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ORIGINAL ARTICLE **OPEN ACCESS**

GIS-Based Interpolation Assessment of Novel Corona Virus (COVID-19) Spread over Rajasthan State, India

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ABSTRACT

The World Health Organization (WHO) has declared the coronavirus disease 2019 (COVID-19) a pandemic. A global coordinated effort is needed to stop the further spread of the virus. Therefore, after almost a year from the initial outbreak of the COVID-19 (in the early of 2021), several vaccines were approved and administered in most countries including India. The present study aims to assess the spatial distribution of COVID-19 cases using the geospatial tools. The spatial distribution maps for selected categories including total sample, cumulative positive, cumulative recovered and cumulative discharge are generated using Quantum-Geographical Information System (Q-GIS) application. After processing and combining the COVID-19 data and geospatial data, district-wise graduated thematic maps of Rajasthan are generated till August, 2020. Results of the study show that the maximum COVID-19 positive cases are recorded in highly populated District of Rajasthan including Jodhpur (10938), followed by Jaipur (9263), Alwar(7024), Kota (4427) and Bikaner (4004) respectively as compared to lower population density areas of Rajasthan. Mapping of spreading epidemics on spatial distribution and variability of corona can provide the most useful insights to the authorities for decision making and it will be useful for administration, strategy makers and researchers for future public health emergencies and other vaccination campaigns.

Keywords: *Covid-19 pandemic, Rajasthan, Geographical Information System,Geospatial application*

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INTRODUCTION

The World Health Organization (WHO) has declared the coronavirus disease 2019 (COVID-19) a pandemic. A global coordinated effort is needed to stop the further spread of the virus (1). A pandemic is defined as "occurring over a wide geographic area and affecting an exceptionally high proportion of the population (2). On 31 December 2019, a cluster of cases of pneumonia of unknown cause, in the city of Wuhan, Hubei province in China, was reported to the WHO. in January 2020, a previously unknown new virus was identified, subsequently named the 2019 novel corona virus, and samples obtained from cases and analysis of the virus' genetics indicated that this was the cause of the outbreak (3). Corona viruses arezoonotic, which are transmitted between animals and humans. It has been determined that MERS-CoV was transmitted from dromedary camels to humans and SARS-CoV from civet cats to humans. Typically, Corona viruses affects with respiratory symptoms and they may have a mild to moderate, but self-limiting disease with symptoms similar to the seasonal flu (4). Symptoms of Covid-19 include respiratory symptoms, fever, cough, Breathing difficulties, fatigue, sore throat etc. A minority group of people will present with more severe symptoms and will need to be hospitalized, most often with pneumonia and in some instances, the illness can include ARDS, sepsis and septic shock.The COVID-19 virus is unique among human corona viruses which has capacity of high transmissibility, substantial fatal deaths in some high-risk groups, and ability to cause huge societal and economic disruption in the state (5). The aim of the research is to assess the spatial distribution of COVID-19 and its trends with the help of GIS applications. Currently, there are no precise antibiotics or treatment options for COVID-19. Besides, several ongoing clinical studies are assessing effective treatments (6,7,8). The best way to protect and sluggish transmission should be well advised about the current COVID-19 virus, the disease it triggers

and also how it continues to spread. Therefore, monitoring activities of the pandemic using geospatial techniques is very important to control such as a COVID-19 virus spreading problem.

MTERIAL AND METHODS

Study area

Rajasthan is a state in northern India The state covers an area of 342,239 square kilometers (132,139 sq. mi) or 10.4 percent of the total geographical area of India. It is the largest area and the seventh Rajasthan is located on the north western side of India, where it comprises most of the wide and in hospitable. The Great Thar Desert and shares a border with the Pakistani provinces of Punjab to the northwest and Sindh to the west, along the Sutlej-Indus river valley (9). It is bordered by five other Indian states: Punjab to the north; Haryana and Uttar Pradesh to the northeast; Pradesh to the southeast; and Gujarat to the southwest. Its geographical location is 23.3 to 30.12 North latitude and 69.30 to 78.17 East longitude, with the Tropic of Cancer passing through southernmost tip of the state. Having the disease spread across all continents and many developed and developing countries in such little time, immediately a geospatial assessment is needed to find a pattern or relation between geospatial dataand Covid-19 data. The first case of the COVID-19 pandemic in Rajasthan was reported on March 2, 2020 in Jaipur. Rajasthan Health Department has confirmed a total of 71,194 positive cases, including 961 deaths and 55443 recoveries as of 25 August 2020 (10). All districts in the state have reported confirmed cases and out of them, Jodhpur and Jaipur are the worst-affected.

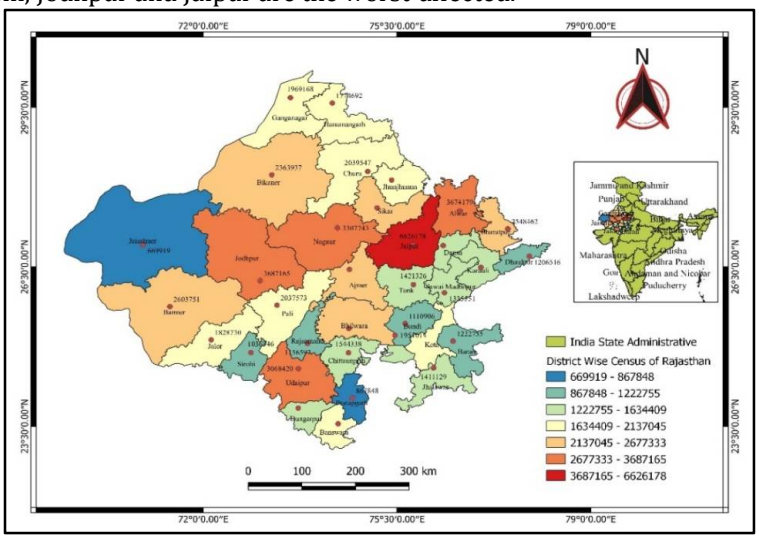


Figure 1: District wise census map of Rajasthan

Analysis Methods

The Covid-19 data was obtained from the websites of Ministry of Health and Family Welfare, India (11) and Department of Medical, Health & Family Welfare, Govt. of Rajasthan (12). The Covid-19 data, including total sample, cumulative positive, cumulative recovered and cumulative discharge was collected from March2, 2020, to August 25, 2020 (Table 1). After collecting data, it was processed and organized in a delimited file in MS Excel. The spatial distribution of Covid-19 data was presented through maps generated by Quantum-GIS (QGIS). QGIS functions as geographic information system software, allowing users to analyze and edit spatial information and compose and export graphical maps (13). QGIS 3.26.0 'Buenos Aires" was used to analyze the spatial distribution of covid-19 data. The boundary or shapefile of Rajasthan administrative was downloaded from diva-gis.org (14). COVID-19 pandemic data and geographical data were integrated into the software to get possible results. The symbology is the essential tool to represent the data with spatial aspects in GIS, so graduate symbology was used to classify and visualize vaccination data by various groups, i.e., total sample, cumulative positive, cumulative recovered and cumulative discharge.

Table1: District wise Covid-19 cases cumulative sample,cumulative positive,cumulative recovered and cumulative discharge

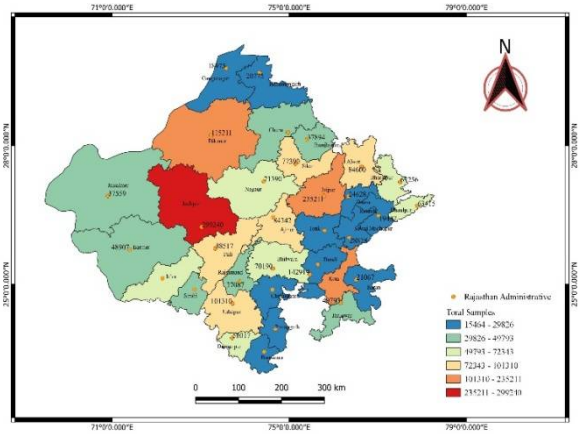
Districts	Latitude	Longitude	Total sample	Cumulative Positive	Cumulative Recovered	Cumulative Discharge
Ajmer	26.4499	74.6399	84342	3759	3256	3256
Alwar	27.553	76.6346	84600	7024	5698	5698
Banswara	23.5461	74.435	15464	456	358	354
Baran	25.1011	76.5132	21067	441	271	271
Barmer	25.7521	71.3967	48907	2137	1908	1908
Bharatpur	27.2152	77.503	63256	3553	3144	3144
Bhilwara	25.3407	74.6313	70190	1987	1176	973
Bikaner	28.23	73.236	115211	4004	3254	3254
Bundi	25.4326	75.6483	15876	469	328	328
Chittaurgarh	24.8829	74.623	29826	755	558	333
Churu	28.2925	74.9707	44802	860	737	737
Dausa	26.8997	76.3323	24628	483	432	432
Dhaulpur	26.6966	77.8908	63415	2162	1705	1705
Dungarpur	23.8417	73.7147	58017	892	782	751
Ganganagar	29.681	73.574	18975	583	353	353
Hanumangarh	29.5815	74.3294	20775	367	282	282
Jaipur	26.9124	75.7873	235211	9263	5929	5929
Jaisalmer	26.9157	70.9083	37559	316	271	268
Jalor	25.1257	72.1416	72343	1324	1301	1301
Jhalawar	24.5973	76.161	49793	1159	967	967
Jhunjhunun	28.1317	75.4022	37894	944	877	877
Jodhpur	26.2389	73.0243	299240	10938	8722	8614
Karauli	26.4883	77.0161	19487	559	407	407
Kota	25.2138	75.4648	142919	4427	2987	2987
Nagaur	27.231	74.422	71390	2226	1920	1920
Pali	25.7781	73.3311	88517	3708	3341	3341
Pratapgarh	24.03	74.692	20021	385	203	203
Rajsamand	25.0583	73.886	37087	1039	923	914
Sawai Madhopur	26.0124	76.356	28878	439	367	367
Sikar	27.6094	75.1398	77390	2422	1985	1985
Sirohi	24.8852	72.8575	39480	1165	1012	1012
Tonk	26.1659	75.7963	23046	553	467	467
Udaipur	24.5854	73.7175	101310	2189	1963	1826

RESULT AND DISCUSSION

After data processing and interpolating geospatial data and Covid-19 data, district-wise maps were generated. Figure 2 to figure 5 shows GIS interpolated mapsof Covid-19 data of Rajasthan including total sample, cumulative positive, cumulative recovered and cumulative discharge patients. According to table 1, Maximum sampling of Covid-19 has been done in Jodhpur (299240) district followed by Jaipur (235211), Kota (142919) and Bikaner (115211) whereas Minimum sampling for Covid-19 has been done in Banswara (15464), Bundi (15876) and Ganganagar (18975) districts. High newly reported cases were noticed in Panchkula district (114) followed by Gurgaon district. In the death case matter, Faridabad (159) district was in top and Gurgaon (131) was at second position. Active cases were highest inPanipat district (741) which is followed by Faridabad district (685). Fig. 4.1 shows diagrammatically district wise Covid-19 sampling status in Rajasthan state. Results shows that the higher sampling has been done in the most populated parts of Rajasthan including Jodhpur and Jaipur.

Figure 3 shows district wise distribution of cumulative positive cases of Covid-19. It has been observed that positive cases have been ranged between 318 to 10938. Jodhpur (10938) district has been observed most severely affected from the pandemic followed by Jaipur (9263), Alwar (7024) and Kota (4427) and (4004). Jodhpur is considered as economic capital and one of most populated and polluted districts of Rajasthan. It has been also observed that Jaipur, as a capital of Rajasthan, is heavilyinfected because of too many migrant or labour workers and some tourists. Most of migrants and labor population has low literacy or primary education which has been resulted as more health risk due to lack of proper awareness about the pandemic and its spread. Minimum positive cases have been recorded in Jaisalmer (316), Hanumangarh (367) and Pratapgarh (385). This trend may have been happened due to lower population density, less transportation and transmission. Figure 4 depicted cumulative recovered patients infected from Covid-19 during the pandemic. It has been observed that higher recovered cases have been observed in Jodhpur (8722) followed by Jaipur (5929), alwar (5698) and Pali (3341) while the

lower removed rate has been recovered in Pratapgarh (203), Jaisalmer (271) and Baran (271).Similar trend has been observed in cumulative discharged category. Total recovered patients were discharged with proper healthcare and medicines.The results of the present study are fairly supported by the earlier findings [15,16,17].



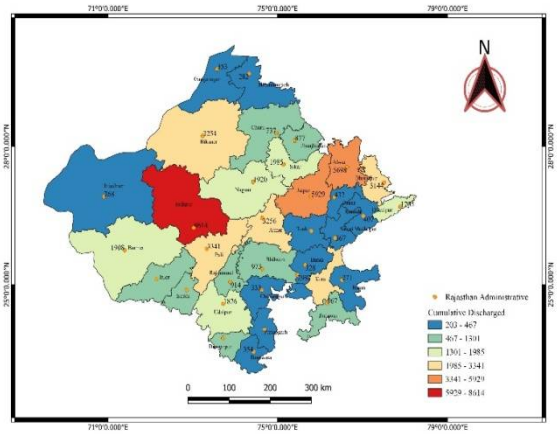
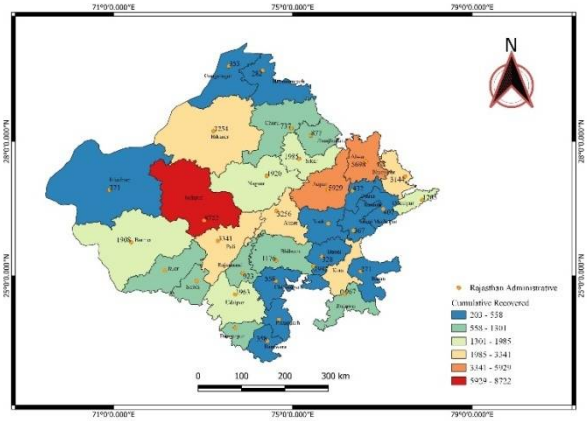


Figure 2: District wise cumulative test sample Figure 3: District wise cumulative positive cases



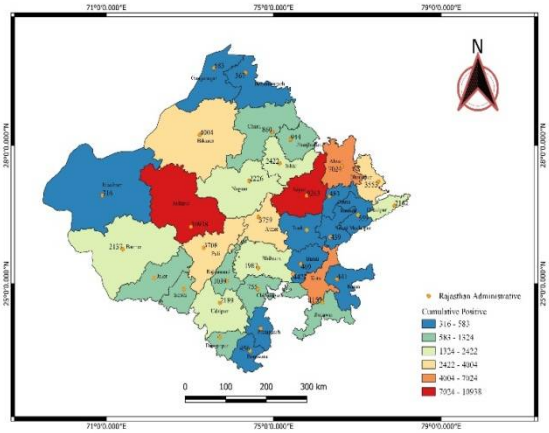


Figure 4: District wise cumulative recovered cases Figure 5: District wise cumulative discharged

CONCLUSION

The prime objective of the prospective study was to highlight the current status and strategies implemented during corona pandemic in Rajasthan. It is also well known that Rajasthan is the one of most affected states of India due to Covid-19 pandemic. Geographical Information System as a mapping tool could be a very valuable instrument in decision making, more mobilization, more importantly, and faithful community response. COVID-19's spatial-temporal dynamics are very crucial to its mitigation, so geospatial tools and techniques has been adopted as Health GIS at global level. GIS capabilities enable us in mapping confirmed cases, active cases, recovered cases, and fatalities cases. So, GIS is needed in the real-time mapping of the infectious area at various risk zones. A suitable plan can be executed after evaluating the available facilities and capabilities and also helpful in making easier coordination among other supporting agencies. The outcome of present study will be useful as baseline data for future pandemic preparedness and to effectively tailor and refine the strategies that will help the population at large.

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