only helps to understand the true spatial spread of the virus but also provides a scientific basis to formulate optimal prevention and control measures. In India, GIS mapping and location tracking is being used for this. The Centre has tested the COVID-19 Quarantine Alert System (CQAS), an application that uses telecom data to trigger emails and text-message alerts to the authorities if a person has jumped quarantine (*The Hindu*, April 3, 2020).⁵ Kerala, Gujarat, Telangana, Punjab among other states have developed an excellent GIS-based monitoring, tracking and alert systems

GIS tools and applications for pandemic/epidemic management

Using GIS capabilities such as spatial analytics, mapping, and location intelligence, health officials and government agencies can map confirmed and active cases, fatalities, and recoveries

⁵https://www.thehindu.com/news/national/coronavirus-geo-fencing-app-will-be-used-to-locate-quarantine-violators/article31241055.ece?utm_source=pushnotifications&utm_campaign=pushnotifications&utm_medium=ALL_USER

to identify where COVID-19 infections have occurred.⁶For example, the centrepoint of COVID-19 cases can be found by using the central feature tool in the ArcGIS spatial statistics tool and compared by the average, median, and minimum centre value. This will give an idea about the vulnerable population and the critical infrastructure in the zone. The location-specific data for the infected cases need to be available for this. Using the ArcGIS spatial statistics tool distribution, the direction of the spread can be calculated to reveal the trends, dispersion and direction trend of infection. Combining the demography, spatial data and the real-time case data helps to understand how the infection is spreading out and in what areas immediate actions are required. Demography data related to age, social vulnerability, slum areas can be mapped to identify the most vulnerable population at risk. Critical infrastructure mapping will help to manage resources efficiently. The power of user-friendly GIS visualization in the form of thematic illustrated maps, web maps, interactive maps helps everyone to understand the situation in a better way.

Conclusion:

The world is changing. It is becoming more technology-dependent. GIS, as a state-of-the-art technological solution, offers many potential applications. This technology is becoming pivotal for management of COVID-19. Test, trace, isolate and treat are the major pathways to manage a pandemic like COVID-19, and GIS is offering key support in tracing the positive cases which could then be isolated and treated. In addition, GIS is helping in creating hotspots/containment zones by suggesting which geographic location and to what extent, needs to be isolated from the rest of the city. In the coming days, planning and management of cities will involve an aspect of pandemic management, and GIS will play a huge role in designing cities which are safe from the impacts of upcoming pandemics.

⁶<https://cio.economictimes.indiatimes.com/news/strategy-and-management/how-enterprises-are-using-gis-to-track-covid-19-impact/74821102>