

Spatial Distribution Analysis of COVID-19 in Tamil Nadu: Geospatial Approach.

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1. INTRODUCTION:

On February 11, 2020, the WHO officially referred to the disease caused by novel coronavirus 2019 as COVID-19 and the Coronavirus Study Group of the International Committee advised the name of the virus as SARS-CoV-2 (Di Ferrante et al., 1975). The WHO formally announced the global COVID-19 pandemic on March 11, 2020. Millions of people were infected within a few months of the start of the COVID-19 pandemic, where hundreds of thousands died and millions lost their jobs due to various restrictions imposed across the world (Harapan et al., 2020). COVID-19 is one of the most infectious diseases and it severely affects certain demographics such as senior citizens, infants, and people with serious health conditions.

Corona virus Covid 19 causing a severe respiratory syndrome (SARS-COV-2) Emerged in Wuhan, Hubei province, china, and rapidly spread to an around the world countries. This Covid 19 disease spread person to person transmission globally. In this paper To identify the geographic information system and among applications of real time mapping of disease cases in social population travel data, disease spreader proportion of Environmental variables, Geospatial analyst in web based mapping and Dashboards maps, integrating geographical data in Covid-19 pandemic surveillance and modelling. The best way to prevent and slow down transmission is to be well informed about corona virus the disease causes and how it spreads in aerosol transmission SARS-COVID-2.

The group of Pneumonia infection cases that is an infection in one or both lungs, Bacteria, Viruses and Fungi cause it's and happened in Wuhan, Hubei province and china in December 2019. The SARS-COV-2 genome sequence (Lu et al.,2020) since 1st March 2020, a total cases of COVID-19 have been reported in china 91,653 cases, Recovered 86,503 cases, Deaths 4,636 cases. Many cases of pneumonia are caused by bacteria. Outside the body, the bacteria are contagious and can spread between people in close proximity through sneezes and coughs. A person becomes infected by breathing in the bacteria are being implemented across the Tamilnadu in districts to suppress transmission and reduce mortality and morbidity from covid-19.

1.1 India:

COVID-19 in India, major strategies for enhanced vigilance and preparedness were initiated at both state and district level to fight with 2019. But the situation was not hopeful and more confirmed cases were reported on 22nd March from 23 states/union territories throughout India, which resulted to announce nationwide lockdown by Prime Minister till 14th April. However, the cases rapidly increased after 22nd March and currently reach to 13, 37,022 confirmed cases in all 33 states/union territories as on 25th July 2020. Human-to-human transmitter, SARS-CoV-2 emanates primarily around families, along with friends and relatives who have been in direct contact with patients.

1.2 Tamil Nadu:

The first COVID-19 positive case in Tamil Nadu was diagnosed on March 7, 2020, and the number of infection crossed thousand by April 12, 2020. Tamil Nadu is one of the states severely affected with the pandemic outbreak. This study is assessing the distribution and growth rate of COVID-19 infection in Tamil Nadu state, India. Ministry of Health and Family Welfare. In India, The first coV-19 case was reported in Kerala on 30th January 2020, the positive cases was a student returning from Wuhan, China as a Patient.

Geographic Information Systems (GIS) and spatial mapping are emerging global health tools, but the degree to which they have been implemented in India for COVID-19 research is unclear. To inform researchers and program developers, this mapping review presents the scope and depth of the GIS and Spatial Analysis Studies conducted by COVID-19 in India. In particular, GIS and spatial analysis can be essential tools for knowledge, prevention, and treatment of diseases. For example, GIS technology can be used as a visualization help to map the geographical distribution of the disease, the potential risk factors and the resources available for treatment and prevention.

In relation to 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 infection with constantly technique. Increasing the number of cases, maximum districts have a chance to come under the red zone. In this regard, the present study aimed to identify major hotspot (red zone) of the COVID-19 by considering Responsible factors and using the geospatial Techniques. The aim of this research is to analyze the spatial distribution of COVID-19 and its trend to predict the spread of diseases with the help of GIS software.

2. DATA AND METHODS:

The present study was mainly based on secondary data. Inspecting the spatial distribution of Corona virus infection the data collected for one month. All COVID-19 cases detailed through May 2021 and June 2021 were extracted from Department of Health and Family Welfare Corona virus updates Tamil Nadu. Spatial analysis approaches and the use of GIS were ambiguously defined for the uses of this analysis in order to obtain a diversity of emerging activities, i.e. they included research papers using any specialized GIS software or explicitly implementing any spatial analysis techniques. The data used in this study is the number of COVID-19 disease patients in district wise in Tamil Nadu from May 2021 to June 2021 obtained from the health department of India. In the present research work, distribution pattern of disease transmission is illustrated with GIS tools forecasts the number of patients per month wise aid Z-Score analysis technique used to analyze the spatial distribution of COVID-19 in 37 district of Tamil Nadu.

Inclusion criteria:

- a. Indigenous cases, imported cases, Active cases, Death cases, Recovery cases.

Exclusion criteria:

- a. a. Age wise cases, Sex wise cases

Statistical Analysis were calculated with the help of SPSS 17.0 Version software and used as attributes in ArcGIS for making maps. In the early stages of an epidemic or pandemic the growth in new cases is often well-modeled as an exponential function of time. Although there's a date variable in the data set dates in SPSS Statistics are expressed in seconds since the beginning of the Gregorian calendar, so it's easier to work with a metric like days for interpreting most models.

Eligible Criteria are available as peer-reviewed journal articles, the primary focus of the paper was on any aspect of the COVID-19 pandemic, demonstrated the applications of GIS or geospatial analyses. Any article that did not comply any of these criteria were excluded from this review. This paper offers pointers to, and describes, a range of practical online/mobile GIS and mapping dashboards and applications for tracking the 2021.Covid 19 Data analysis using SPSS 17.

3. OBJECTIVES:

1. Spatial distribution of Covid-19 cases of total cases and active, positive, death cases covered by month wise May and June 2021 - Z score statistical analysis with mapping
2. Delineate population density and World level travel dissemination of covid 19 cases.

4. STUDY AREA:

Tamil Nadu is the southern state of India (Figure.1) It is located in the Indian peninsula between the Bay of Bengal in the east, bordering States with Kerala in the western side, Andhra Pradesh to the north and Karnataka on the north-west was selected as a study area.

Tamil Nadu is India's 11th largest state in terms of size, and the country's third largest urbanized population. The state, with a population of 72,138,958 (Census 2011), is the seventh most populated state in the country and covers an area of 130,058 sq. km. This state is bounded by Andhra Pradesh and Karnataka on the north, Kerala on the west, the Bay of Bengal on the east and the Indian Ocean on the south (Fig. 4). Tamilnadu extends with a geographical extent between 8° 5' and 13° 35' North and 76° 15' and 80° 20' east (Census of India 2011).(Fig.1)

The two important techniques used in the present study are statistical techniques and cartographic interpretation. It includes mapping of the study area using the GIS software. In the present study, population density, Corona cases and total cases, active cases and death cases in Tamil Nadu total foreign tourist arrivals (FTAs) to India and total confirmed cases of the COVID-19 were considered as determining factors for hotspot mapping.

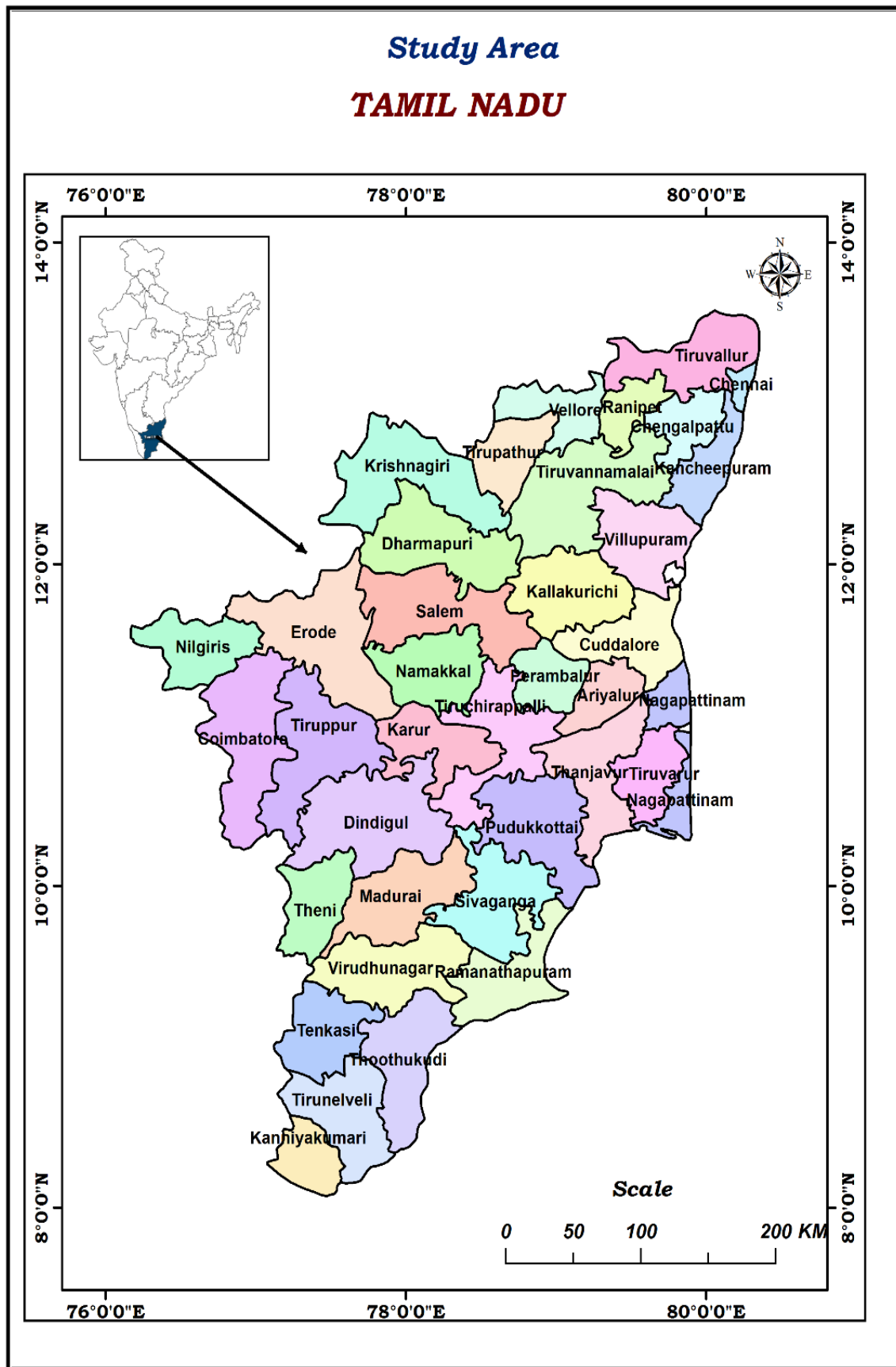


Fig.1 Study area –Tamil Nadu

5. POPULATION DENSITY:

Tamilnadu has recorded 175,678 corona positive cases which is the highest number in south India. According to the state health bulletin, the Chennai district alone reported 87,235 cases of corona virus which have a population density of 26,553 persons per square km. Initially, North Chennai Koyambedu market has identified as the recent hotspot of COVID-19 (The Hindu 2020). Near about 2000 cases were related to the popular market of Chennai. Later the infection rate has increased all over the state especially

in northern Tamilnadu districts. These districts has medium to very high-population density with a large number of COVID -19 positive cases. However, this state also has a low mortality rate of about 1.45%. Data represented in Fig.2 shows the strong positive correlation between the population density and the number of covid-19 cases. In order to understand the spatial distribution, we have shown a TP map for better representation of COVID-19 and population density.

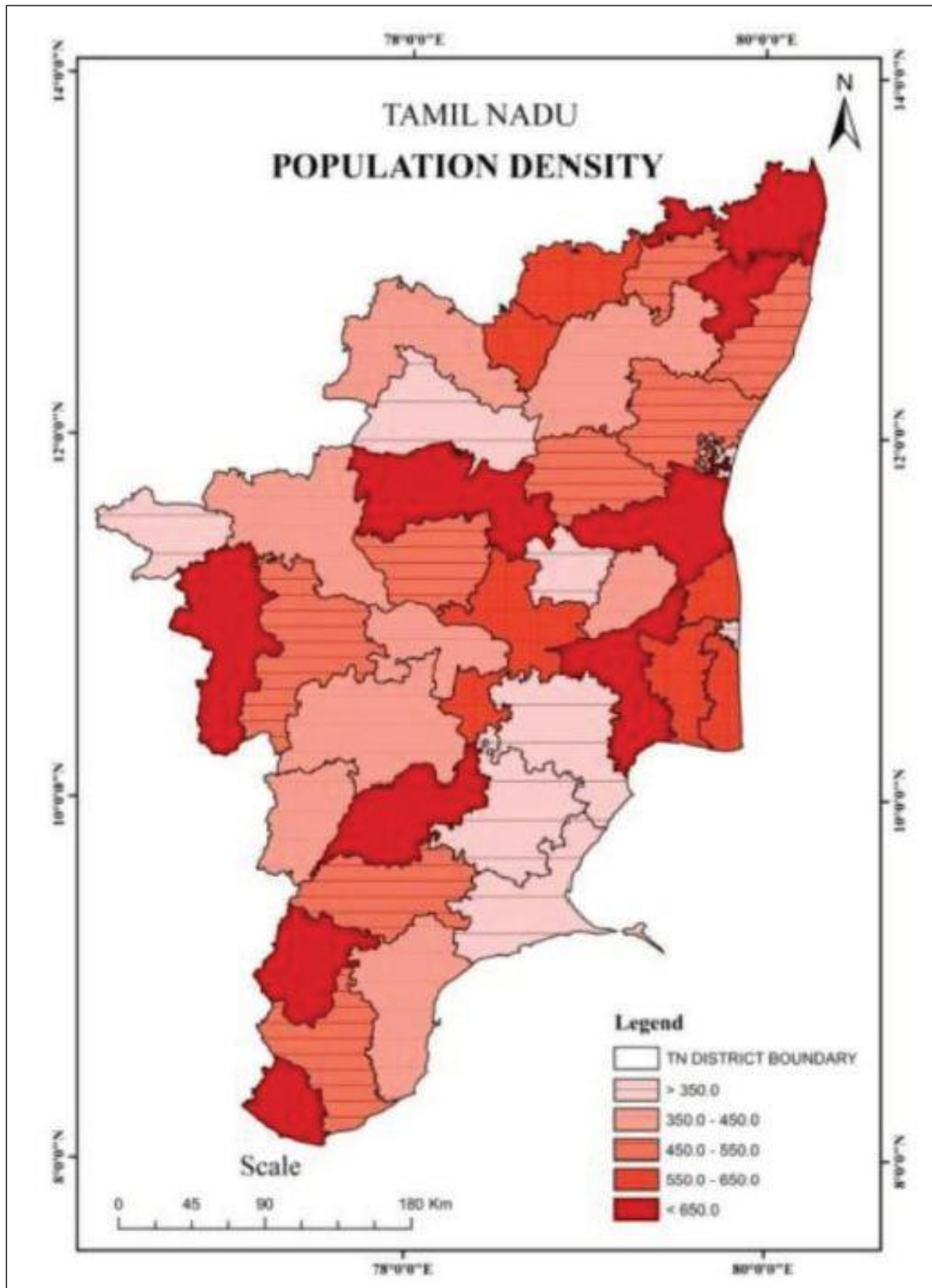


Fig.2 Population Density

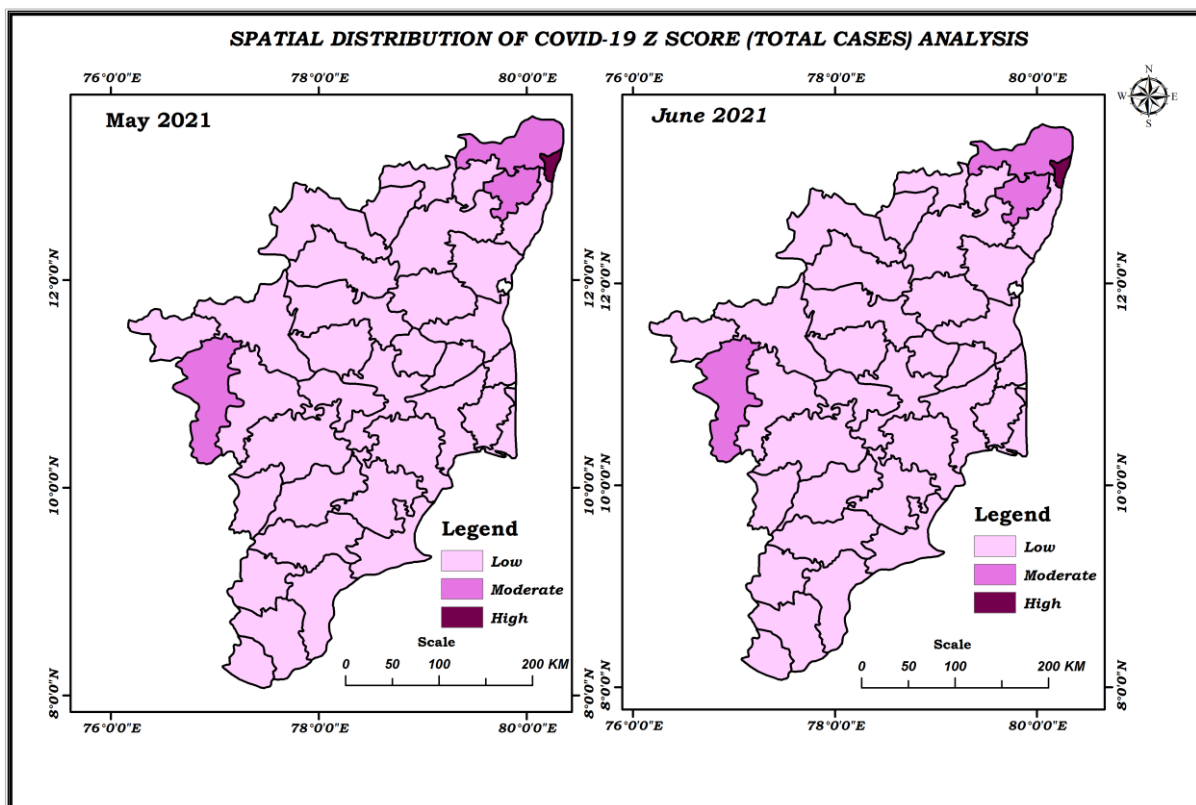


Fig.3 Total Cases of Covid-19 in Tamil Nadu

6. TOTAL CASES:

The month wise analysis of COVID-19 cases reveals the total cases in all districts in Tamil Nadu. The spatial distribution of COVID 19 Total cases (Table.1 and Fig 3) for the month of May and June 2021 reveals the peak Z score (high level concentration) found in Chennai district (5.46) which has the highest population density. high Z score (Moderate level score in month wise) found in Coimbatore (1.26, 1.68) and Tiruvallur (0.54, 0.50), Chengalpet (1.01, 1.01) it reveals that disease spread decreases in number of districts. The high Z score above the avg (0.64, 0.72)) found in 33 districts of Tamil Nadu.

Table 1. Emergence Pattern of Covid-19 Total cases in Tamil Nadu as on May 2021 to June 2021 (Z core Analysis)

S.No	District	Total Cases	
		May-21	Jun-21
1	Ariyalur	-0.496493519	-0.584883248
2	Chengalpattu	1.014294417	1.012409067
3	Chennai	5.461008096	5.28924883
4	Coimbatore	1.268888715	1.684398889
5	Cuddalore	-0.091233363	-0.101191001
6	Dharmapuri	-0.449260082	-0.479484478
7	Dindigul	-0.346199676	-0.392801484
8	Erode	-0.047236453	0.214822938
9	Kallakurichi	-0.417415644	-0.451547592
10	Kancheepuram	0.090458501	0.043633998
11	Kanniyakumari	-0.104477078	-0.085814886
12	Karur	-0.474457862	-0.502862101
13	Krishnagiri	-0.281295552	-0.306380647
14	Madurai	0.099002433	0.066532898
15	Nagapattinam	-0.337234127	-0.323614663
16	Namakkal	-0.307696179	-0.260765218

17	Nilgiris	-0.452732217	-0.436342449
18	Perambalur	-0.572768884	-0.6247882
19	Pudukkottai	-0.397686477	-0.448264922
20	Ramanathapuram	-0.470142494	-0.527140178
21	Ranipet	-0.257635433	-0.290503013
22	Salem	0.089218452	0.213375372
23	Sivaganga	-0.49472025	-0.554062628
24	Tenkasi	-0.403006284	-0.448253524
25	Thanjavur	-0.116579949	-0.050617373
26	Theni	-0.239121513	-0.271536477
27	Thoothukudi	-0.104898694	-0.136126357
28	Tiruchirappalli	-0.011547865	0.020336163
29	Tirunelveli	-0.146626317	-0.210750099
30	Tirupathur	-0.402795476	-0.437903996
31	Tiruppur	0.01276948	0.154743246
32	Tiruvallur	0.546511031	0.502455464
33	Tiruvannamalai	-0.179413191	-0.201882332
34	Tiruvarur	-0.322403151	-0.335445951
35	Vellore	-0.161283687	-0.219173338
36	Villupuram	-0.267109401	-0.271946811
37	Virudhunagar	-0.228680307	-0.247873901
	Total cases	23.88075862	26.92028616
	Avg	0.645425909	0.727575302
	Standard deviation	0.336645594	0.424582939

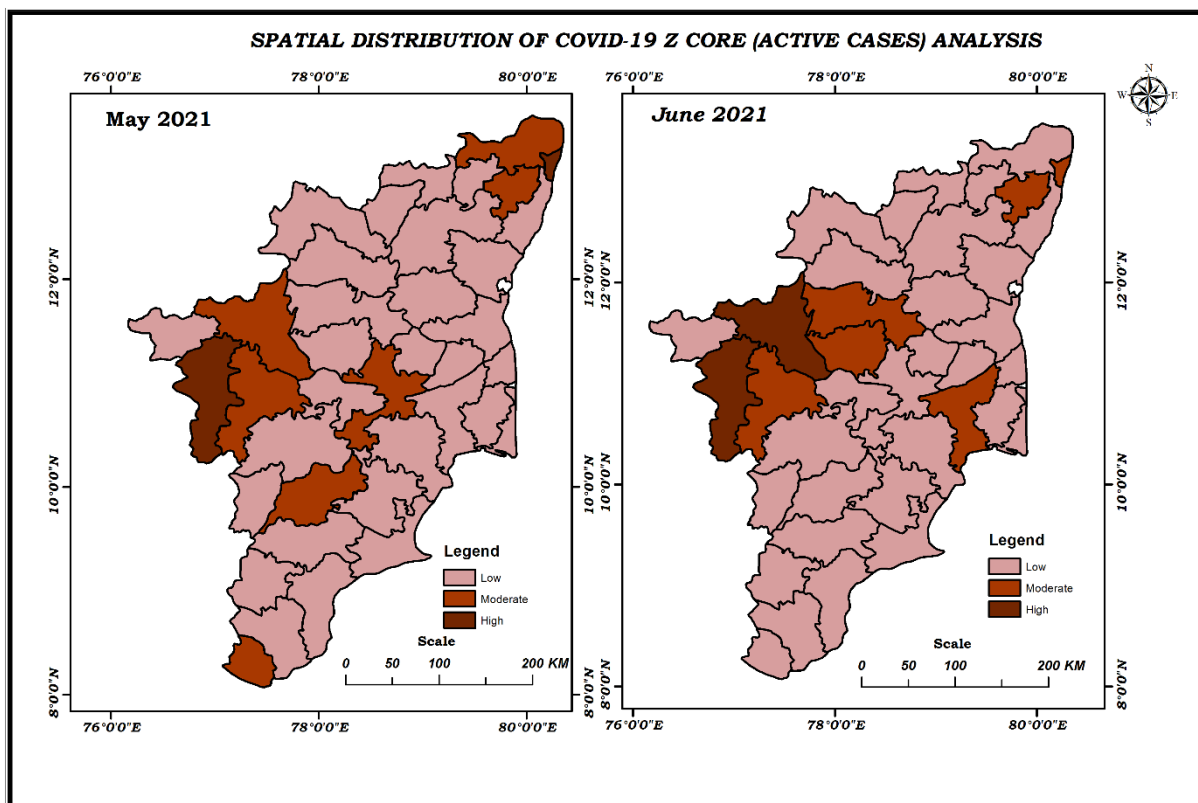


Fig.4 Active Cases of Covid-19 in Tamil Nadu

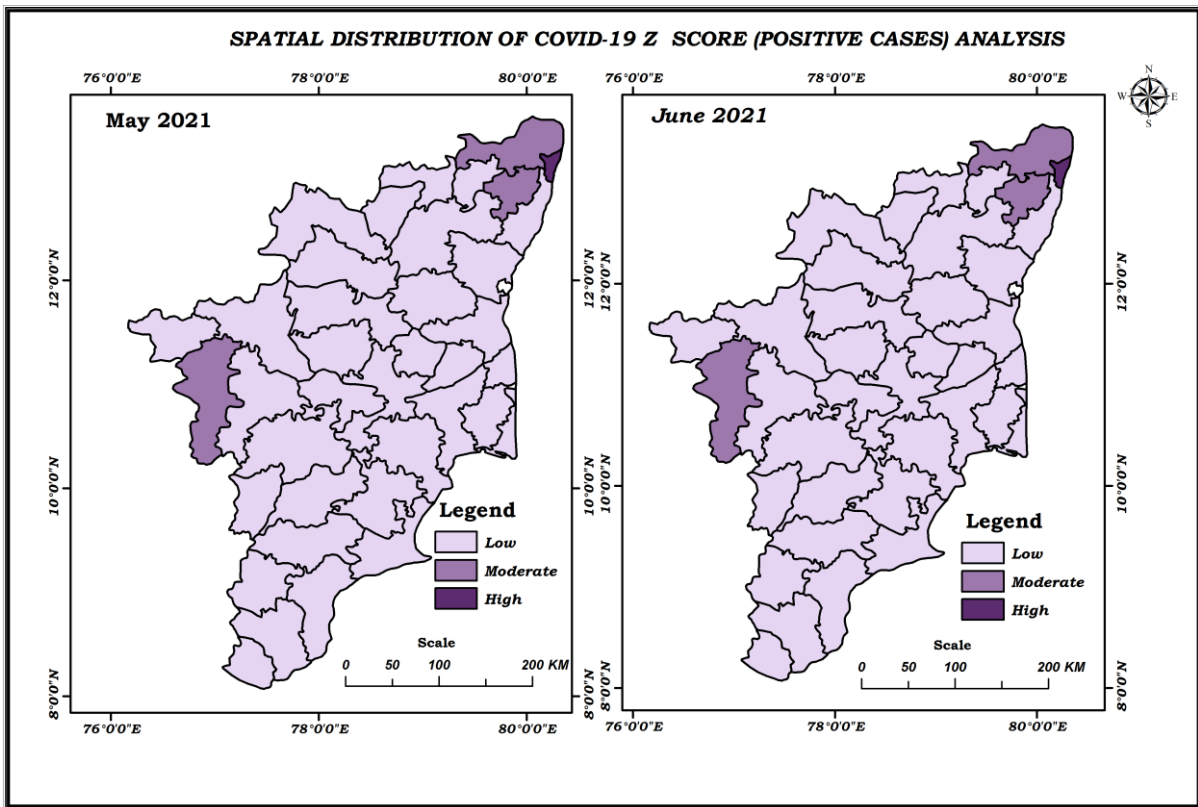


Fig.5 Positive Cases of Covid-19 in Tamil Nadu

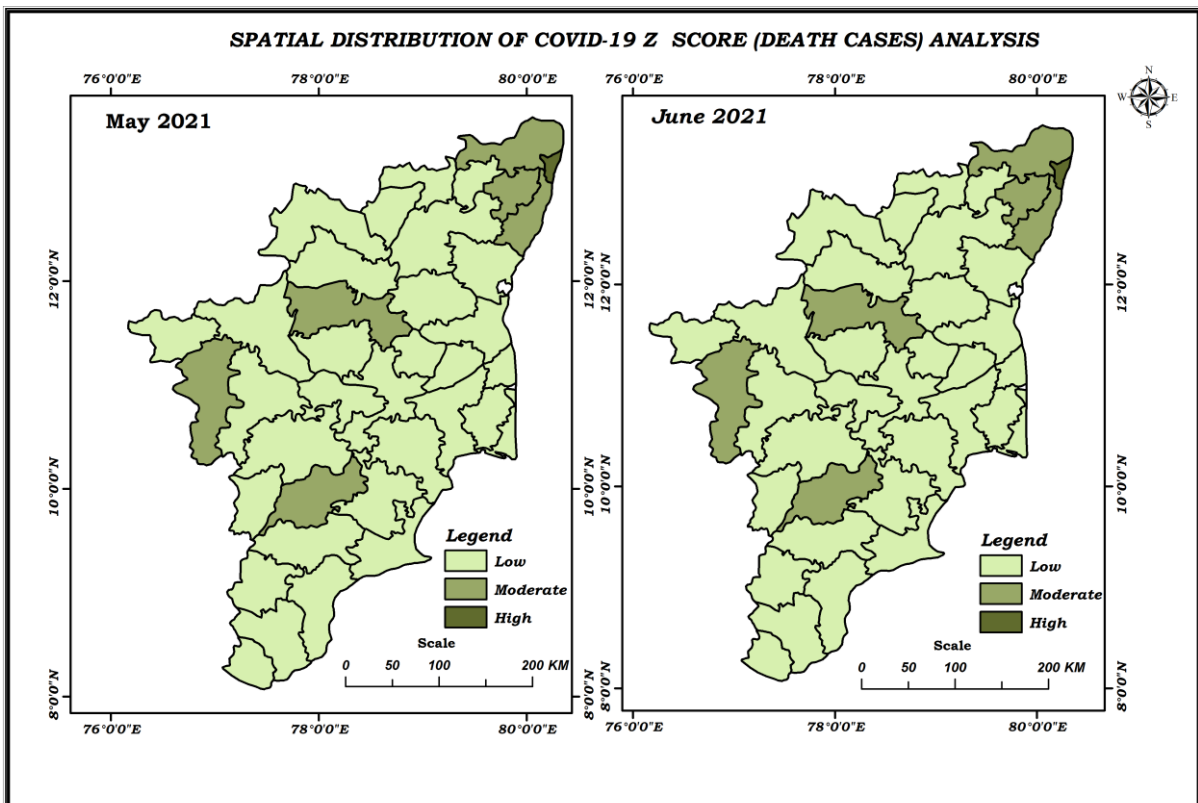


Fig.6 Death Cases of Covid-19 in Tamil Nadu

7. RESULTS:

The Z score value (6 standard deviation greater than the mean) found in Chennai (5.49). The belong district of Coimbatore (1.69) the covid patient returned from Indonesia in the month of May 2021. Similarly other foremost district such as Trichy, Coimbatore Thanjavur Kancheepuram Thiruvavarur, Cuddalore, Erode, and Salem also recorded imported COVID-19 cases in May to June 2021. Interstate migration also play important role in disease transmission. The Census 2011 information on migrants as of late had come as a convenient instrument in this specific situation. According to the 2011 census 18.85 lakh migrants who were born outside Tamil Nadu were living in the State. This is generally 2.6% of the State's complete populace. Of the considerable number of migrants in

Tamil Nadu, these migrants from different States comprise just 6.2%. The remaining were the individuals who have moved inside Tamil Nadu.

Z score (Standard score) shows what number of standard deviations a components is from the mean. A Z – score can be determined from the following

$$\text{Formula } z=(x-\mu)/\sigma$$

Where z is the Z score, X is the value of the element, μ is the population mean, and σ is the standard deviation.

The trend in the number of covid 19 cases was associated with the population density where higher numbers are recorded in the eastern, southern, central and western parts of the Tamilnadu. The death rate in Tamilnadu throughout the pandemic period under study was lower than the global average. 75% of cases in Tamilnadu concentrated in cluster population districts.

The month wise analysis of COVID-19 early confirmed cases from international travel related and through contact infection in Tamil Nadu from May 2021– June 2021 (Table 2 Fig 4,5,6) reveals migration play important role in COVID -19 cases both international travel returnees and migration of guest workers from other states leads to high disease transmission. The end of May month, the status of COVID19 in Tamil Nadu was in first stage and June 2021 is second stage, which means, the virus is locally transmitted and can spread from an infected person having a travel history from the virus spread state or country can pass on the infection to another person when coming in contact. In this stage, the infected persons can be identified and isolated.

Positive cases as declared high level of Z score value of Chennai district has (5.4 for May and 5.2 June month) moderately distributed name of the district like Coimbatore and Tiruvallur, Chengalpatu, spatially very low cases in remaining 33 districts only.

Active cases as declared high level of Z score analysis of Coimbatore and Chennai district is very highly distributed and moderately covered district are Erode, Tiruppur, Madurai, Tiruchy, Kanniyakumari, Thanjavur, Tiruvallur, Chengalpatu. spatially low Z score value remaining 28 districts only

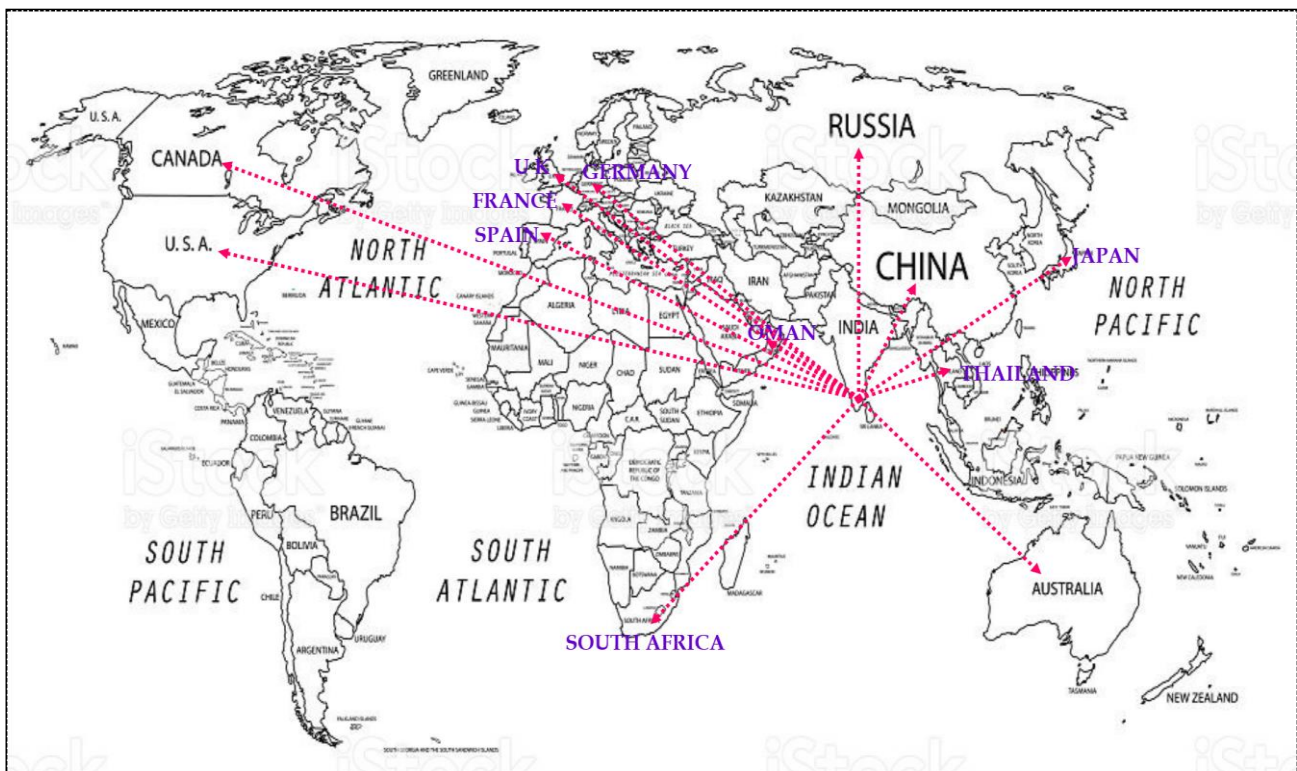
Death cases as spatially distributed Z score value month of May and June has moderately death cases common district Coimbatore, Madurai, Salem, Chengalpet, Kancheepuram. Thiruvallur districts. High death cases Chennai district only, remaining districts has low death cases covered in the districts.

Table.2 .Emergence Pattern of Covid-19 Disease cases in Tamil Nadu as on May 2021 to June 2021 Z core Analysis

SNo	District	May-21	Jun-21	May-21	Jun-21	May-21	Jun-21
		Total_Positive_Cases		Active_Cases		Death_Cases	
1	Ariyalur	-0.53448	-0.58555	-0.69873	-0.615	-0.46529	-0.498
2	Chengalpattu	1.01479	1.01241	0.73669	0.2486	0.97437	1.1111
3	Chennai	5.459	5.28589	4.04926	1.1225	5.59113	5.4751
4	Coimbatore	1.26924	1.69042	3.34267	4.2307	0.48657	0.8139
5	Cuddalore	-0.09012	-0.10113	-0.10119	0.1248	-0.11907	-0.093
6	Dharmapuri	-0.44794	-0.47994	-0.60903	-0.306	-0.44793	-0.499
7	Dindigul	-0.34494	-0.3937	-0.57966	-0.651	-0.22138	-0.214
8	Erode	-0.04615	0.2208	0.58215	2.7261	-0.28533	-0.223
9	Kallakurichi	-0.41612	-0.45164	-0.51448	-0.146	-0.43331	-0.502
10	Kancheepuram	0.09147	0.04272	-0.16936	-0.693	0.26368	0.2287
11	Kanniyakumari	-0.10336	-0.0866	0.23898	-0.14	0.03439	0.0753
12	Karur	-0.47313	-0.50338	-0.64219	-0.471	-0.39312	-0.394
13	Krishnagiri	-0.28007	-0.30639	-0.1932	-0.112	-0.37942	-0.428
14	Madurai	0.10001	0.06574	0.84528	-0.525	0.22257	0.1675
15	Nagapattinam	-0.33598	-0.32413	-0.38666	-0.303	-0.27071	-0.273
16	Namakkal	-0.30646	-0.25957	-0.35776	0.4435	-0.35932	-0.351
17	Nilgiris	-0.45141	-0.43641	-0.60603	-0.091	-0.47899	-0.53
18	Perambalur	-0.57138	-0.62586	-0.65912	-0.786	-0.50274	-0.502
19	Pudukkottai	-0.3964	-0.44894	-0.54454	-0.561	-0.37394	-0.421
20	Ramanathapuram	-0.46881	-0.52824	-0.61467	-0.628	-0.36389	-0.399
21	Ranipet	-0.25643	-0.29096	-0.45495	-0.415	-0.19398	-0.14
22	Salem	0.09023	0.21672	-0.24444	1.336	0.2655	0.4193

23	Sivaganga	-0.49338	-0.55453	-0.74226	-0.505	-0.40774	-0.505
24	Tenkasi	-0.40172	-0.44944	-0.49767	-0.585	-0.27254	-0.302
25	Thanjavur	-0.11545	-0.04856	-0.1142	0.7183	-0.09989	-0.124
26	Theni	-0.23792	-0.2726	-0.20218	-0.366	-0.2497	-0.285
27	Thoothukudi	-0.10378	-0.13702	-0.07171	-0.238	-0.31913	-0.367
28	Tiruchirappalli	-0.01048	0.02078	0.29737	-0.089	-0.0871	0.0065
29	Tirunelveli	-0.14548	-0.21212	-0.34762	-0.539	-0.24514	-0.339
30	Tirupathur	-0.40151	-0.43886	-0.4698	-0.573	-0.25427	-0.236
31	Tiruppur	0.01383	0.15746	0.87418	0.8112	-0.17297	-0.107
32	Tiruvallur	0.54727	0.50193	0.36243	-0.375	0.62816	0.6151
33	Tiruvannamalai	-0.17825	-0.20172	-0.09324	-0.06	-0.1885	-0.214
34	Tiruvarur	-0.32116	-0.33614	-0.29857	-0.435	-0.38307	-0.411
35	Vellore	-0.16013	-0.2202	-0.52439	-0.763	0.05723	0.0972
36	Villupuram	-0.2659	-0.27261	-0.49214	-0.337	-0.34379	-0.4
37	Virudhunagar	-0.22749	-0.24862	-0.09923	-0.455	-0.21134	-0.253

Figure-7: Early Confirmed Cases from International Travel Related and Through Contact Infection in Tamil Nadu



In India, the first corona positive case was detected in Thrissur district of Kerala on 30th January 2020 which is neighboring state of Tamil Nadu. The patient was a student from Wuhan University, China.²¹ As per the medical guidelines, the patient was kept in isolation until his complete recovery as per the Ministry of Health and Family Welfare. Only symptomatic patients are isolated other asymptomatic patients are not identified and quarantined. As per Department of Health and Family Welfare reports (80%) COVID -19 patients were asymptomatic which leads the transmission of SARC-CoV-2 from asymptomatic carriers to others. In Tamil Nadu the lockdown was announced in March 26,2020. The last case of International COVID- 19 confirmed case entered in Tamil Nadu in April 5. But till May 15 the number of COVID-19 cases increased in Tamil Nadu this proves that number of humans become the host of COVID-19 disease transmission.

8. CONCLUSION:

This present research was completed utilizing Z score and GIS mapping to represent the spatial dispersion of COVID19 disease all over Tamil Nadu. The primary goal was to assess the change in the rate of the COVID19 cases across various districts by performing

spatial pattern assessment from May 2021 and June 2021. it was discovered that, Chennai was the intensely influenced area by COVID19 disease followed by Chennai (529650), Coimbatore (213384), Chengalpattu 154428 and Thiruvallur 109688 according to the spatio-temporal change dissemination of COVID19 examination, it will be useful to make important strides by the government to manage and estimate the immense of further spread of the COVID19 contagious at the most influenced areas and the nearby locales to it just as to forestall the least influenced districts.

ACKNOWLEDGEMENTS:

The authors are grateful to all the data providing agencies viz. Ministry of Health and Family Welfare (India), World Health Organization and Centers for Disease Control and Prevention for providing us with valuable COVID19 related data that lend a hand us in our research work.

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