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Thematic Mapping of COVID-19 Spread in Nigeria: A Tool for Pandemic Rapid Containment Measures

Adebayo.H. Oluwasegun

Department of Geography, Olabisi Onabanjo University, Ago-Iwoye, Ogun State, Nigeria
Email Address: adebayooluwasegunhezekiah@gmail.com; adebayo.oluwasegun@oouagoiwoye.edu.ng

Abstract: Since the end of 2019, pneumonia, later named 2019 novel corona virus disease (COVID-19), originated in Wuhan and rapidly spread throughout the globe including Nigeria. This study explored the techniques of Thematic mapping in assessing the spread of COVID-19 across the thirty-six states in Nigeria with the main objective of showing how thematic maps can be employed in explaining pandemic situations for easy interpretation and quick decision-making. The study relies on publicly available data on confirmed cases and death across Nigeria from the website of Nigeria Centre for Diseases Control (NCDC). Geo-visualization analysis technique was adopted for this study with results presented in form of maps. Results show that Lagos (34.7%, 18.8%) Kaduna (6.0%, 4.0%) Plateau (5.5%, 3.4%) Oyo (4.5%, 3.9%) Rivers (3.9%,4.9%) states and the Federal Capital Territory (FCT), Abuja (13.4%, 7.9%) are hardly hit by COVID-19 in terms of the total number of both confirmed cases (90,147) and deaths (1,311) cases respectively as at Sunday 3th of January, 2021. The use of thematic maps for easy explanations, effective planning, preparedness and response to pandemic phenomena was equally established by this study. Since the virus spreads easily through human to human contact, it is recommended that restrictions of movements should be the priority of every concern stakeholder..

Keywords: Thematic Mapping, Geographic Information System, COVID-19, Spread, Containment

1. Introduction

The COVID-19 global pandemic has impacted the whole of society, requiring rapid implementation of individual-, population-, and system-level public health responses to contain and reduce the spread of infection. COVID-19 originated in Wuhan, China, with the first cases reported in December 2019 (WHO, 2020) and was officially declared as a public health emergency of international concern on January 30, 2020, by the World Health Organization. The first Nigerian confirmed case of COVID-19 was on February 28, 2020, in Lagos (NCDC, 2020), subsequently resulting in the closing of Nigerian borders to all non-residents in March. Physical distancing rules were imposed on March 30, 2020, with the associated closure of all non-essential services including retail outlets, cafés, restaurants, schools, recreational facilities, and playgrounds. To assist in physical distancing, additional measures including working, studying, or completing school from home were imposed; social gatherings were banned, and stringent restrictions on individual movement were put in place (NCDC, 2020). These public health policies profoundly impacted individual and population-level health, disrupted normal social interactions, and contributed to economic insecurity. Currently, the impact of COVID-19 on Nigerians and its associated levels of distress are poorly understood, yet are critical in ascertaining the spread by presenting it in a visual understanding. COVID-19 as an object of this study is a thematic polyhedron where geographical variables are present in several of its facets.

A thematic mapping is a type of mapping technique that portrays the geographic pattern of a particular subject matter (theme) in a geographic area (Dent et al., 2009; Robinson, 1982). Thematic Maps focus on a specific theme by pulling together relevant information of the subject (such as health, election, income, etc.) and represents it spatially to understand the relationship between these themes and their locations. Its usually involves the use of map symbols to visualize selected properties of geographic features that are not naturally visible (Kraak and Omeling, 2003; Bartz Petchenik, 1979; Keates, 1973). Thematic mapping is closely allied with the field of Geovisualization. Therefore, the aim of this study is to employ thematic mapping techniques in explaining the spread pattern of COVID-19 in Nigeria with the objective of using it as a tool for showing pictorially the direction of spread and a guide in taking quick and rapid decision for effective containment of the virus.

1.1 Study Area

Nigeria is situated between Latitudes 4º and 14º North of the Equator and Longitudes 3º and 14º East of Greenwich Meridian. The country is bordered on the west by the Republic of Benin; on the east by the Republic of Cameroon; on the north by Niger and Chad Republics and on the south by the Gulf of Guinea and Atlantic Ocean (see Figure 1). The land area is 909,890sqkm with an estimated population of over 200 million people. It is the most populous nation in Africa and contains more than 350 ethno-linguistic groups. The country as at today

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has evolved into a political structure that consists of 36 states and a Federal Capital Territory (Abuja), all constitutionally summarized into six geopolitical zones. There are also, 774 Local Government Areas in Nigeria (Ademiluyi, 2020).

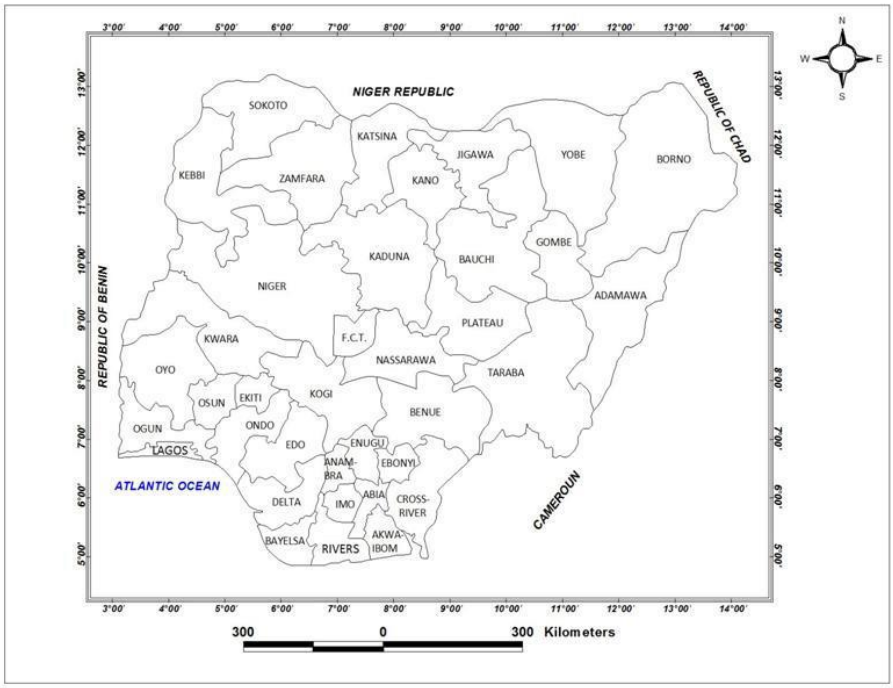

Figure 1: Map of the Study Area (Nigeria). Source: Oyo State Ministry of Lands, Survey and Urban Planning, Ibadan

2. Methodology

2.1 Data Source and Types

Data used for this study include: (1) Analogue map of Nigeria sourced from the Oyo State Ministry of Lands, Survey and Urban Planning, Ibadan and (2) situation reports on COVID 19 in Nigeria as at January 3, 2021 by the Nigeria Centre for Disease Control (NCDC). The GIS software used for this study is ArcGIS 10.

2.2 Data Conversion and Processing

The health indicators (number of COVID-19 attributable deaths, active, discharged and confirmed cases) across the thirty-six (36) states in Nigeria including the Federal Capital Territory (FCT), Abuja as at January 3,2021 (Table 1) served as the input data for generating the thematic maps to study the spread of the pandemic. The Geographic Information System (GIS) software used in generating the thematic maps is ArcGIS 10.0. The hard copy of the map of Nigeria acquired was scanned into the GIS environment. Geo-referencing was done by the use of tied-points method. The geo-referenced map portrayed information as to where the areas represented on the map fits on the surface of the earth. It was then digitized using on-screen method with the national and state boundaries captured as polygon feature. The health indicators data were restructured in a format (Text Delimited) for implementation in the GIS environment and linked it to the digitized national and state boundaries as their attributes to produce maps (Figures 1, 2, 3&4) that show the situation of COVID-19 in Nigeria.

3. Results and Discussions

The thematic maps generated in this study (Figures 1 to 4) present the spread pattern of COVID-19 Confirmed, Recoveries, Death and Active cases in Nigeria by States including the Federal Capital Territory (FCT), Abuja. The figure shows a high spread in the confirmed cases of COVID-19 across the country with Lagos State recording the highest making the state an epicenter of the pandemic followed by FCT, Abuja (see Figure1). There are also high prevalence of confirmed cases of COVID-19 in the following States; Oyo, Rivers, Kaduna and Plateau, these are followed closely by Katsina, Kano, Gombe, Kwara, Ogun, Ondo, Edo, Delta and Enugu. The high level of spread in confirmed cases of COVID-19 in these states is may be largely due to the following pandemic risk factors; high exposure to international travelers, high urban population and densities plus displacement of people especially in the conflict areas (ACSS 2020,April 3). The number of people that have recovered from the virus infection as at 3rd of January, 2021is also shown graphically (see Figure 2). Lagos State has the highest number of recoveries followed by Kaduna State, Plateau State and FCT, Abuja. The death rate recorded due to the pandemic is high in Lagos State ranging between 118 and 247 cases followed by Edo State and FCT, Abuja ranging from 69 to 117 cases (Figure 3).

States	Confirmed cases	Total Active cases	Discharged cases	Number of Deaths
Lagos	31321	4279	26795	247
FCT, Abuja	12083	4391	7588	104
Kano	2324	326	1930	68
Oyo	4035	581	3402	52
Rivers	3572	299	3209	64
Edo	2902	104	2681	117
Ogun	2552	226	2292	34
Kaduna	5447	686	4708	53
Delta	1888	99	1737	52
Borno	806	32	738	36
Bauchi	1020	143	860	17
Gombe	1338	300	1001	37
Katsina	1636	180	1429	27
Jigawa	407	28	368	11
Plateau	4997	393	4560	44
Ebonyi	1107	5	1072	30
Imo	766	31	722	13
Abia	1028	50	968	10
Nasarawa	898	560	325	13
Kwara	1414	289	1094	31
Bayelsa	534	92	421	21
Enugu	1400	31	1348	21
Sokoto	380	92	270	18
Ondo	1843	39	1763	41
Zamfara	112	25	82	5
Kebbi	173	20	144	9
Anambra	328	35	274	19
Niger	417	84	320	13
Akwa Ibom	437	43	385	9
Osun	1019	30	965	24
Yobe	201	49	144	8
Adamawa	424	161	238	25
Benue	532	52	469	11
Ekiti	415	14	395	6
Taraba	217	23	187	7
Kogi	5	0	3	2
Cross River	169	0	157	12
Total	**90,147**	**13,792**	**75,044**	**1,311**

Table 1: COVID-19 Situation Report in Nigeria.
Source: Nigeria Centre for Disease Control (NCDC, 2021).

Active cases of COVID-19 infection across the country is still very high as at January 3,2021 with the following States; Lagos, Kaduna, Nasarawa, Oyo, Plateau and FCT, Abuja still potentially at risk of the virus infections (see Figure 4). The findings of this study shows a rise in the spread of COVID-19 in Nigeria as at January 3,2021and still on the increase as the country is into the second wave of the virus prevalence (NCDC, 2021).

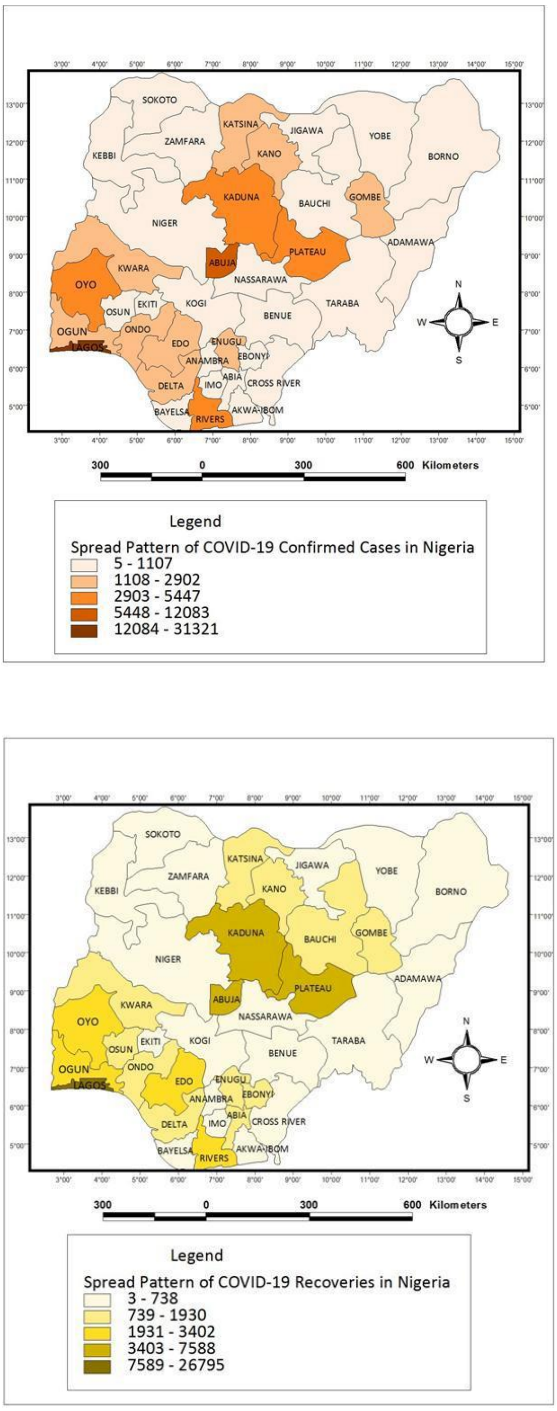

Figure 1& 2: Spread Pattern of COVID-19 Confirmed Cases and Recoveries in Nigeria

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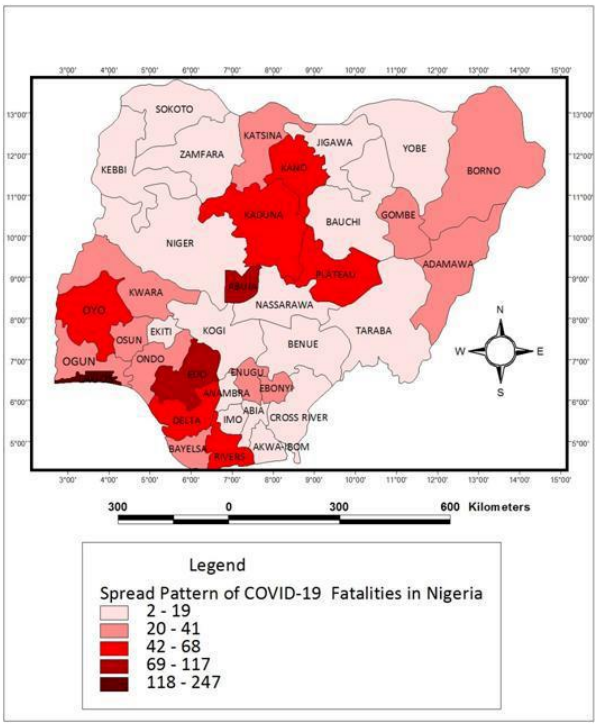

Figure 3: Spread Pattern of COVID-19 Fatalities in Nigeria

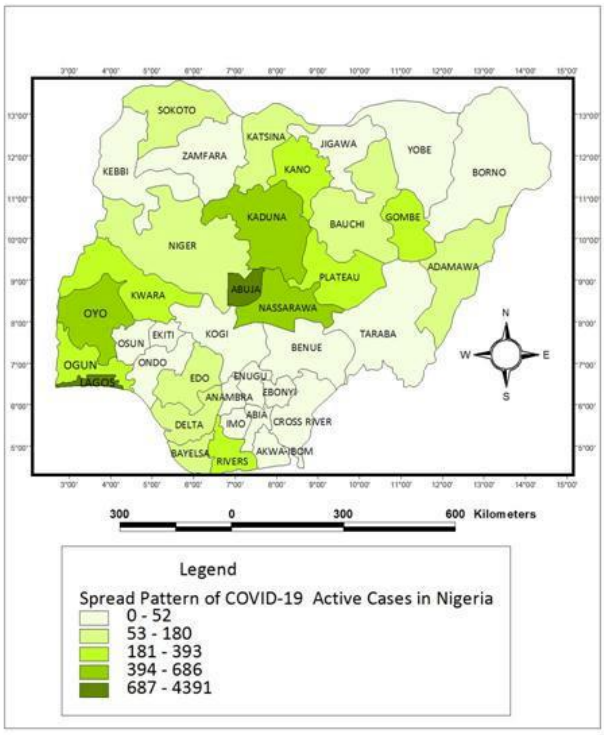

Figure 4: Spread Pattern of COVID-19 Active Cases in Nigeria

3.1 Implications of Study

Since human to human contact is still the major factor for the spread of this deadly virus, thematic maps like the ones generated and presented visually in this study can be employed by all relevant stakeholders for quick decision making concerning its spread such as restrictions of movements from and into hotspot states (intra and inter-state movement), whether to have total or partial lockdown, in having effective responses in terms of medical facilities and palliative measures that will help in reducing the effects. These maps put together can also serve the purpose of early warning now and in the future. These maps can further be used to control community and neighborhood spread in Nigeria and globally. Generally, geo-visualization analysis of health events through the use of thematic mapping techniques has the capacities of storing, analyzing and displaying such in a simple graphic form for quick understanding and interpretation.

4. Conclusion and Recommendations

This study explored the techniques of Thematic mapping to visualize the spread of the novel corona virus disease (COVID-19) across the 36 states in Nigeria including the Federal Capital Territory (FCT), Abuja. It equally presented how thematic maps could be used to explain public health phenomenon for quick decision and intervention. Lagos, Kano, Kaduna, Oyo, Plateau and Rivers states together with FCT, Abuja were found to be the most hardly hit areas in Nigeria by the rampaging virus (estimated in terms of confirmed cases and the number of deaths recorded) with the South-West geopolitical zone having the highest number of both confirmed and active cases. It also established how maps like the ones generated in this study can be used to checkmate the spread of diseases across the space. The study concludes by recommending a proactive involvement of thematic mapping among other numerous methods for explaining public health phenomena by all relevant stakeholders for quick planning, preparedness and responses.

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