Assessment of the impact of ungoverned spaces on insurgency in Borno State, Nigeria

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Abstract

This study examines the relationship between ungoverned spaces and insurgency in the Borno State, Nigeria. The aim is to understand the influence of geographical variables on the activities of insurgence. The study used satellite data, population data and data on insurgency attack in the study area. Normalized Difference Vegetation Index, percentage rise in slope analysis and reclassification were used for the satellite data processing. Geographically Weighted Regression (GWR) models was employed for data analysis. The findings revealed that LGAs in the central and the southern parts of the state recorded the highest number of insurgency attacks. The central and far northern part of the state has more vegetal cover, which has influenced the high incidence of insurgency attack observed. In addition, the very high incidence of insurgency attack (145) observed in Gwoza LGA, is largely attributed to the presence of the Gwoza Mountain, which is one of the main strong holds of the insurgents in Borno State. The GWR analysis reveals that the performance of the model with the population density was much better than the other variables with a corrected Akaike Information Criterion (AICc) value of 273.15, R-Squared values of 0.0323, 0.0224, 0.0203 and 0.8901 for the undulating terrain, vegetation, combination of vegetation and undulating terrain, and population density respectively. Thus, the study concludes that vegetal cover and population density have more influence on insurgency attack in the study area. Hence, the need for policy makers and security establishments to properly monitor the forested areas.

Key Words: Ungoverned Spaces, Insurgency, Geographical Variables, Borno State

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Introduction

Ungoverned areas are physical or nonphysical areas where there is absence of state capacity or political will to exercise control. Ungoverned territories are generally rugged, remote, maritime, or littoral areas not effectively governed by a sovereign state. As an emerging and contested area of discourse, ungoverned space resonates constant global debate being an issue surrounding global security challenges (Lenshie, 2018). Rabasa (2007) refers to ungoverned space as an area of abdicated governance. Abdicated in situations when a government, either by choice or force, abandons its control leaving an area relatively lawless (Menkhaus, 2007). The resulting ungoverned space may remain partially governed, or ineffectively governed (Olaniyan and Akinyele, 2017). In such a situation, the government abdicates to some degree and still maintains the intent to govern (Whelan, 2006a). Alternatively, an adversarial group, such as criminals, a terrorist organization or an insurgent group, may take up governance of the area resulting in contested governance (Rabasa, 2007). Whatever the outcome, ungoverned space can be seen in most instances as a failure of capacity by a sovereign state to exercise effective control over a geographic area within the state (Forest, 2010).

Ungoverned spaces abound worldwide. The virtual or cyber haven is an ungoverned space, which rely on physical infrastructure but exists in the nebulous world of cyberspace. They exist and operate evading detection not as a physically contiguous space, like a remote, urban, or maritime area, but as a network (Hoiston, 2012). A plethora of armed militias and sea pirates also abound setting up bases on seas, creeks, swamps and river channels (ungoverned space) in the violent campaign/agitation or the perpetration of one form of heinous crime or the other (Lenshie, 2018). The Taliban in Afghanistan and the Revolutionary Armed Forces of Colombia in Northern Ecuador use mountains and forests respectively as their safe havens (Theresa, 2006). In the Sub-

Saharan Africa region (West Africa), ungoverned space exists between North Africa, Sahel region (ungoverned territories) and the Sahara Desert, where criminals transit and governments do not have the capacity to control such movement (Southern Pulse, 2011).

Forest (2010) identified a more complex modern security challenge regarded as a 'zone of competing governance' or a 'region with parallel governance structures' an area that is governed by entities other than the forces of an established nation-state. According to Rabasa (2008), these hybrid zones of competing governance (both rural and urban) comprise several cities and rural parts of a particular region. Cronin (2009) cautions that ungoverned spaces should not only be taken to mean isolated regions of inhospitable terrain where governments cannot reach, but also in migrant and immigrant populated slums and inaccessible border regions of well governed states. They guarantee some semblance of order and security, provided by entities who are often suspicious of outsiders, and who draw on local disenchantment (or even hostility) toward a corrupt, ineffectual or completely absent nation-state regime (Patricia and Poplack, 2008).

Insurgency as a social science concept has been given many conceptions. However, insurgency is one element of the spectrum of political violence (O'Neill, 1990; Hammes, 2006; Reed, 2007). O'Neill (1990) defined insurgency as a struggle between a non-ruling group and the ruling authorities in which the non-ruling group consciously uses political resources and violence to destroy, reformulate, or sustain the basis of one or more aspects of politics. Insurgents have the "nihilistic goal of ensuring the government cannot function. Insurgency is further seen as an organized use of subversion and violence to seize, nullify or challenge political control of a region. As such, it is primarily a political struggle, in which both sides use armed force to create space for their political, and economic activities to be effective (Blanchard, 2014). The goal of insurgency

is to confront and overthrow an existing government for the control of power, resources or for power sharing (Siegel, 2007).

Insurgents seek to subvert or displace the government and completely or partially control the resources and population of a given territory. They do so using force (guerrilla warfare, terrorism and coercion/intimidation), propaganda, subversion and political mobilization (UNPD, 2017). Insurgent activity is designed to weaken government control and legitimacy while increasing insurgent control and influence (Mustapha, Ummu and Mohammad, 2018).

The Nigerian nation state had never enjoyed an appreciable period of stability that could guarantee security and sustainable development. In the last two decades, Northern Nigeria has been a major epicenter of violence (Abdu, 2010). Until recently, Boko Haram terrorists relied on the Sambisa forest and Gwoza Mountains to launch attacks against state and civilian targets. The Sambisa forest (said to be the size of Belgium), Fagore, Kamuku, Kiyanbana forests, Duste forest, Rijana forest along Kaduna - Abuja express way and Dajin Rugu, a forest stretching from Birnin-Gwari in Kaduna State through Katsina to Zamfara forests are some of the ungoverned spaces in Northern Nigeria. Bandits hold sway in these climes; terrorists, smugglers capitalize on the porosity of such places to smuggle Small Arms and Light Weapons (SALWs) (Adewuyi and Daful, 2021; Olaniyan and Akinyele, 2017).

Some parts of Borno State are ungoverned spaces exploited by insurgents who exploit geographic spaces in the area to hone their militant capabilities, spread chaos into surrounding states, and sometimes impose their hardline version of sharia (Islamic law) (Pragati, 2015). The state has continued to experience conflicts, ranging from small-scale communal and ethno-religious violence to high intensity insurgency of the Maitatsine in 1980s and Boko Haram in recent years

(Abdu, 2016). By the end of 2014, this insurgent group had controlled 14 districts becoming the most dangerous insurgent group that Nigerians ever had (Ardo, 2015; Ewokor, 2015).

This Insurgent group mostly youths from the Northern parts of Nigeria and refugees from neighboring African countries of Chad and Niger Republic explore the socio-economic negativities of the country to recruit and radicalize its members to carry out their nefarious activities (Adesoji, 2011). They indulge in the acts of killing, arson, bombing and shooting targeting important public institutions like markets, churches, mosques, schools, police stations and government, private and public owned facilities with a kind of guerilla warfare tactics. Since the occupation by this insurgent group in 2013 most of these, forests and game reserves have not been under any kind of effective forest management control. Not only did the insurgents establish their headquarters inside the forest, but they also established various camps within its confines (Aju and Aju, 2018).

Despite government policies, measures and huge investment in crime monitoring and prevention, the challenge has continued to escalate constituting a huge embarrassment to the people and Government of Borno State (Aju and Aju, 2018). Hence, the failure to understand why these spaces exist and persist may lead government and policy makers as well as security agents to undermine the danger they pose. The tendency of governments to view forested areas as peripheral places containing few people and being of little political importance or economic value could be an attributable reason according to Aju and Aju (2018). Aju and Aju (2018) are of the view that more often than not, the only interest governments have in such areas is to extract woods, timber or minerals. As a result, forested areas are traditionally poorly integrated into the national political processes and consequently, receive few public services (USAID, 2005). Many violent outbreaks of insurgency in such areas are, therefore, the result of long-standing government neglect or a weak

and ineffective presence of central authorities. Such situations leave room for criminals, political activists or insurgents and other groups to fill the void (FAO, 2005).

In several cases also, governments have often taken insurgents for granted or only made perfunctory efforts to control them as long as they remained in remote forested areas, believing that sustained military campaigns in areas of little strategic importance are too costly. It was however, under such situation as this, that insurgent group in countries such as Nigeria, Colombia, Nepal and the Philippines were able to build up military capacity (FAO, 2005). On the other hand, Aju and Aju (2018) point to the fact that areas within countries that are most likely to experience insurgency tend to be those with characteristics that provide the means or motives for crime. Such areas include secluded places where criminals or insurgents can hide and exploit valuable natural resources to finance their nefarious activities. In addition, such areas also tend to be remote and inaccessible and are capable of providing refuge, funds and food for its members (FAO, 2005). It is not surprising, therefore, that several research findings on insurgency show that many violent crimes often occur in forested areas particularly in poor countries (Aju and Aju, 2018).

Although the socio-political, socio-economic and socio-cultural consequences of these insurgency problems have been widely reported by many researchers, their environmental consequences have only received cursory attention. Outside the wide coverage of forest occupation by insurgents in the mass media, the consequences of such occupation itself has never been given any serious consideration. Forest occupation by the insurgents and indeed the use of forests in general as hideouts for criminal elements is throwing up a disturbing and worrisome challenge for security of lives and property in Borno State. However, no none study have been caried out on the impact of geographical variables on insurgency in Nigeria and Africa as whole, thus crate a gap in knowledge for a study such as this. The question that begs for answer is “what are the geographical

or ecological characteristics of an ungoverned spaces that have aided insurgency in the Borno State and how has such ungoverned spaces affected the activities of insurgence in the Borno State. Answers to these questions will no doubt help the government, security agents, authorities concerned with new means of confronting such menace. This research, therefore, assesses the impact of ungoverned spaces on insurgency in Borno State, Nigeria. It seeks to provide an in-depth study on the geographical characteristics therein and other geographic factors that have been disturbed because of the insurgent activities between the state and the non-state actors within the study area. The ultimate aim of the study is to raise the consciousness of government, policy makers and natural resource managers on the influence of geographical variables on the activities of insurgence groups in the Borno State, Nigeria. Thus, the research examines the environmental determinism of the activities of insurgency.

Study Area

The Borno State is located between Latitude 10^0 58$^{'}$ E to 13^0 58$^{'}$ E and Longitude 11^0 25$^{'}$ N to 14^0 50$^{'}$N on a terrain elevation (height) of 4350 feet at 10^0 07$^{'}$ N and 13^0 16$^{'}$ E. with an aerial extent of about 70,898,000km^2. The state is bordered to the North by Niger Republic and to the East by the Lake Chad region and the Republic of the Cameroun. In the South, Adamawa borders Borno State and Gombe States while to the West by Yobe State (City population, 2018) as shown in Figure1. These borders are poorly manned, thus allowing for the easy cross-border movement of small arms and light weapons. Chad and Niger in particular have been badly affected by internal conflict, and this has had grave implications for Nigeria's security as it relates to these particular borders.

Borno State located within the Sahel and Sudan savannah vegetation zones has a semi-arid climate, with a dynamic physical setting, which arises from an amalgam of factors relating to location, geology, climate as well as the intensity of resources exploitation in the area. It lies almost entirely within the Lake Chad Basin typographic formation, which is an area that was formed because of down warping during the Pleistocene period. The Chad Basin is a shallow depression of about 2.5 million square kilometers encircling the Lake Chad in the heart of the central Sudan (Adelekan 1998). The Basin and its hydrological catchment area span Borno, Yobe, Jigawa, Kano and Plateau States. About 17 million people occupy it with most being farmers, pastorals and fishermen (Oladipo 1996). However, Borno State accounts for more than 75% of the Basin area.

Borno State has two basic relief formations consisting of the highlands of the Biu Plateau and Mandara mountains to the southern part rising to about 650m above sea level and the vast Lake Chad plains covering northern part of the State with an average height of 300m above sea level.

Borno is often honored as the gateway to Islam in Nigeria, as Islam was declared a state religion in Kanem Borno as early as the eleventh century (Alkali, 1987). Thus, the people of Borno are predominantly Muslims. Sunni Islam of the Tijaniyya order is the main practice, although there have been rapid inroads by the Izala (Salaf) in the last few decades. Christian missionary activity in the southern part of the state in the early part of the twentieth century has also resulted in a sizeable population of Christians in the state, producing a distinct cultural landscape. Contact with the West has become a dominant factor in not only the Borno State's socio-cultural and religious differences, it also reflects on the differential level of development within the state. The southern part of the state is more advanced in formal education and, therefore, shows better social development indicators. The literacy rate for men in Borno was observed to be 41.7% against a national average of 75.2%, while that of women was 22.2% as against a national average of 53.1%

(Muhammad, et al., 2009). Recent data on economic indicators disaggregated according to states hardly exist, but a recent General Household Survey Panel estimated that 50.2% of the people in the northeast are poor (World Bank, 2014). More specifically, in 2010 the National Bureau of Statistics estimated that 55.1% of the people in Borno earned less than one US dollar a day (National Bureau of Statistics, 2012). In terms of health indicators, the current conflict in the state has had a negative impact on healthcare delivery.

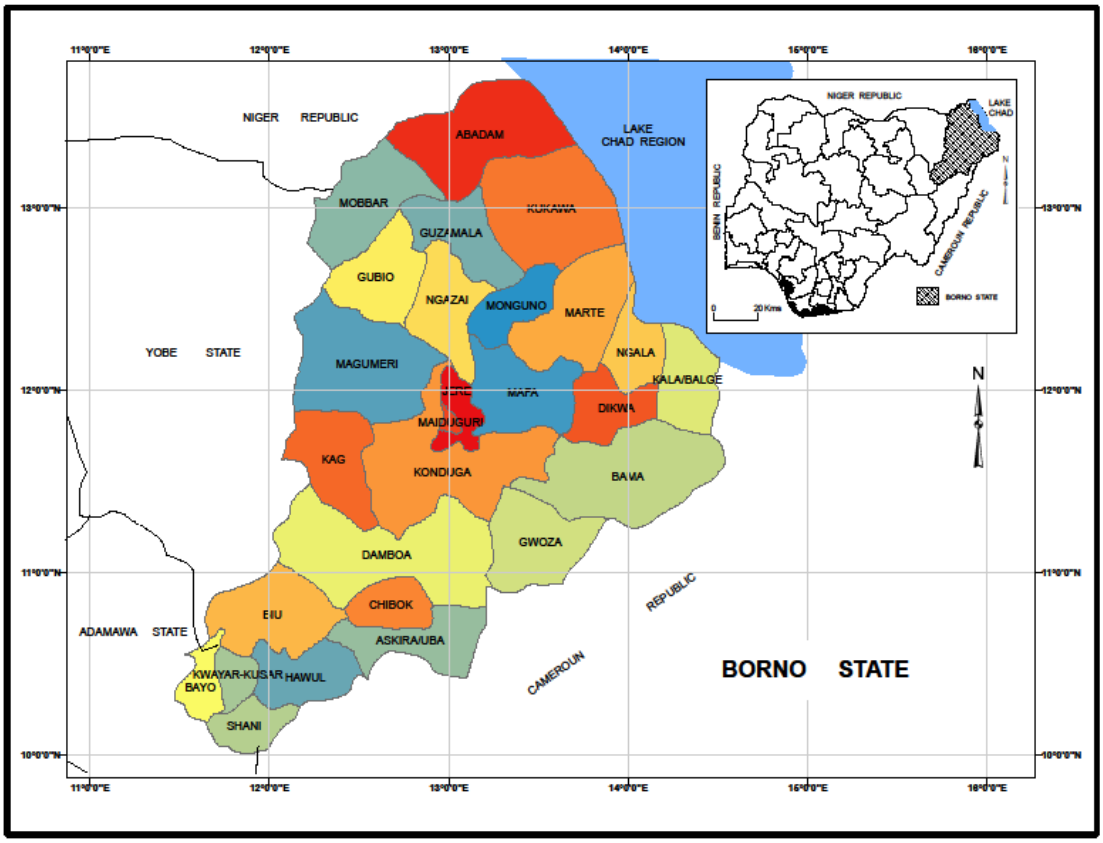

Figure 1: Borno State. Nigeria
Source: Department of Geography NDA, Kaduna (2019).

Materials and Methods

By their nature, factors that influence insurgency emanate from spatial and non-spatial dimensions. The non-spatial factors are more associated with the existing population, economic, socio-cultural,

religious and political contexts. Spatial factors are more associated with geographical location because insurgency activities can be positively or negatively influenced by geographical attributes, such as vegetation cover, terrain and demographic ones. Thus, this study focuses on the spatial factors and seek for information on the spatial pattern and density of vegetation cover, percentage rise in slope, population density and the number of insurgency attacks in each Local Government Area of the state from 2009 to 2017.

Materials and Data Sources

Data used for this study were obtained mainly from documentary sources. Data on the vegetation cover was derived from Landsat 8 (OLI) imagery of December 2019, downloaded from USGS earth explorer site. Data on the percentage rise in slope was derived from Digital Elevation Model (DEM) with a resolution of 30m, equally acquired from the USGS earth explorer site. Information on the population density was acquired from the Nigeria National Population Commission, and Armed Conflict Data (ACLED) was utilized for data on the spatial distribution of insurgencies activity in Borno State from 2009 to 2017. The ArcGIS 10.6 software provided the platform or environment for the data analysis.

Data Processing and Analysis

Data Sub-setting: Band 4, Band 5 of Landsat 8 image of December 2019 and the Digital Elevation Model (DEM) data covering the Borno State, were sub-set for each of the Local government area in the state, this was to aid easy analysis of the vegetation cover and the percentage rise in elevation in each of the local government areas.

Vegetation Cover: This was done to ascertain the percentage of vegetation cover in each of the local governments, the study utilized the concept of Normalized Difference Vegetation Index (NDVI), using band 4 and band 5 of landsat 8 (OLI) image.

The model used in estimating NDVI is; NIR - PAR / NIR + PAR ---------- 1

This formula yields a value that ranges from -1 (usually water) to +1 (strongest vegetative growth.)

where; NDVI - Normalized Difference Vegetation Index, NIR - Near Infrared band imagery, PAR- Photosynthetic Active Radiation band imagery.

Nevertheless, in this study, the Red band imagery was used as the PAR. Thus, the formula is;

NDVI = NIR - Red / NIR + Red ---------- 2

Thus, R band 5 and R band 4 are the land surface reflectance in the near infra-red and the visible bands respectively;

The raster calculator option of the spatial analysis tool in ArcGIS 10.6 was utilized for the NDVI calculation.

Elevation: The digital elevation model data was used to calculate the percentage rise in slope utilizing the slope function of the surface tool in spatial analysis tools in ArcGIS Software. The percentage rise in slope was utilized to determine mountainous areas, areas with steep valley and flat or relatively flat terrain.

Reclassification: The calculated NDVI were reclassified into 3 classes; the study area located in the Sahel and Sudan savanna region which is generally characterized by sparse and stress vegetation. Thus, areas with NDVI value above 0.2 were classified as vegetation cover area, areas with NDVI values between 0 and 0.199 were classified as bare soil, rock and built-up area, while areas with negative NDVI values were classified as water body (Myneni, Hall, Seller and Marshak,

1995). The reclassify pixels for the vegetation class, were used to ascertain the land area covered by vegetation in each of the LGAs, this was achieve using the raster calculator tool in ArcGIS software.

For the percentage rise in slope, the study classifies the slope into two, areas with percentage rise in slope less than 10% were classified as relatively flat terrain. Whereas areas with percentage rise in slope above 10% were classified as rough terrain, which encompasses mountains and valleys. These were achieved using the reclassify tool in ArcGIS software. The area with the rough terrain was then clip out, forming a new raster image. This was used to calculate the area of the surface with rough terrain and its percentage cover in each of the local government, equally utilizing the raster calculator tool.

Data Analysis

Cross tabulation correlation, Ordinary Least-Squares (OLS) regression and Geographically Weighted Regression (GWR) models were employed to examine the relationships of the insurgency attack with vegetation cover, rough terrain and population density. Thus, the dependent variable will be the insurgency attack, while the independent variables are the percentage of vegetation cover, percentage of rough terrain and the population density. This was achieved utilizing the spatial statistics tool of the ArcGIS 10.6 software. Data are presented using tables and maps.

Results and Discussion

The foremost task of graphical analysis in assessing the impact of ungoverned spaces on insurgency activities is to analyses the geographical terrain and its features as it relates with insurgency attacks. This was to ascertain the relationship between insurgency with the

geographical variables, such as vegetation, undulating terrain and population density. Thus, the study considered the area with vegetation cover and undulating terrain to be having high chances of being ungoverned as Olaniyan and Akinyele (2017) observed that Boko Haram terrorists relied on the Sambisa forest and Gwoza Mountains to launch attacks against state and civilian targets. They use the forested and mountainous areas as spaces to establish havens and training camps for their nefarious activities. Table 1 shows the various geographical characteristic of each local government in Borno State. Figures 2 to 6 show the spatial distribution of the population density, incidence of insurgency, vegetal cover, undulating terrain, vegetal cover and undulated terrain (potential ungoverned space).

Table 1. Geographical Characteristics and Insurgency Incidence in the study area

LGAs	Area (Sq. KM)	Insurgency Incidence	Population	pop density (per Sq. KM)	Percentage Vegetation	Percentage Undulating	Percentage Vegetation/ Undulating
Abadam	4611.35	23	100180	21.72465764	9.830232	0.174032	10.00426
Asikira	2371.22	45	138091	58.23626656	7.853043	2.192674	10.04572
Bama	5328.73	143	269986	50.66610618	7.03632	0.010588	7.046908
Bayo	969.67	0	78978	81.44832778	2.313513	25.28971	27.60322
Biu	3169.74	54	176072	55.54777363	0.635829	12.14914	12.78497
Chibok	1371.72	29	66105	48.19132184	1.56712	0.474052	2.041172
Damboa	6283.29	108	231573	36.85537354	3.43986	0.255664	3.695524
Dikwa	1766.94	29	105909	59.93921695	4.261175	0.009979	4.271154
Gubio	2545.44	5	152778	60.02027154	0.013425	0.099778	0.113203
Guzamala	2321.84	21	95648	41.19491438	2.700265	0.150405	2.850669
GwoZa	3024.42	145	276312	91.36032694	7.084068	2.297335	9.381403
Hawul	2091.2	35	120314	57.5334736	0.779989	46.53718	47.31717
Jere	890.07	19	211204	237.289202	5.085503	0.243528	5.32903
Kag	2687.47	28	90015	33.49432738	1.396024	0.000327	1.396351
Kala	2023.96	24	60797	30.03863713	0.287922	0.007023	0.294945
Konduga	5677.54	76	156564	27.57602765	3.837691	0.055086	3.892777
Kukawa	5005.25	38	203864	40.73003346	9.646465	0.623206	10.26967
Kwayar	750.39	1	56500	75.29418036	0.532827	24.10666	24.63949
Mafa	2880.94	42	103518	35.93202219	8.873399	0.166269	9.039668
Magumeri	5037.12	34	140231	27.83951941	0.300076	0.036973	0.337048
Maiduguri	142.59	413	521492	3657.283119	4.132439	0	4.132439
Marte	3545.22	26	129370	36.4913884	10.42684	0.237175	10.66402
Mobbar	3233.26	22	116654	36.079375	7.617238	0.183209	7.800446
Monguno	1548.56	24	109851	70.93751614	1.43058	0.023393	1.453973
Ngala	1518.49	46	99799	65.72252698	5.437219	0.087252	5.524471
Ngazai	2440.34	24	237071	97.14670907	0.064551	0	0.064551
Shani	1225.82	7	102317	83.46820904	1.107321	16.14539	17.25271

Relationship between Insurgency and Population Density, Vegetal Cover and Terrain

Traditional statistical methods such as Pearson correlation, Spearman rank correlation and Ordinary Lease Square (OLS) are used to produce only global relationship because they do not have the capacity to model spatially varying relationships in data (Brown et al., 2012; Su et al., 2012; Javi et al., 2013). This study employed cross tab correlation to determine the existence of

relationship between the incidence of insurgency attack with Vegetation, Undulating Terrain, a combination of Vegetation and Undulating Terrain and Population Density in the Borno State. Table 2 shows the correlation coefficients.

Table 2: Cross Tabulation/OLS Regression

Variables	Incidence of Insurgency Attack
Vegetation	0.148
Undulating Terrain	-0.179
Vegetation and Undulating Terrain	-0.142
Population Density	0.883

Based on the findings from Table 2, it is observed that the percentage of vegetation showed a weak positive correlation (0.148) with the incidence of insurgency attack. The percentage of undulating terrain and the combination of the undulating terrain and vegetation (potential ungoverned spaces) with the incidence of insurgency attack both shows weak negative relationship with a coefficient of -0.179 and -0.142 respectively; whereas the incidence of the insurgency attack with population density showed a very strong positive correlation of 0.883.

Population density is one of the most important variables in the study of the impact of ungoverned space on insurgency. This is because most insurgents usually look for areas with high population to strike. Thus, this study analyzed the population density of each Local Government Area (LGA) in the Borno State. The study categorized the population density into 5 classes, LGAs with population density of less than 40 people per sq km are classified as very low population density, between 40 to 59 are classified as low population density, between 60 to 79 are classified as being medium population density, 80 to 99.9 are classified to be having high population density and LGAs with population density above 100 people per sq km are classified to be having very high density (see Figure 2). The findings reveal that 33.33% of the LGAs have very low population

density, 29.64% have low population density, and LGAs with medium and high population density both have 14.81%, while 7.41% of the LGAs have very high population density. This implies that most of the LGAs has low concentration of people, thus, might have most of its area with the potentials of being ungoverned. The spatial distribution of the population density as shown in Figure 2, which reveals that only the central part of the state has LGAs with very high population density, though both the northern and southern parts of the state have LGAs with high and medium population densities. In addition, the findings depicted in Table 2 show that population density has a strong positive relationship with insurgency attack.

The frequency of insurgency attack in each LGA is the most important index in assessing the impact of ungoverned space on insurgency. This is because without information on the frequency of occurrence, relationships and influences cannot be ascertained. Thus, this study categorized the incidences of insurgency into six classes. 14.82% of LGAs had no or less than 10 insurgency attacks, only Kwayar-Kusar LGA has between 11 to 20 attacks, about 37% of LGA had between 21 to 30 attacks, 11.11% LGAs had between 31 to 40 attacks, also 11.11% LGAs had 41 to 50 attacks and 22.22% LGAs had over 50 insurgency attacks. This implies that over 20 LGAs had more than 20 attacks. The spatial analysis of the finding as shown in Figure 3 reveal that LGAs with over 50 insurgency attacks are in the central and southern part of the state, most LGAs in the northern part of the state had between 21 to 30 insurgency attacks, LGAs with less than 10 insurgency attacks are in the far southern part of the state except for Gubio LGA in the northern part of the state.

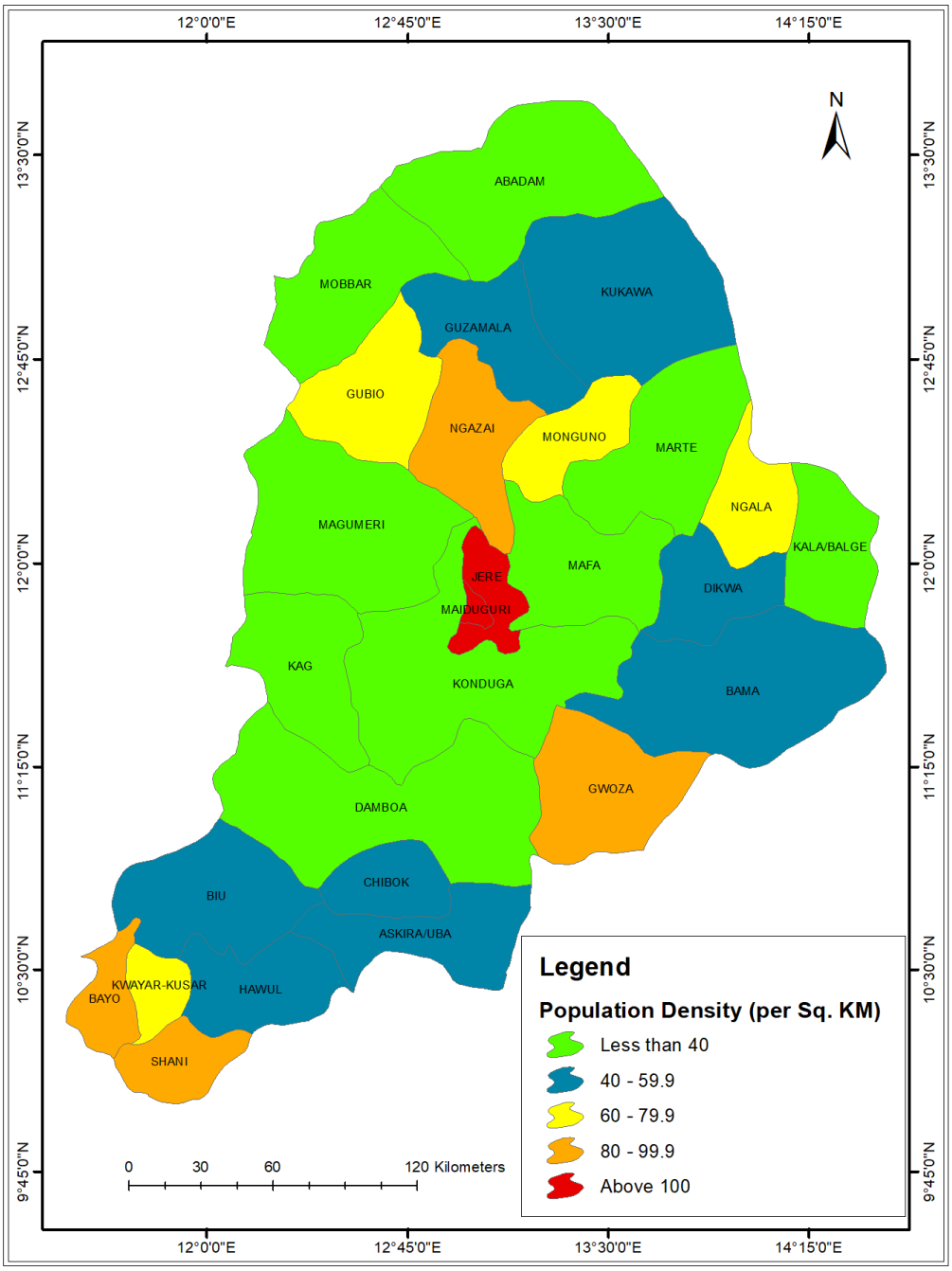

Figure 2: Population Density Distribution in the Borno State

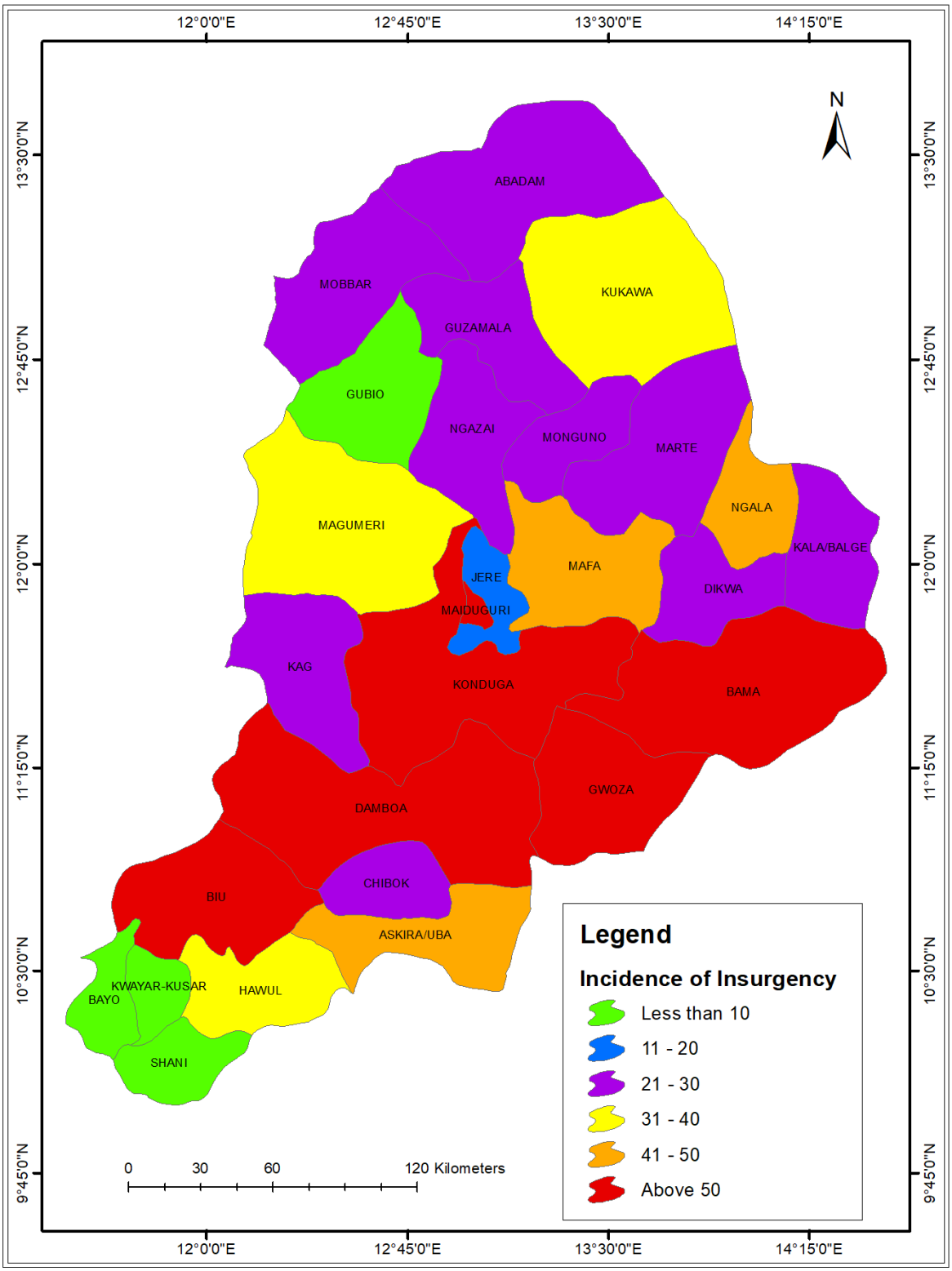

Figure 3: Spatial Distribution of Incidences of Insurgency Attack in Borno State

Vegetation cover is one of the most essential variables in defining an ungoverned space, this is because most insurgents used it for seal and concealment, for training and to launch attack on targeted population. However, vegetal cover exhibits a weak positive relationship with insurgency attacks, with a correlation value of 0.148. The findings further reveal that about 26% of the LGAs have less than 1% of their land area covered with vegetation. 29.63% LGAs has their land area cover with between 1 – 3.9% vegetal cover, also another 29.63% of the LGAs has their land area covered with between 4 – 7.9% vegetal cover. Whereas 14.81% of the LGAs has their land area covered with above 8% vegetal cover.

The finding further reveals that Gubio LGA has the lowest percentage vegetal cover (0.0134%), this might have attributed to the low incidence of insurgency attack in the LGA. Whereas, Marte LGA has the highest percentage vegetal, with 10.4268% of its land area covered with vegetation, this might be attributed to the high number of insurgency attack experience in the LGA despite its low population density. The spatial analysis of the distribution of the vegetal covered as shown in Figure 4 reveals that the central and far northern part of the state has more vegetal covered than the southern part of the state. This might have influenced the high incidence of insurgency attack observed in the central LGAs of the Borno State and the lowest incidence observed in the far southern part of the state. This agrees with the findings of Theresa (2006) that Taliban in Afghanistan and the Revolutionary Armed Forces of Colombia in Northern Ecuador used mountains and forests respectively as their safe havens. Furthermore, Usman and Yusuf (2021) identify forested ungoverned spaces as areas used for the proliferation of small arms and light weapon.

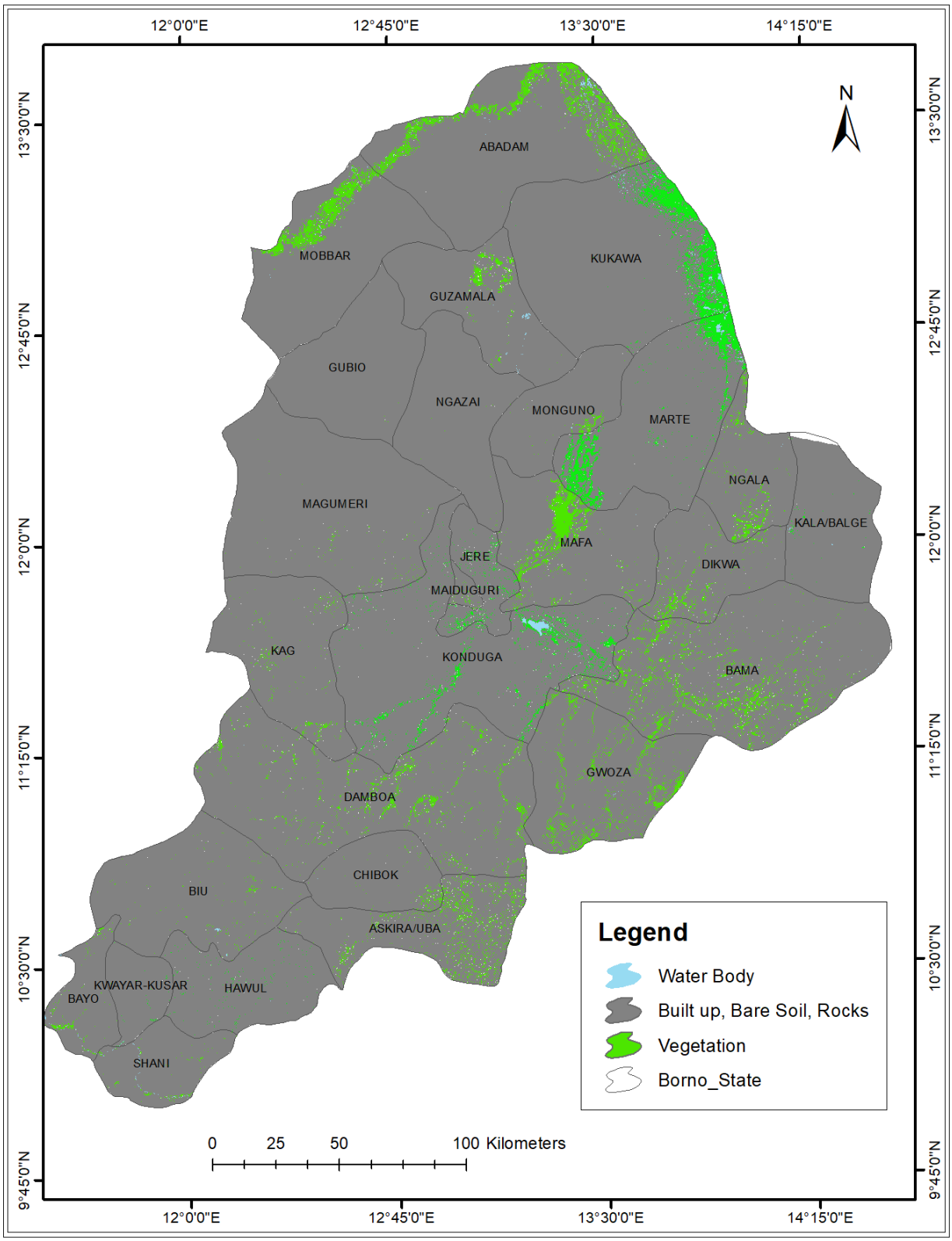

Figure 4: Spatial Distribution of Vegetal Cover in Borno State

Undulating terrain are generally features of mountains, valleys and rocky terrains. Which are equally very important index in defining an ungoverned space as posited by Whelan (2006b). This is because just as insurgents used vegetation for seals and concealment, they equally use undulating terrains for it too. Thus, this study characterizes the terrain of the study area into two, relatively flat terrain and undulating terrain. The findings from Table 1 reveal that most of the LGAs about 74% has their land area with less than 1% undulating terrain, thus, over 99% of their land area is relatively flat and only 18.52% of the LGAs has above 10% of their land area covered with undulating terrain.

Further analysis of the findings reveals that Ngazai and Maiduguri LGA have all of their land area covered with relatively flat terrain, while Hawul LGA has the highest percentage of land area covered by undulating terrain (46.54%). This might have influenced the high incidence of insurgency attack observed in Hawul LGA. Similarly, Olaniyan and Akinyele (2017) observed that Boko Haram terrorists relied on the Sambisa forest and Gwoza Mountains to launch attacks against state and civilian targets. Thus, the very high incidence of insurgency attacks (145) observed in Gwoza LGA is largely attributed to the presence of the Gwoza Mountain, which is one of the strongholds the insurgence in the Borno State use for their training and to launch attack on targeted population. The spatial analysis of the undulating terrain as shown in Figure 5 reveals higher concentration in the southern part of the state. Thus, this might be attributable to the number of attacks observed in these areas. However, the relationship between the percentage of undulating terrain and incidence of insurgency attacks shows a week negative relationship (-0.179).

Equally, the study analyzes the combination of vegetation and undulating terrain, which are both vital indices of defining an ungoverned space. The findings as shown in Table 1 and Figure 6

reveal that 14.81% of the LGAs has less than 1% of its land area covered with both vegetation and undulating terrain, about 30% of the LGAs has between 1 to 5 % of its land area covered with both vegetation and undulating terrain, 22.22% of the LGAs has between 6 to 10 % of its land area covered by vegetation and undulating surface and 33.33% of the LGAs has over 10% of their land area covered by vegetation and undulating landscape. The finding equally reveals that Ngazai and Gubio LGAs had the lowest land covered with the potential of being ungoverned, while Hawul LGA has the highest land cover with the potential of being ungoverned. Equally, the relationship between the combination of vegetation and undulating terrain shows a week negative correlation (-0.142) indicating a week association.

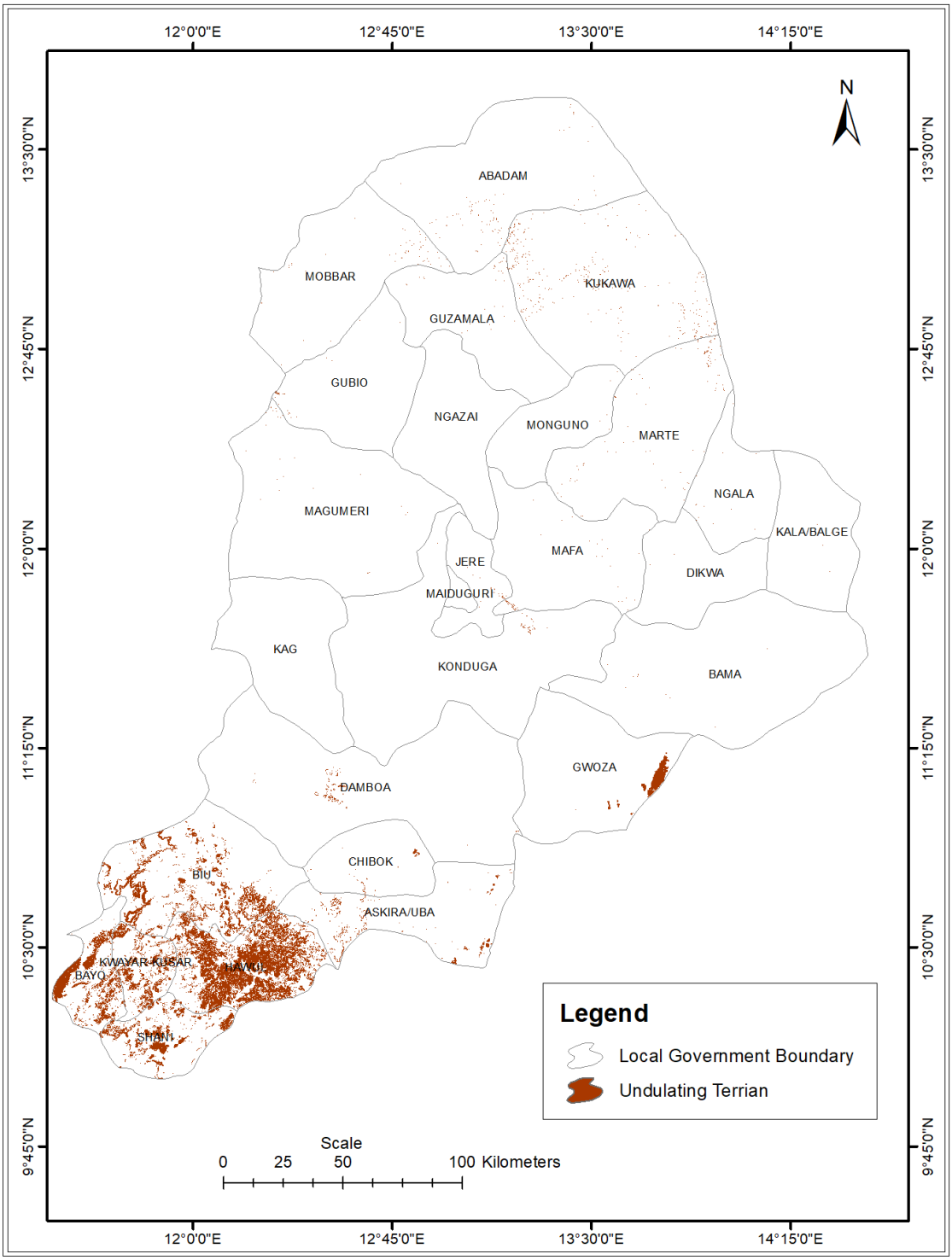

Figure 5: Spatial Distribution of undulating Terrain in the Borno State

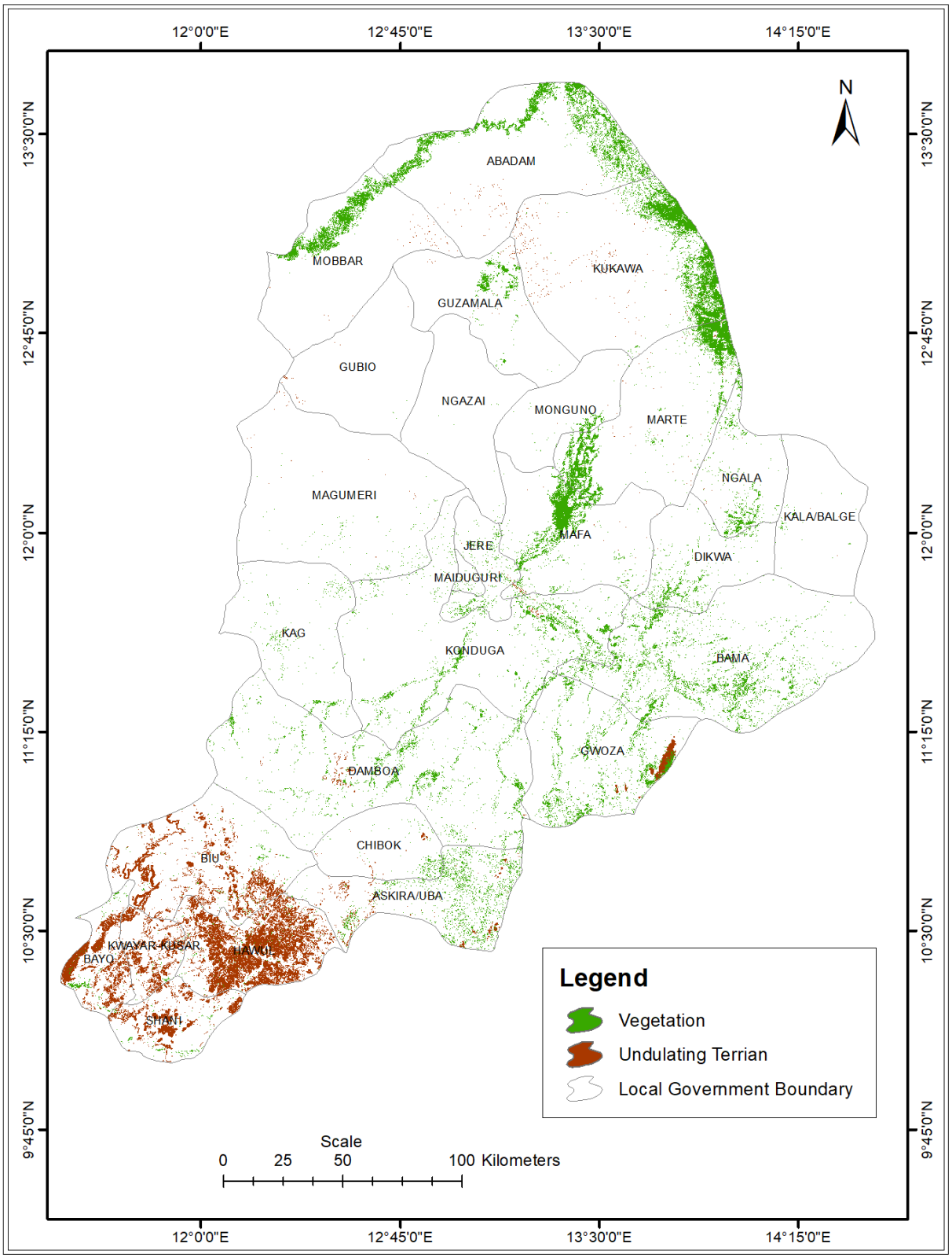

Figure 6: Spatial Distribution of both Vegetation and Undulating Terrain (Potentially Ungoverned)

Examining spatially varying Relationship between Insurgency and Geographical variables

Geographically Weighted Regression (GWR) was used to ascertain the spatial variation in the relationship between the incidence of the insurgency attack with Vegetation, Undulating Terrain, a combination of Vegetation and Undulating Terrain and Population Density. The finding reveals corrected Akaike Information Criterion (AICc) values of 319.00, 319.28, 319.34 and 273.15 for undulating terrain, vegetation, combination of vegetation and undulating terrain, and population density respectively. This implies that the model performance for vegetation and undulating terrain is relatively the same, but the performance of the model with the population density performs better than the others with an AICc value of 273.15.

The findings also reveal R-Squared (R^2) values of 0.0323, 0.0224, 0.0203 and 0.8901 for the undulating terrain, vegetation, combination of vegetation and undulating terrain, and population density respectively. This implies that only the population density has about 90% of the proportion of dependent variable variance accounted for by the regression model, while the others have less than 5% of the proportion of dependent variable, variance accounted for by the regression model. Figures 7 to 10 show the spatial variation of the deviation in standard residuals for the GWR analysis of the relationship between incidence of insurgency attack with Vegetation, Undulating Terrain, Combination of Vegetation and Undulating Terrain and Population Density.

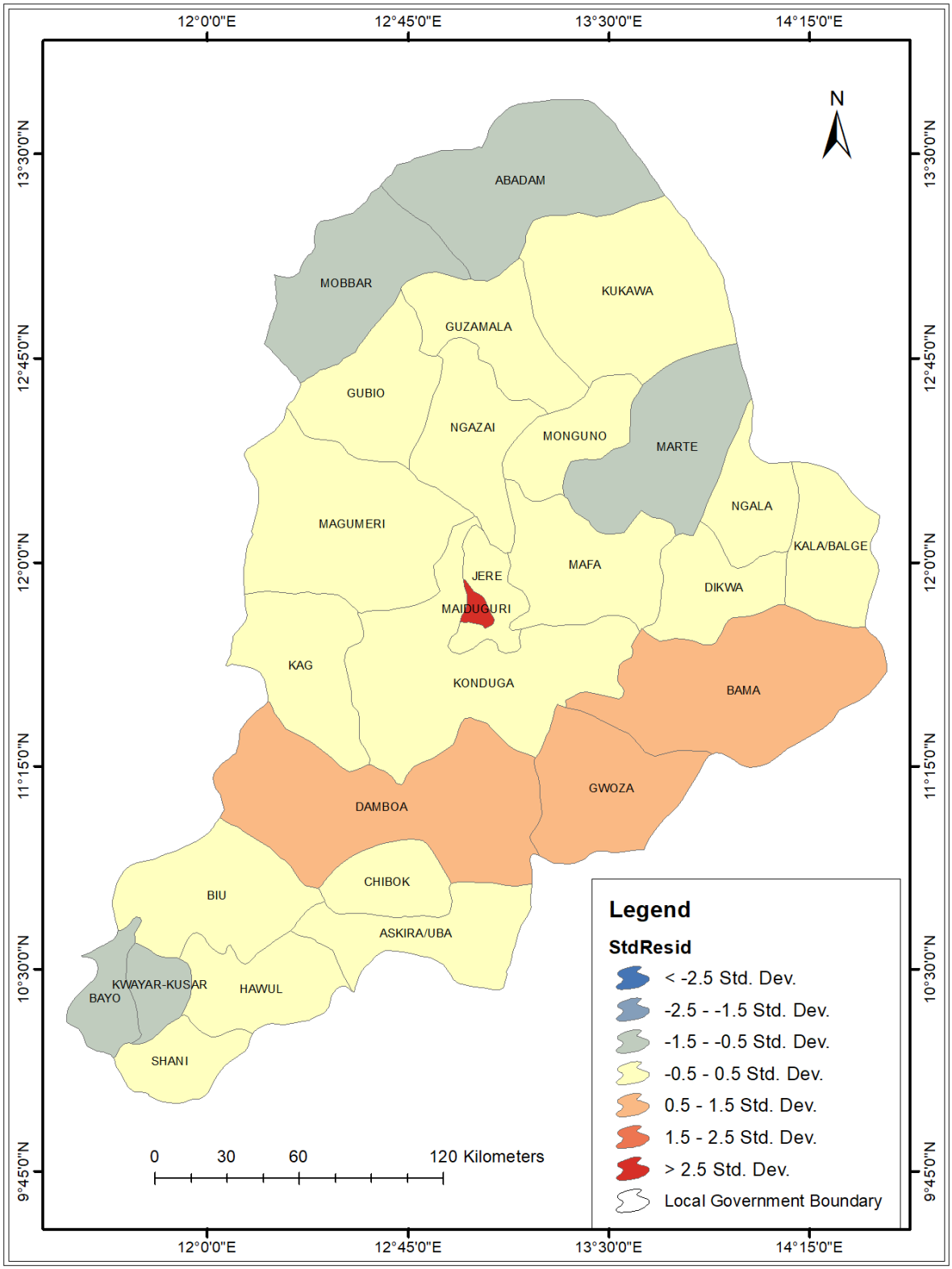

Figure 7: Spatial Variation in Standard Residuals for Incidence of Insurgency with Vegetation

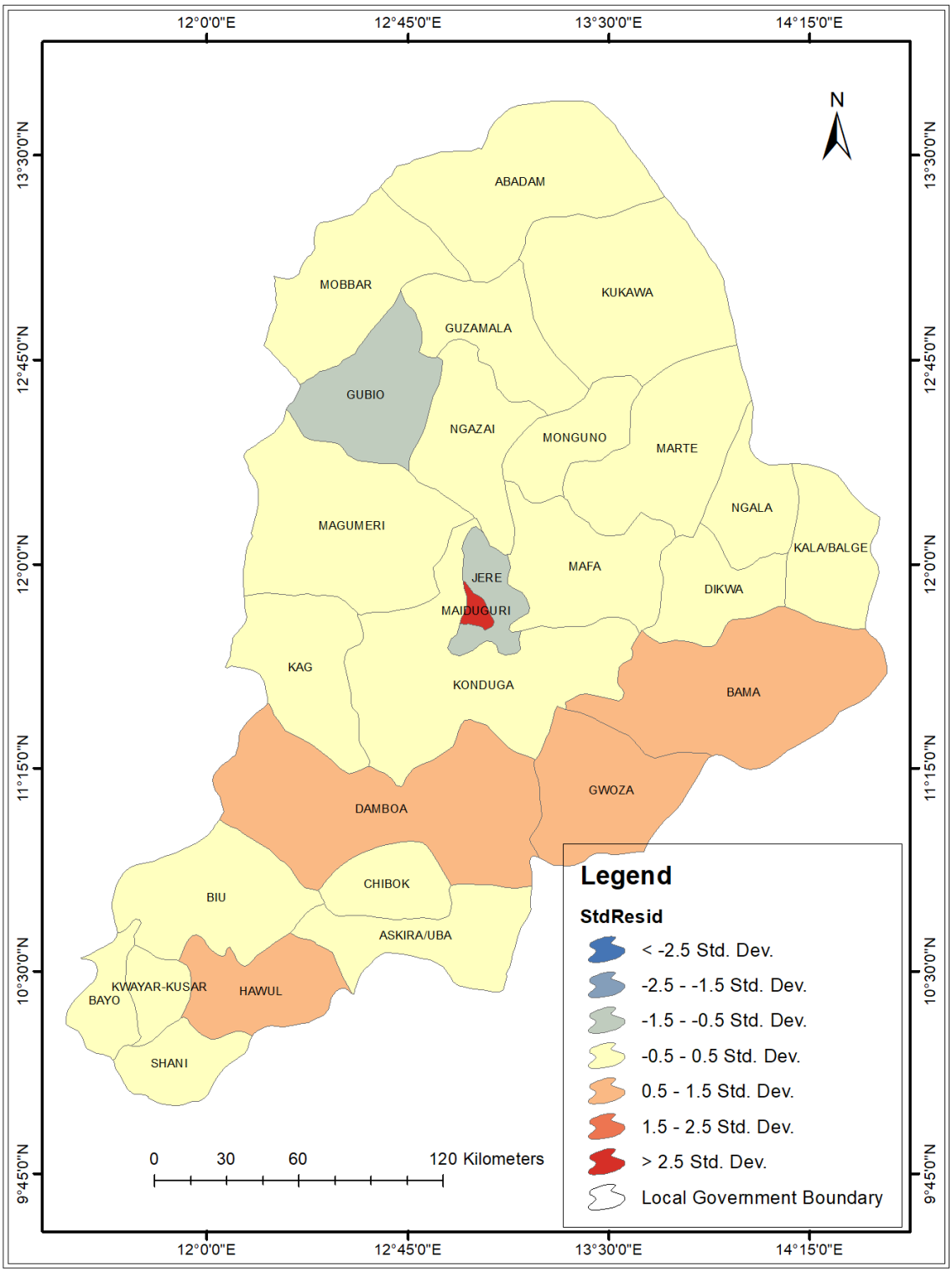

Figure 8: Spatial Variation in Standard Residuals for Incidence of Insurgency with Undulating Terrain

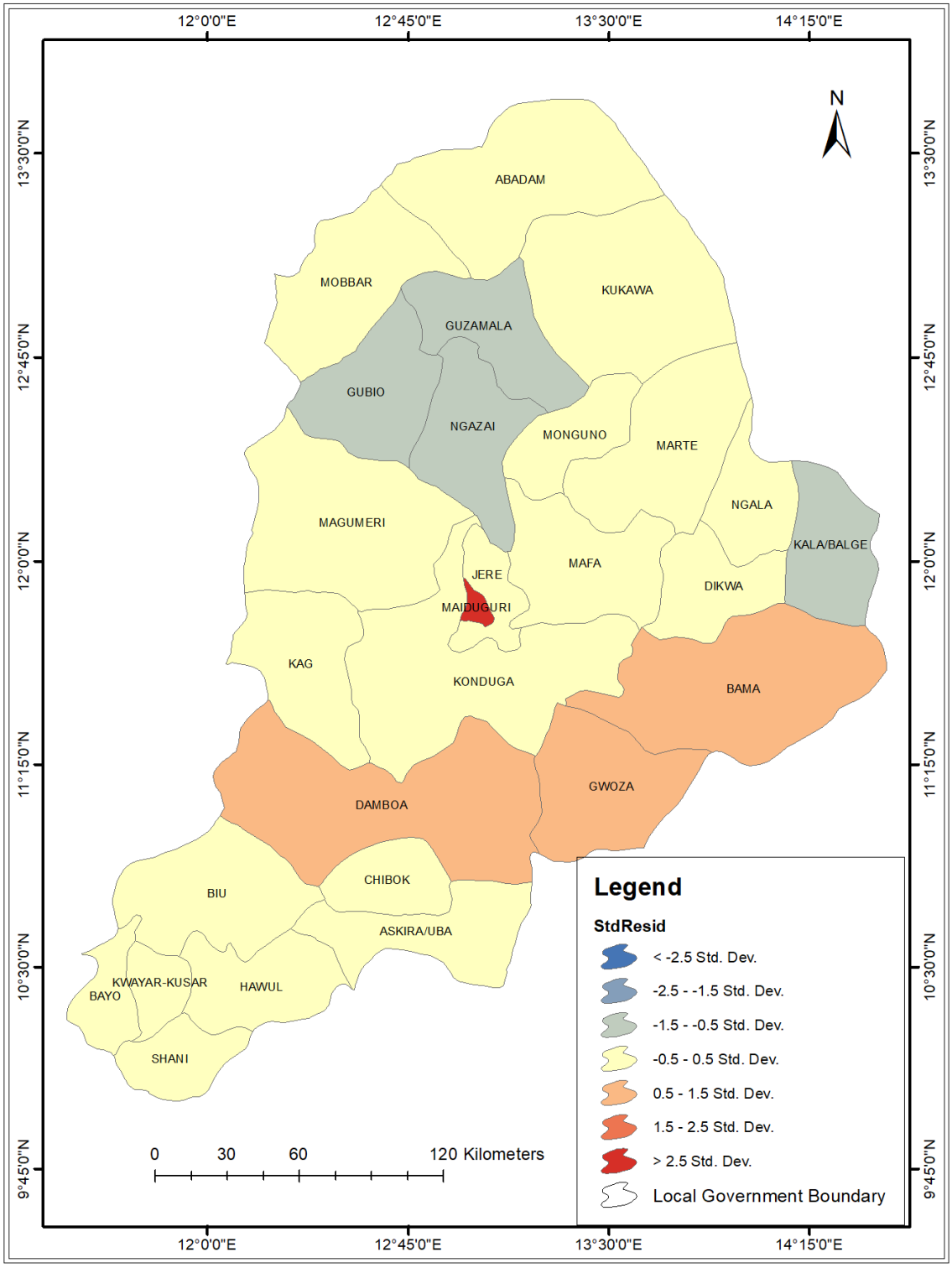

Figure 9: Spatial Variation in Standard Residuals for Incidence of Insurgency with the Combination of Vegetation and Undulating Terrain.

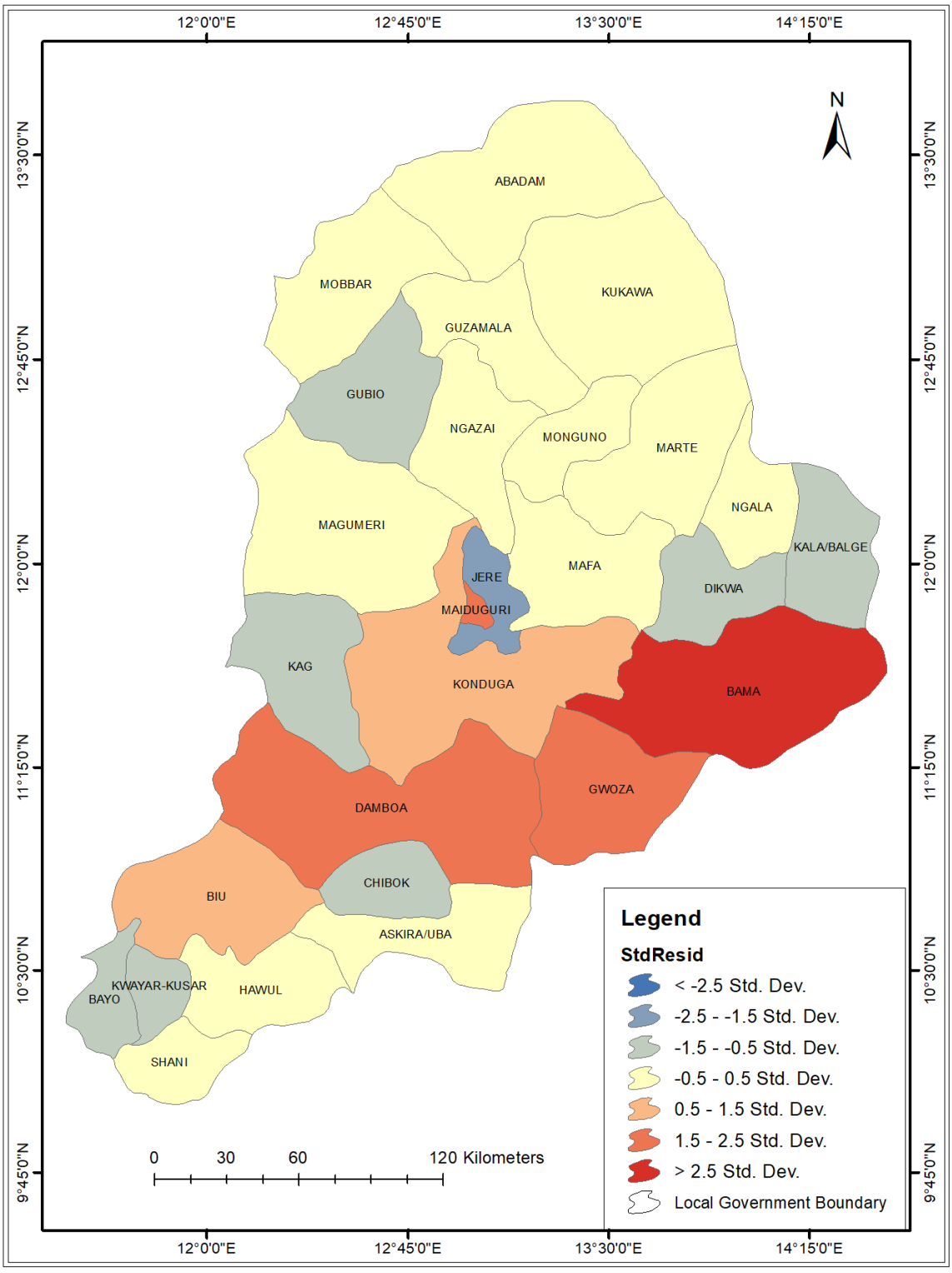

Figure 10: Spatial Variation in Standard Residuals for Incidence of Insurgency with the Combination of Vegetation and Undulating Terrain

The findings from Figure 7 reveal that residuals lower than the standard residual were observed in the far northern LGAs of Mobbar and Abadam and far southern LGAs of Bayo and Kwayar-Kusar. Residuals close to the standard residuals were observed all over state, this implies that the residuals in most of the LGAs are close to that of the standard residual. Whereas residuals higher than the standard residual are found only in the central LGAs of Maiduguri, Bama, Gwoza and Damboa. This indicates that the incidence of insurgency has more strong association with the percentage of vegetation in the central LGAs, than the other parts of the state. This finding tallies with that of Olaniyan and Akinyele (2017) that insurgence relies on the Sambisa forest to lunch attacks in the state.

The result in Figure 8 shows that the residuals values in most of the LGAs are very close to the standard residual, except for Gubio and Jere LGAs that display lower residuals. Likewise, Maiduguri, Bama, Gwoza, Damboa and Hawul LGAs show higher residuals than the standard residual. This also indicates that the percentage of undulating terrian have more association with the incidence of insurgency in Maiduguri, Bama, Gwoza, Damboa and Hawul than the other LGAs, this agrees with the view of Forest (2010) on areas of competing governance.

The findings from Figure 9 equally shows that the residuals in most of the LGAs are very close to the standard residual. Even though, lower residuals values are observed in the northern LGAs of Gubio, Guzamala, Ngazai and North Eastern LGA of Kala/Balge. Whereas higher residuals value were observed around the central LGAs of Maiduguri, Bama, Gwoza and Damboa. This also indicates that the percentage of the combination of vegetation and undulating terrain have more strong association with the incidence of insurgency in Maiduguri, Bama, Gwoza and Damdoa LGAs than in the other LGAs of the State.

The GWR analysis for the relationship between the incidence of insurgency attack and population density in Figure 10 shows that residuals values close to the standard residual and lower than the standard residuals are distributed randomly in all parts of the state. However, the concentration of higher residuals values were observed in LGAs around the central part of the state, such as Maiduguri, Bama, Gwoza, Damboa, Konduga and Biu LGA in the southern part of the state. Likewise, these indicate that population density and the incidence of insurgency attack have more strong association in Bama, Gwoza, Damboa and Maiduguri LGA than the other LGAs in the State, this concurs with the assertion of Menkhaus (2007).

Conclusion

The study analysed the influence of geographical variables, being considered to have the characteristics of an ungoverned spaces on insurgency activities. The main objective of the study was to analyses the geographical terrain and its features as it relates with insurgency attacks in the Borno State, Nigeria. This was to ascertain the relationship between insurgency with the geographical variables, such as vegetation, undulating terrain and population density. The study concludes that only the central part of the State has LGAs with very high population density, thus recorded the highest number of insurgency attacks, which shows a strong positive relationship. Vegetal cover had a week positive relationship with the insurgency attacks. Marte LGA has the highest percentage vegetal cover, this is attributed to the high number of insurgency attack experience in the LGA despites its low population density. Likewise, the central and far northern part of the state has more vegetal covered than the southern part of the state. This have equally influenced the high incidence of insurgency attack observed in the central LGAs of the state.

The study also concludes that undulating terrains and the combination of the undulating terrain and vegetation have a week negative relationship, this shows that places with the combination of

the undulating terrains and vegetation are not mostly areas of attack by the insurgence, this might be as a result of very low population density found in these areas. However, they are used for concealment to lunch attacks in areas with high population density; a good example is the Gwoza Mountain. The use of GWR to establish the existence of spatial local relationship shows that the incidence of insurgency attack and the geographic variables have more strong association in the central and southern LGAs of Maiduguri, Bama, Gwoza, Damboa and Hawul, than the other LGAs. However, the population density and the incidence of insurgency attack show more strong association.

Thus, the need for an advanced hi-technology, which is provided by, advances in Geographic Information Systems (GIS) and Earth observations such as Unmanned Aerial Vehicle (UAV). This guarantees long-endurance, high-altitude monitoring and sustainable intervention strategy for government and its security establishments to monitor all ungoverned spaces within the state used by miscreants to launch attack.

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