MAPPING OF SPATIAL DISTRIBUTION OF TUBERCULOSIS CASES IN KEBBI STATE, NIGERIA 2008-2011

Usman Lawal Gulma
Usmangulma38@yahoo.com
Department of Geography,
Adamu Augie College of Education, Argungu,
Kebbi State, Nigeria.

ABSTRACT

The World Health Organization has declared tuberculosis a global emergency in 1993. It has been estimated that one third of the world population is infected with Mycobacterium tuberculosis, the causative agent of tuberculosis. The identification of clusters in space-time is of great interest in epidemiological studies. The objective of this paper was to identify and map the spatial distribution of Tuberculosis during the period 2008-2011 in Kebbi State. Kernel Density Analysis tool in ArcGIS Spatial Analyst was employed to map the trend of TB cases over the period. The results revealed that the highest occurrence of 2,220 cases was in 2009 while year 2011 recorded the least cases of 1179 across the state. It was further revealed that Birnin Kebbi LGA with a population of 268,620 recorded the highest cases of 1,639. However, Suru LGA with population of 148,474 recorded only 70 cases over the period. In conclusion, TB cases were unevenly distributed in the state but high cluster rates were identified in the four emirate headquarters of Gwandu, Yauri, Argungu and Zuru. Increasing the number of diagnostic and treatment centers were recommended in order to reduce the number of cases across the state.

Key Words: Tuberculosis, ArcGIS, Population, Cluster, Kernel Density

1. Introduction

Tuberculosis (TB) is an infectious disease caused by the bacillus *Mycobacterium tuberculosis* and spreads through air by a person suffering from TB. The 1990 World Health Organization (WHO) report on the Global Burden of Disease ranked TB as the seventh most morbidity-causing disease in the world, and expected it to continue in the same position up to 2020 [WHO, 1996]. In 2001, the WHO estimated that1.86 billion persons (32% of the world population) were infected with TB. Each year, 8.74 million people develop TB and nearly 2 million die. This means that someone somewhere contracts TB every four seconds and one of them dies every 10 seconds [Dye et al, 1999]. TB is one of the oldest human diseases that still affect large population groups, mainly in marginal areas and comprising vulnerable groups impacted by extreme poverty, malnutrition, and crowded housing. These groups are prone to infection by the tuberculosis bacilli and to acquiring active TB Baker et al (2011).

The World Health Organization (WHO) reported in 2010 that there were an estimated 9.4 million incident cases (range 8.9 million–9.9 million) of TB globally, equivalent to 137 cases per 100,000 populations, and that 1.1 million of those cases also tested positive for human immunodeficiency virus (HIV). The mortality of HIV-negative patients with TB was estimated at 1.3 million, this being equivalent to 20 deaths per 100,000 people. The incidence of TB patients in Asia was 55% and 30% in Africa; smaller proportions of cases occurred in the Eastern Mediterranean Region (7%), the European Region (4%), and the Americas Regions (3%) (WHO, 2010).

At present, geographic information systems (GISs) are among the most useful tools in epidemiology, as they can be used to identify geographical areas and population groups with a higher risk of sickness or premature mortality and which therefore require higher preventive care or health information and monitoring of diseases in time and space.

In the case of TB, various researchers have used GIS to study this infectious disease. Moonan et al. [2004] used GIS to identify the geographic locations of TB transmission and incidence in the United States of America during 1993 to 2000. In India, Tiwarin et al. [2006] carried out a geospatial investigation of TB occurrence in the Almora district using GIS and the SCAN statistics program. Nunes [2007] in Portugal detected spatial and temporal clusters during 2000–2004 by using SCAN. The above-mentioned authors agree that GIS and SCAN are useful tools for vigilance against TB.

According to United States embassy in Nigeria (2010), Nigeria ranked 10th among the 22 high burden TB countries of the world. Kebbi state, the study area ranked 17th out of 36 states of Nigeria within the same period. This trend is alarming considering the fact that millennium development goal (MDG)is set to achieve the reduction of TB cases to half by the year 2015.

1.2 Objectives

The main purpose of this paper was:

1. To analyse the spatial distribution of tuberculosis (TB) cases by area in Kebbi state, Nigeria over a four-year period (1998-2011), using geographical information systems (GIS) technique.

2. To demonstrate capability of GIS in disease mapping and surveillance. It is expected that the results obtained by this study would assist policy makers in decision making.

2. Methodology

Density analysis takes known quantities of some phenomena and spreads it across the landscape based on the quantity that is measured at each location and the spatial relationship of the locations of the measured quantities.

Kernel Density calculates the density of point features around each output raster cell. In other words, it calculates a magnitude per unit area from point or polyline features using a kernel function to fit a smoothly tapered surface to each point or polyline.

Conceptually, a smoothly curved surface is fitted over each point. The surface value is highest at the location of the point and diminishes with increasing distance from the point, reaching zero at the Search radius distance from the point. Only a circular neighborhood is possible. The volume under the surface equals the Population field value for the point, or one if NONE is specified. The density at each output raster cell is calculated by adding the values of all the kernel surfaces where they overlay the raster cell center. The kernel function is based on the quadratic kernel function described in Silverman (1986).

3. Result

The results of the analysis revealed that the prevalence of TB cases in the study area could be attributed to high population densities per square kilometer. This is evident in the 2008 analyzed map which shows Zuru local government area which is the 4th in terms of number of cases but has the highest spatial density of the disease. This demonstrated the need for the employment of GIS for TB analysis in order to map and highlight the most affected areas for timely intervention and decision making.

LGAs	2008 CASES	2009 CASES	2010 CASES	2011 CASES	TOTAL CASES	POPULATION
ALIERO	70	87	64	43	264	67078
AREWA	60	68	32	110	270	189728
ARGUNGU	318	268	141	191	918	200248
AUGIE	42	23	21	19	105	116368
BAGUDO	74	96	35	61	266	238014
B/KEBBI	356	474	295	514	1639	268620
BUNZA	42	28	10	20	100	123547
DANDI	71	72	26	59	228	146211
DANKO/WASAGU	63	54	20	74	211	265271
FAKAI	62	32	21	29	144	119772
GWANDU	42	52	25	45	164	151077
JEGA	126	106	61	138	431	197757
KALGO	17	19	12	25	73	84928
KOKO/BESSE	168	141	58	95	462	154818

MAIYAMA	9	33	17	30	89	173759
NGASKI	49	69	25	52	195	126102
SAKABA	59	28	15	21	123	91728
SHANGA	22	45	46	76	189	127142
SURU	25	17	11	17	70	148474
YAURI	269	272	138	254	933	100564
ZURU	259	236	106	197	798	165335

Table 1: TB Cases (Source National TB Control Programme Kebbi State)

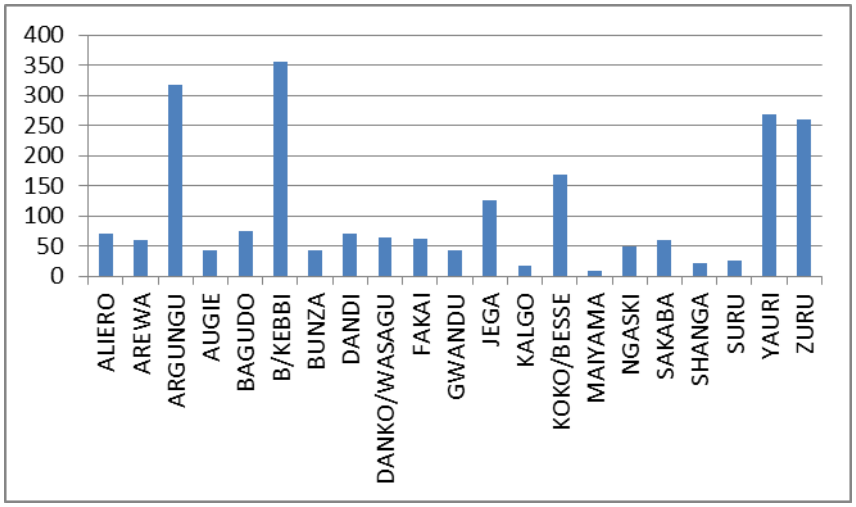

Figure 1: Graph of TB cases 2008

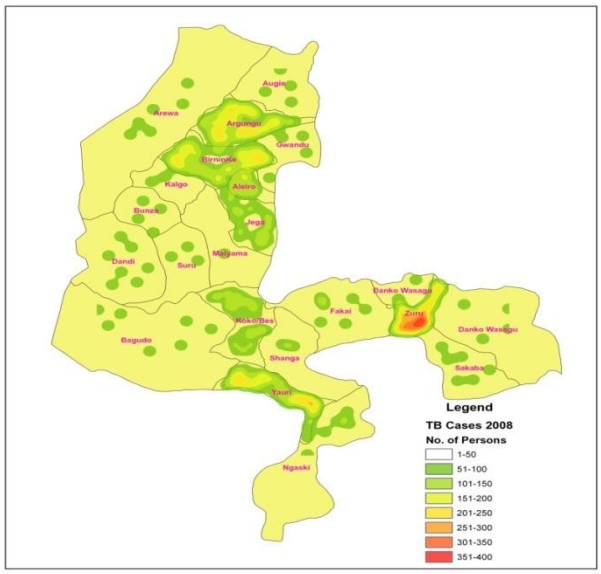

Figure 2: Map of Kebbi state showing density of TB Cases 2008

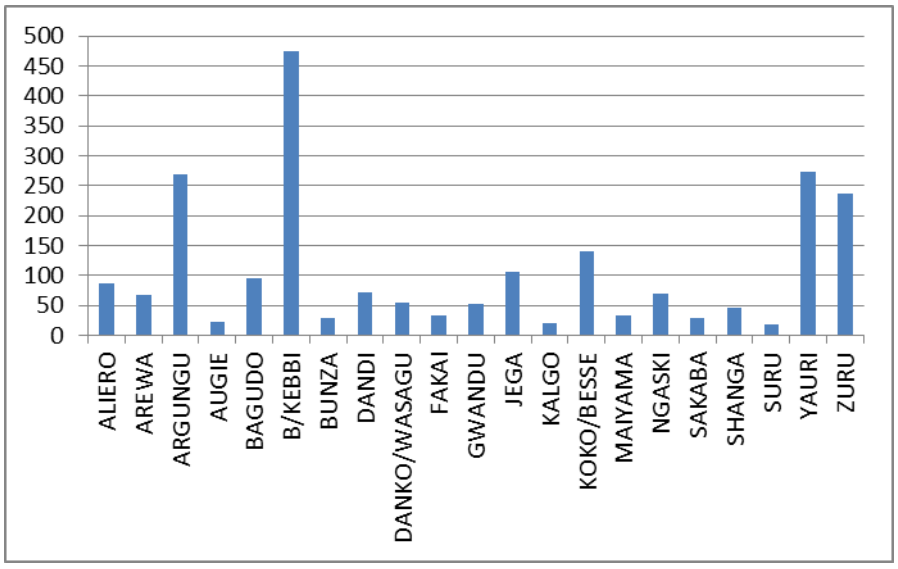

Figure 3: Graph of TB cases 2009

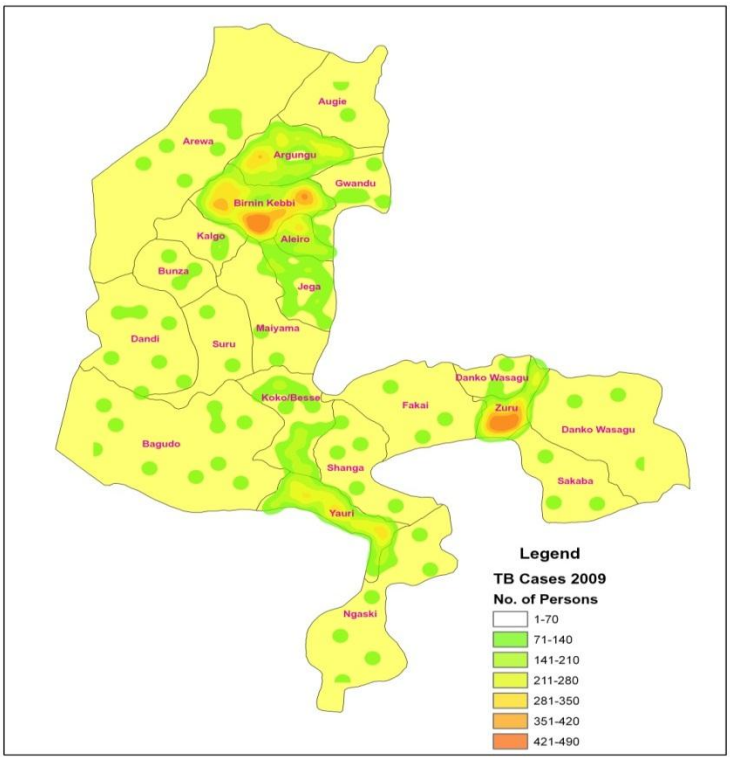

Figure 4: Map of Kebbi state showing density of TB Cases 2009

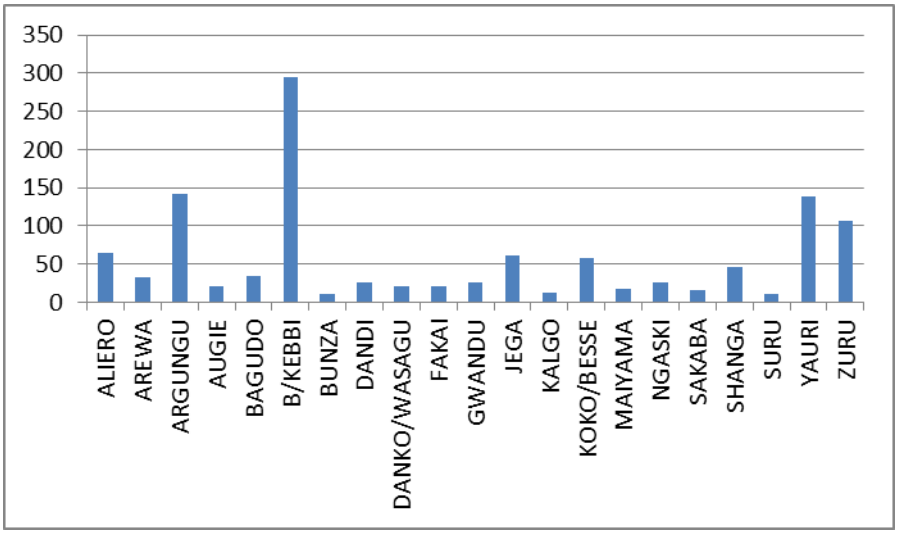

Figure 5: Graph of TB cases 2010

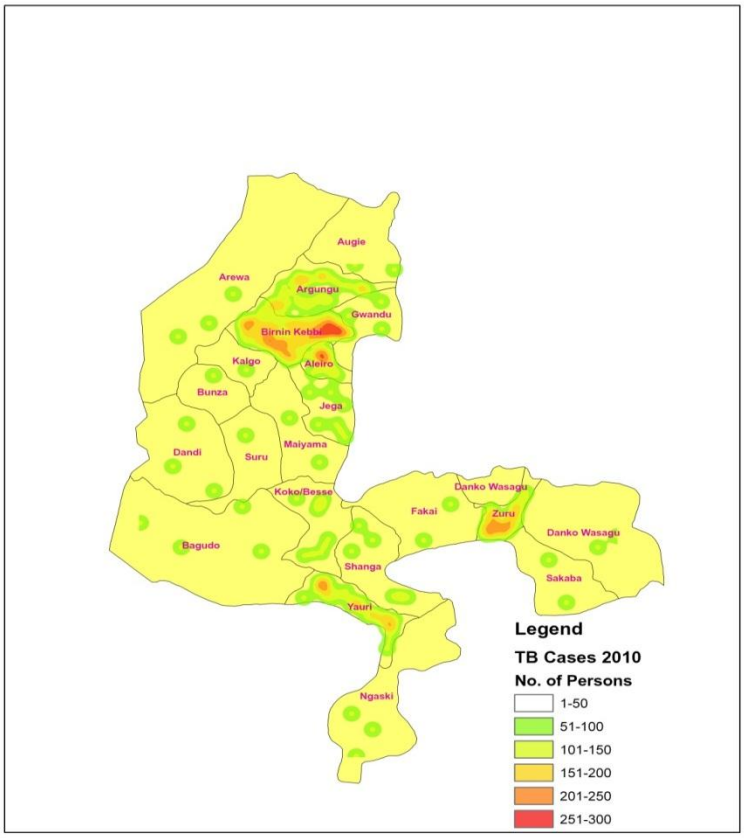

Figure 6: Map of Kebbi state showing density of TB Cases 2010

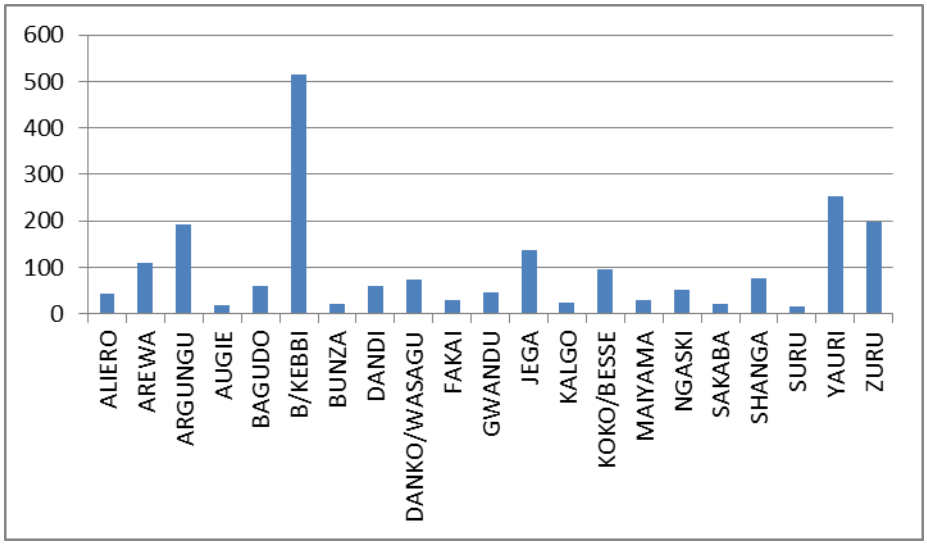

Figure 7: Graph of TB cases 2011

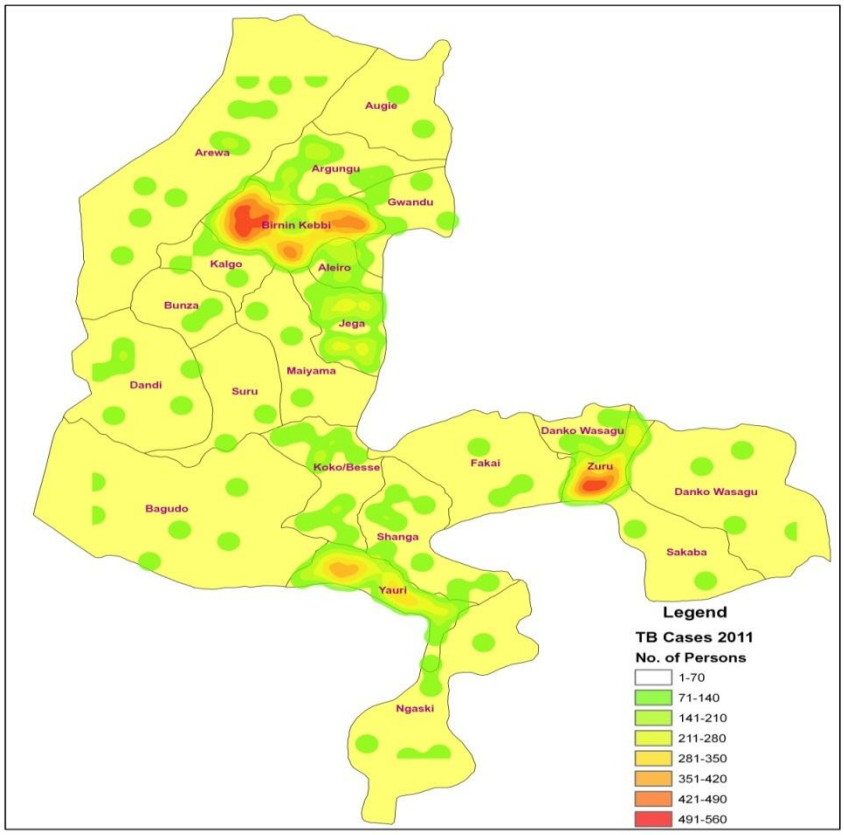

Figure 8: Map of Kebbi state showing density of TB Cases 2011

Acknowledgement
The author wishes to acknowledge the profound contribution of the state coordinator of national tuberculosis control programme in kebbi state, Nigeria for providing data for this research. I equally acknowledged the contributions of the authors whose works were reviewed in this paper. I thank you very much.

Biography of the Author
Usman Lawal Gulma is a lecturer in Geography at Adamu Augie College of Education, Argungu, Kebbi state, Nigeria. He holds a Bsc degree (Geography) and a Master of (GIS) all from the Usmanu Danfodiyo University, Sokoto, Nigeria. He is also a member of international research and development institute. He has a number of publications in national and international journals to his credit. The author is currently a research postgraduate student in the school of Geography, University of Leeds, United Kingdom and he is interested in spatial analysis.

References

B W Silverman (1986), *Density Estimation for Statistics and Data Analysis*. New York: Chapman and Hall.

C Nunes (2007), *Tuberculosis incidence in Portugal: Spatio-temporal clustering* International Jounal of Health Geographics Vol. 6 No. 30.

Dye C, Scheele S, Dolin P, Pathania V, Raviglione M (1999), *Global Burden of Disease estimated incidence, prevalence, and mortality by country*. Journal of Medical Association 1999, 282:677-686.

M G Baker, K Venugopal, and C P Howden (2011), *Household Crowding and Tuberculosis*, World Health Organization Regional Office for Europe, Copenhagen, Denmark.

N Tiwari, C M Adhikari, A Tewari and V Kandpal (2006), *Investigation of Geo-spatial hotspot for the occurrence of Tuberculosis in Almora District* International Journal of Health Geographics VOL.5 NO.33.

P K Moonan, M Bayona and T N Quitugua (2004), *Using GIS Technology to identify areas of tuberculosis transmission* International Journal of Health Geographics Vol. 3 No. 23.

United States Embassy in Nigeria (2012), Nigeria Tuberculosis Facts Sheet http//Nigeria.usembassy.gov retrieved on 26/01/2014.

World Health Organization (2010), *Global Tuberculosis Control*, WHO Report, Geneva, Switzerland.