Analysis of Land Use/Land Cover Changes and Armed Banditry Occurrence in Gusau, Zamfara State, Nigeria

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Abstract

There are speculations that land cover changes triggers banditry in Northern Nigeria. This empirical study analysed land cover change and armed banditry in Gusau Zamfara State, Nigeria. The objectives were to assess the temporal changes in land cover, pattern of banditry in Gusau, and to compare the trend in land cover change and occurrence of armed banditry in Gusau from 2013-2019.Data on land cover were collected using GIS technique while data on occurrence of armed conflicts were collected through stakeholders' consultation. Data collected were analysed using percentage increase/decrease and correlation. Results showed that built-up and Agricultural land had 59.31 and 21.70 percentage increases respectively. Forest land, water bodies and barren land had 101.12, 6.62 and 49.20 percentage decreases respectively. The year 2016 recorded the highest no of armed bandit occurrence followed by 2017. There is no significant relationship between changes in land cover classes and occurrence of armed banditry at 95% confidence level. In conclusion, there is growing armed banditry in the area that cannot be explained by changes in land cover alone. Research on other possible causes of banditry was recommended.

Keywords: Land cover, Land use, Armed banditry, Urbanization, Resources conflict, Gusau

Introduction

A Land cover change is a fundamental course of resource conflicts. It is a major issue of concern with regards to changes in the global environment and insurgency. The role of land and natural resources in conflict is attracting increased international attention due to the changing nature of armed conflict and as a result of a variety of longer-term global trends. Competition for land resources is a major cause of conflict between and within nations and there can be significant impacts on land from violent conflicts. Violent activities such as bombing and forest burning can

be a direct causes of land degradation and land use change (Witmer, 2017), but usually occurs across small spatial and temporal scales. Growing urbanization or expansion or urban land use, have led to land resources scarcity, thus, land use conflicts are getting more frequent, deeper, more diversified and more severe. The key to solving many difficult problems in regional sustainable land use lies in the research of land use conflicts. UN (2010) reported that "disputes over land and resources are an important source of deadly conflict. They may stem from land grabs, boundary disputes, displacement as a result of man-made or natural disasters, government resettlement policies, climate change or other factors. They are often made more complex by the multiplicity of actors and economic interests involved, and both the drivers and actors involved may change over time".

Briassoulis (2000) has it that "land is used to meet a multiplicity and variety of human needs and to serve numerous or diverse purposes. When the users of land decide to employ its resources towards different purposes, land use change occurs, producing both desirable and undesirable impacts. The analysis of land use change is essentially the analysis of the relationship between people and land. Why, when, how, and where does land use change happen?" Human activities are the key factor of the changing environment which also has direct and indirect consequence on human life and livelihoods (Russell, 2012). The dynamics in land use alter the availability of different important resources including vegetation, soil, water and others (Chomitz and Kamari, 1998; Bruijnzeel, 2004). According to Cheruto, Matheaus, Patrick and Patrick *(*2016) "the surface of the earth is undergoing rapid land-use/land-cover (LULCC) changes due to various socioeconomic activities and natural phenomena".

Land use change results from the rapid growth and expansion of urban centres, rapid population growth, scarcity of land, the need for more production, changing technologies and so on (Barros, 2004; Satterthwaite, 2005). According to Masek, Lindsay and Goward*, (*2000) LULCCs respond to socioeconomic, political, cultural, demographic and environmental

conditions and forces which are largely characterized by high human populations. LULCC has become one of the major concerns of researchers and decision makers around the world today.

According to Abiodun (2011) "countries across West Africa have recorded many resource-centered conflicts that have affected inter-group relations and quite expectedly, the resource that has been in contention here is land. Broadly, the root causes of this category of conflict can be brought under six headings: disagreements over historical claims, changes in climatic conditions, consequences of changes in the nature of power balance; elite manipulation, youth reactions to vulnerability and exclusion and alterations in boundary structures. While in some cases each one of the listed items has been the sole cause of conflicts, in most cases, many of these have come together to explain the causes of acrimonious intergroup relations".

The recent classification of some Fulani herdsmen as Boko Haram collaborators by the Nigerian military and politicians (McGregor, 2014) reveals the complexities of violent clashes between cattle breeders and sedentary agriculturalists across different parts of the country. The alleged involvement of camel pastoralists from the Republic of Niger in some conflicts in the north-western and central regions of Nigeria also highlights the need to analyse land use changes and occurrence of conflicts (Blench, 2010; Krause, 2011; Abass, 2012; Audu, 2013; McGregor, 2014; Musa, *et al.*, 2016).

Major conflicts in Northern Nigeria has been attributed to land resource use and climate change which the latter is also a consequence of land use. Nigeria Watch (2017) stated that Zamfara remains the second most dangerous state in Nigeria after Borno. Though, Zamfara killing has been linked to the conflict between herdsmen and farmers which resulted from population growth, land use change, climate change and others. There is poor documentation on land use changes and conflict occurrence in Gusau metropolis Zamfara State, Nigeria. Since the early 1990s, LULC changes have gained significant attention from researchers and funding institutions seeking to quantify these changes and understand their underlying mechanisms

(National Research Council, 2005). Consequently, there are abundant research reports on land cover changes in many regions including Nigeria. Literature has highlighted the complexity of biophysical and anthropogenic factors underpinning LULC change, and their interactions at different spatial and temporal scales (Cassidy *et al.*, 2010). Researcher has linked land-use change to the overall global change processes (Selvaraj *et al.*, 2013).

Studies on land use abound in Nigeria (Adepoju, *et al.,* 2006; Zubair, 2006; Ishaya, Ifatimehin and Okafor, 2008; Eludoyin, Wokocha and Ayolagha, 2010; Bernerd and Anyadike., 2012; Ujoh, Kwabe and Ifatimehin, 2011; Oluseyi 2006; Olaleye, Abiodun and Asonibare, 2012; Igbokwe, 2006; 2010; Dami *et al.*,2011; Chigbu Igbokwe and Orisakwe, 2011; Adepoju, Millington and Tansey, 2006; Abbas, 2009) and many have also relate land use change with conflicts (Blench, 2010; Olabode and Ajibade, 2010;Solagberu, 2012; Abubakar, 2012; Audu, 2013; Agom and Atte, 2017; Musa, Shadu and Igbawua, 2016; Nigeria Watch, 2017). Among the studies that linked conflict to land use change none was done in Guasau Zamfara State.

Thus, this study is situated in Guasau Zamfara State Nigeria to bridge this gap and document land cover change and armed banditry occurrence in Gusau Zamfara State, Nigeria. This was achieved by assessing the temporal changes in land cover/land use in Gusau; temporal pattern of banditry in Gusau and then compared the trend in land cover change and occurrence of armed banditry in Gusau from 2013-2019.

Material and Method

The materials used in urban land use data is land use/cover images; the land use/cover image for the year 2013, 2015, 2017 and 2019 based on the period of the banditry as it started in 2013 were acquired from Global Land Cover Facility (GLCF). After which subsets of Gusau were extracted using the composite band and clip tool in ArcGIS 10.5. To generate the land use/land cover change of Gusau, supervised image classification with a Maximum Likelihood Algorithm was carried out using ENVI 4.2 to classify all the images into unique spectral land cover classes.

The classification used bands 4 and 5, to generate a false colour image of Gusau. With the aid of extensive ground truthing, the images were appropriately classified and sizes urban land use for the various years were presented in a table. Thereafter, statistical techniques (mean, percentage increase and moving average) were used to analsyed the changes in land cover six years (2013 - 2019). The trend was compared with frequency of arm banditry occurrence. The data on armed banditry occurrence was collected from Nigeria Police Force, Nigeria watch data base, Newspapers and stakeholders' consultation.
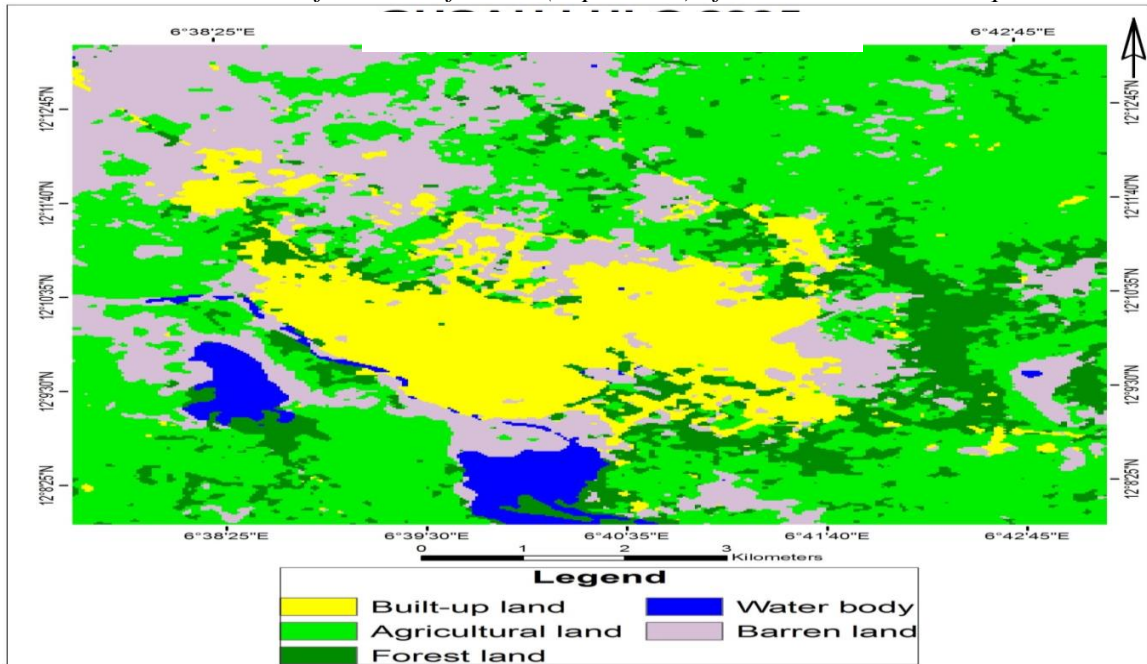
Results and Discussion

Temporal Changes in Land Use in Gusau

Land use maps of Gusau in the years 2013, 2015, 2017 and 2019 were produce to show the temporal pattern of land use changes in Gusau LGA (Figures 1-.4)
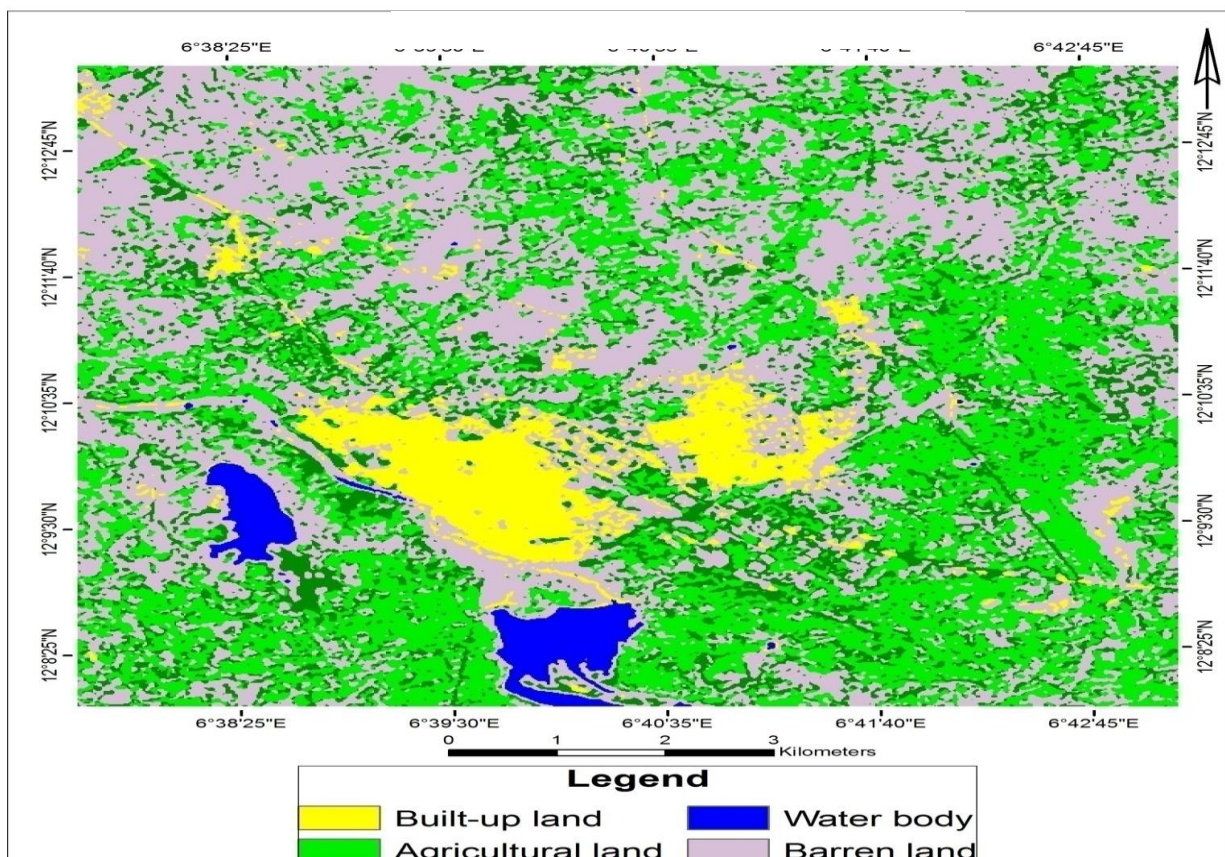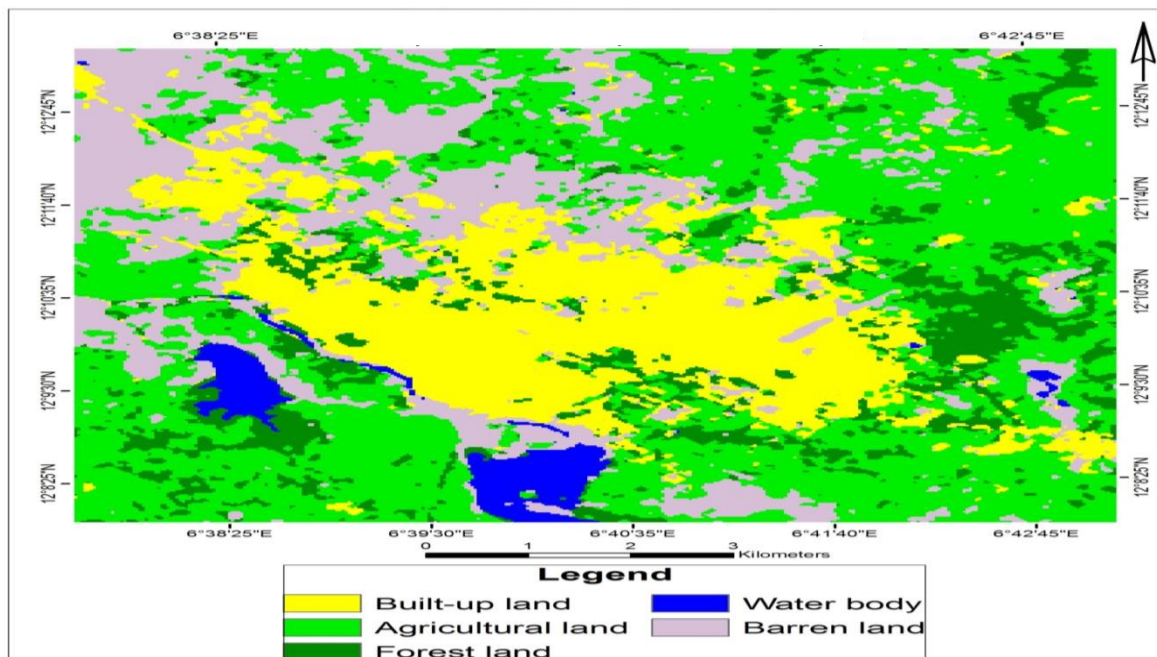

Figure 1: Land Use in Gusau in 2013

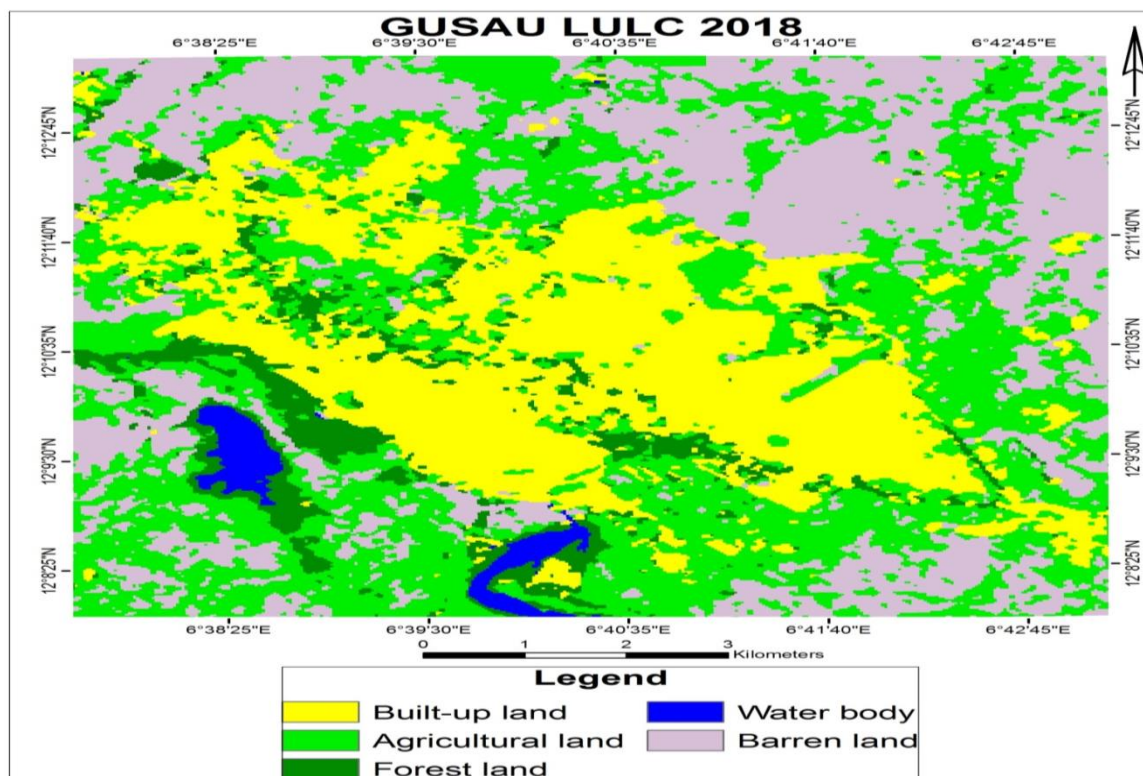*Source:Derived from classification (supervised) of Landsat P190/R52 acquired 24/10/2013*

Figure 2: Land Use in Gusau in 2015

Source: Derived from classification (supervised) of Landsat P190/R52 acquired12 September, 2015

Figure 3: Land Cover in Gusau in 2017

Source: Derived from classification (supervised) of Landsat P190/R52 acquired 03 October, 2017

Figure 4: Land Use in Gusau, 2019

Source: Derived from classification (supervised) of Landsat P190/R52 acquired 23 September, 2019

Figures 1-4. illustrate the temporal patterns of land cover at four different intervals. The figures showed changes in the pattern and sizes of different land cover among the years (2013, 2015, 2017 and 2019). Though, built -up is found mostly at the centre in the four maps, the sizes varies and showd continued increase in size. The expansion of built-up area have reduce other land covers. The sizes of each land cover were presented in table 1 to assess the temporal pattern of land cover changes over the period of study. Table 1 shows the size of the varous land cover classes (Built-up, Agricultural and Forest land) as follows:

Temporal Change in Built –up Land in Gusau

Table 1 showed that the size of built –up land in Gusau in 2013 was 27.76 Km² covering 17.28% of the entire land. In 2015, it has increased to 31.08 Km² covering 19.35%, in 2017 and 2019 built-up covered 37.01 Km² (23.04%) and 44.21 Km² (27.53%) respectively. This suggests continuous increase in built-up land from 2013-2019. The result that built up land currently

covered 27.53% of Gusau shows relatively high coverage than global coverage of 1.2% (Usman and Lay, 2013). Table 2 presents the percentage increase in built-up land from 2013-2019.

Table 1: Land Use Land Cover Distribution in Gusau (2013 −2019)

Year Size Class	2013 Area (Km^2)	Area (%)	2015 Area (Km²)	Area (%)	2017 Area (Km²)	Area (%)	2019 Area (Km²)	Area (%)
Built-up land	27.76	17.28	31.08	19.35	37.01	23.04	44.21	27.53
Agricultural land	58.29	36.29	61.88	38.52	69.65	43.36	71.73	44.65
Forest land	32.80	20.42	27.59	17.18	17.24	10.73	8.96	5.58
Water body	2.89	1.80	2.81	1.75	2.42	1.51	2.27	1.41
Barren land	39.49	24.58	37.26	23.19	34.30	21.35	32.8	20.43
Total	160.63	100	160.63	100	160.63	100	160.63	100

Table 2 shows that from 2013 to 2015 built up land had increased by 2.07% which is 11.98 percentage increase, from 2015-2017 it had increased by 3.69% which is 21.35 percentage increase, from 2017-2019 built-up land had increased by 4.49% which is 25.98 percentage increase. Therefore, from 2013-2019 built-up had increased by 10.25% which is 59.31 percentage increase. The moving average is 3.42% per two years, which means 1.71% per annum. The 1.71% annual increase is less than 3.98% average growth rate in Nigeria, 2010-2020 reported by Fox *et al.,*(2015).

The finding that built −up is on the increase is consistent with most report of previous studies in Nigeria (Bernerd and Anyadike., 2012; Abubakar, 2012; Adepoju, *et al.,* 2006; Usman and Lay, 2013). However, the 10.25% increase in six (6) years (2013-2019) is relatively lower than most earlier reports in other state capitals in Nigeria (Bernerd and Anyadike., 2012);

Abubakar , 2012; Adepoju, *et al.,* 2006; Usman and Lay, 2013). Bernerd and Anyadike., (2012) reported 130% increase in Makurdi between 1991 –2006. Abubakar (2012) reported 547.3% increase for the periods (1986-1999) in Birin Kebbi. Adepoju, *et al.,* (2006) reported 35.5% increases in Lagos for two decades (1984-2002), Usman and Lay, 2013) reported 207% increase in built up area from 1986 to 2011 in Abuja.

Temporal Changes in Agricultural Land in Gusau

Table 1 showed that the size of agriculture land in Gusau in 2013 was 58.29Km² covering 36.29% of the entire land. In 2015, it has increased to 61.88 Km² covering 38.52%, in 2017 and 2019 built-up covered 69.65Km² (43.36%) and 44.65Km² (44.65%) respectively. This suggests continuous increase in agricultural land from 2013-2019(Figure 4.5). The 44.65% current coverage is greater than the 11 percent global coverage in 2015(FAO, 2016). The finding is in line with the assertion of FOA (2016) that arable land in developing countries is on the increase. Though, there is observed continuous increase, the rate of increase is declining. This declining trend in the rate of increase is consistent with the report of FOA (2002) that "less new agricultural land will be opened up than in the past". Table 3 present the percentage changes in agricultural land from 2013-2019.

Table 3: Percentage Changes in Agricultural Land From 2013-2019

Year	Percentage Coverage	Increase	Percentage Increase
2013	36.29		
2015	38.52	2.23	6.15
2017	43.36	4.84	12.57
2019	44.65	1.29	2.98
TOTAL		8.36	21.70
Moving average		2.79	7.23

Table 3 shows that from 2013 to 2015 agricultural land had increased by 2.23% which is 6.15 percentage increase, from 2015-2017 it had increased by 4.84% which is 12.57 percentage increase, from 2017-2019 agricultural land had increased by only 1.29% which is 2.98 percentage increase. Therefore, from 2013-2019 agricultural land had increased by 8.36% which is 21.70 percentage increase. Thus, the moving average is 2.79% per two years which means 1.39% per annum.

Temporal Change in Forest Land in Gusau

Table 1 shows that the size of forest land in Gusau in 2013 was 32.80Km² covering 20.42% of the entire land. In 2015, it has decreased to 27.59 Km² covering 17.18%, in 2017 and 2019 forest covered 17.24Km² (10.73%) and 8.96Km² (5.58%) respectively. This suggests continuous decrease in forest land from 2013-2019. Percentage decrease and moving average was used to analysed this trend. Table 4 presents the percentage decrease in forest land from 2013-2019.

Table 4: Percentage Changes in Forest Land From 2013-2019

Year	Percentage Coverage	Decrease	Percentage decrease
2013	20.42		
2015	17.18	3.24	15.59
2017	10.73	6.45	37.54
2019	5.58	5.15	47.99
Total		14.48	101.12
Moving Average		4.95	33.71

Table 4 shows that from 2013 to 2015 forest land had decreased by 3.24% which is 15.59 percentage decrease, from 2015-2017 it had decreased by 6.45% which is 37.54 percentage decrease, from 2017-2019 forest land had decreased by 5.15% which is 47.99percentage decrease. Therefore, from 2013-2019 forest land had decreased by 14.48% which is 101.12 percentage decreases. Thus, the moving average is 4.95% per two years which means 2.48% per

annum. The 2.48% decrease per annum is less than Global Forest Resources Assessment (2017) that estimated 4.2% global forest decrease per year.

Temporal Change in Water Body in Gusau

Table 1 shows that the size of water body in Gusau in 1996 was 2.89Km² covering 1.80% of the entire land. In 2003, it has decreased to 2.81 Km² covering 1.75%, in 2010 and 2017 water bodies covered 2.42Km² (1.51%) and 2.27Km² (1.41%) respectively. This suggests continuous decrease in water body from 1996-2017. The continuous decrease in water body may be due to the recent global climate change that is currently causing desertification in Northern Nigeria (Audu, 2013). Table 5 presents the percentage decrease in water body from 1996-2017.

Table 5: Percentage Changes in Water Body From 1996-2017

Year	Percentage Coverage	Increase/ Decrease	Percentage Increase/ decrease
2013	1.8		
2003	1.75	0.05	2.78
2010	1.51	0.24	13.71
2017	1.41	0.1	6.62
Total	6.47	0.39	23.11
Moving average		0.20	7.67

Table 5 shows that from 2013 to 2015 water body had decreased by 0.05% which is 2.78 percentage decrease, from 2015-2017 it had decreased by 0.24% which is 6.62 percentage decrease, from 2017-2019 water body had decreased by 0.1% which is 6.62 percentage decrease. Therefore, from 2013-2019 water bodies had decreased by 0.39% which is 23.11percentage decrease. Thus, the moving average is 0.20% per two (2) years which means 0.10 % per annum.

Temporal Change in Barren Land in Gusau

Table 1 shows that the size of barren land in Gusau in 2013 was 39.49Km² covering 24.58% of the entire land. In 2015, it has decreased to 37.26Km² covering 23.19 %, in 2017 and 2019 barren land covered 34.30Km² (21.35%) and 32.8Km² (20.43%) respectively. This suggests continuous decrease in barren land from 2013-2019. The continuous increase in barren land may be due to population growth and expansion of economic activities within the region. Table 6 presents the percentage decrease in barren land

Table 6: Percentage Changes in Barren Land from 2013-2019

Year	Percentage Coverage	Decrease	Percentage decrease
2013	39.49		
2015	23.19	16.3	41.27
2017	21.35	1.84	7.93
2019	20.43	0.92	4.31
Total	84.03	18.14	49.20
Moving Average		9.07	24.63

Table 6 shows that from 2013 to 2015 barren land had decreased by 16.3% which is 41.27percentage decrease; from 2015-2017 it had decreased by 1.84% which is 7.93 percentage decrease, from 2017-2019 barren land had decreased by 0.92% which is 4.31 percentage decrease. Therefore, from 2013-2019 barren land had decreased by 18.14% which is 49.20 percentage decreases. Thus, the moving average is 18.14% per two years which means 9.07% per annum.

Temporal Pattern of Banditry in Gusau

Data collected on occurrence of banditry in Gusau local Government Area, Zamfara State shows that the local Government had remain peaceful until the year 2013 when its resident started losing their lives and properties to armed bandits, this is shown on table 7.

Table 7 presents the annual occurrence of armed bandits in Gusau from 2013 to 2019. It shows the mean annual occurrence and average no of people killed to be 1.72 times and 7 people respectively. However, the coefficients of variations being 40% and 89% for the mean occurrence and numbers of people killed respectively indicate disparities in the distribution, especially in the numbers of people killed.

Table 7: Annual Patterns of Armed Bandits in Gusau Local Government Area Zamfara State Nigeria (2013-2019)

Year	No of Occurrence	No of Person Killed	Percent (%)
2013	4	12	9.38
2014	5	13	10.16
2015	4	12	9.38
2016	7	25	19.53
2017	6	21	16.41
2018	3	35	27.35
2019	2	10	7.81
Total	31	128	100.02
Mean	1.72	7	
Standard Deviation(SD)	±2.47	±11.89	
Coefficient of Variation(CV)%	40	89	

The year 2016 recorded the highest number of armed bandit occurrence followed by 2017 while 2018 and 2019 has the least numbers of occurrences. However, the number of people killed in 2018 is more than the numbers of people killed in other years (Figure 5).
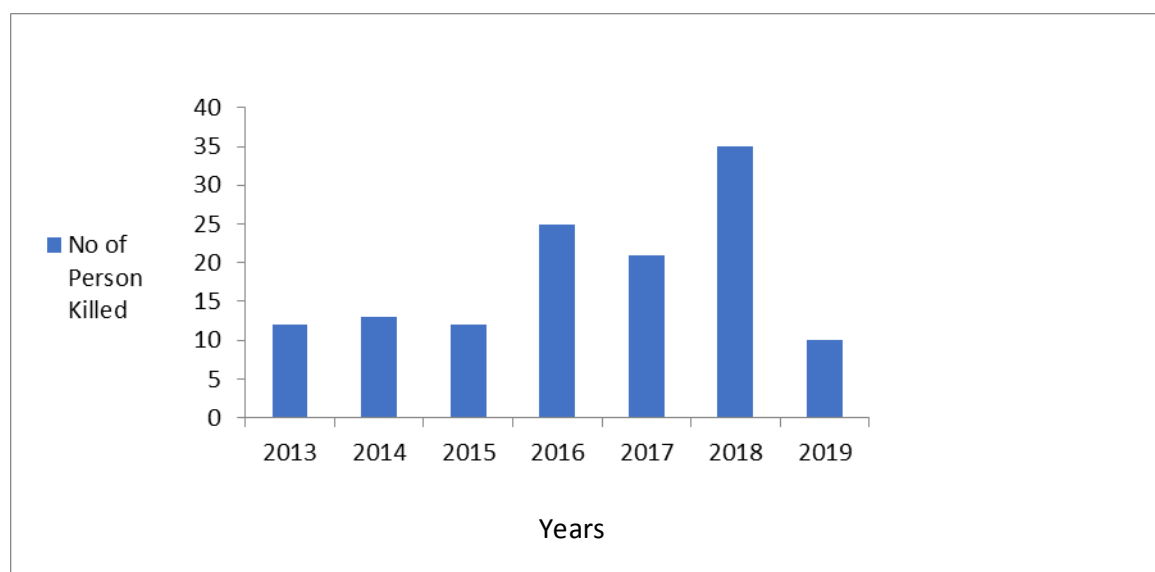
Figure 5: The no of People Killed by Armed Bandits in Gusau (2013-2019)
Source: Field Survey, 2019

Figure 7 shows the number of people killed in Gusau Local Government Area, Zamfara State Nigeria (2013-2019) by Armed Bandits. It shows that loss of lives to armed bandits is on the increase and was highest (35) in 2018 followed by 2016. This is because the bandits are becoming more equipped with weapons than before.

The Trend in Land Cover Change and Occurrence of Armed Banditry in Gusau

Table 8 present the trend in land cover and occurrence of banditry in Gusau within the study period (2013-2019)

Table 8: Land Cover and Occurrence of banditry in Gusau (2013-2019)

Year	Built -up land (%)	Agricultural land (%)	Forest land (%)	Occurrence of Armed Banditry
2013	17.28	36.29	20.42	4
2015	19.35	38.52	17.18	4
2017	23.04	43.36	10.73	6
2019	27.53	44.65	5.58	2

To compare the land cover change and occurrence of armed bandit in Gusau LGA from the year 2013 to 2019, each land cover class was correlated with the occurrence of armed bandit in Gusau (Table 9).

Table 9: Correlation Coefficient for Occurrence of Armed Bandit and Changes in Land Cover Classes

	Built-up land/	Agricultural land (%)	Forest land (%)	Water Body	Barren Land
Occurrence of Armed Bandit					
R	-0.41	-0.13	0.32	0.30	0.23

Table 9 shows the correlation coefficients (r) for land cover classes and occurrence of armed bandit in Gusau LGA from the year 2013 to 2019. It shows as follows:

The Correlation Coefficient (r) for Built-up Land and Occurrence of Armed Banditry

The correlation coefficient (r) for built-up land and occurrence of armed banditry is -0.41. Correlation coefficients -0.41 means negative correlation. This suggests that increase in built –up land reduces banditry occurrence. However, the significance of this negative correlation was tested using dependent t-test Analysis in SPSS Package.

Result showed that t value of 0.024, since the calculated t value of 0.024 is less than 0.05, Ho "there is no significant relationship between changes in built-up land and occurrence of armed banditry at 95% confidence level is accepted. Therefore, increase in built-up land has no significant influence on armed banditry occurrence in Gusau. This contradict the common assumption that conversion of other land uses like agricultural land use to buildings triggers conflicts and then armed banditry (Blench, 2010; Krause, 2011; Abass, 2012; Audu, 2013; McGregor, 2014; Musa, *et al.*, 2016). The result suggests that urbanization cannot account for the prevailing armed banditry in Gusau.

The Correlation Coefficient (r) for Built-up Land and Occurrence of Armed Banditry

The correlation coefficient (r) for agricultural land and occurrence of armed banditry is -0.13. Correlation coefficients -0.13 means weak negative correlation. This suggests that increase in agricultural land reduces banditry occurrence. However, the significance of this negative correlation was tested using dependent t-test Analysis in SPSS Package and t value was 0.036. Since the calculated t value of 0.036 is less than 0.05, "there is no significant relationship between agricultural land changes and occurrence of armed banditry at 95% confidence level" is accepted. Therefore, increase in agricultural land has no significant influence on armed banditry occurrence in Gusau.

The Correlation Coefficient (r) for Forest Land and Occurrence of Armed Banditry

The correlation coefficient (r) for forest land and occurrence of armed banditry is 0.32. Correlation coefficient 0.32 means weak positive correlation. This suggests that decrease in forest land led to decrease in armed banditry occurrence. However, the significance of this positive correlation was tested using dependent t-test Analysis in SPSS Package and t value was 0.04. Since the calculated t value of 0.04 is less than 0.05, there is no significant relationship between changes in forest land and occurrence of armed banditry at 95% confidence level is accepted. Therefore, decrease in forest land has no significant influence on armed banditry occurrence in Gusau.

The Correlation Coefficient (r) for Water Body and Occurrence of Armed Banditry

The correlation coefficient (r) for water body and occurrence of armed banditry is 0.30. Correlation coefficients -0.30 means weak negative correlation. This suggests that increase in water body reduces banditry occurrence. However, the significance of this negative correlation was tested using dependent t-test Analysis in SPSS Package and t value was 0.034. Since the calculated t value of 0.034is less than 0.05, there is no significant relationship between changes

in sizes water body and occurrence of armed banditry at 95% confidence level is accepted. Therefore, increase in water body has no significant influence on armed banditry occurrence in Gusau.

The Correlation Coefficient (r) for Barren Land and Occurrence of Armed Banditry

The correlation coefficient (r) for barren land and occurrence of armed banditry is -0.23. Correlation coefficients 0.23 means weak positive correlation. This suggests that increase in barren land increases banditry occurrence. However, the significance of this positive correlation was tested. Since the calculated t value of 1.16 is less than the critical t value of 12.79, Ho " there is no significant relationship between changes in barren land and occurrence of armed banditry at 95% confidence level is accepted. Therefore, increase in barren land has no significant influence on armed banditry occurrence in Gusau.

This study has statistically disagreed on common assumptions that changes in land use/cover is the cause of the current and increasing conflicts and armed banditry in Nigeria and across the globe. Studies that linked changes in land use/cover with conflicts/armed banditry has grown wide with many concepts like 'land use conflict and resource conflict'. However, many (Blench, 2010; Olabode and Ajibade, 2010;Solagberu, 2012; Abubakar, 2012; Audu, 2013; Agom and Atte, 2017; Musa *et al.*, 2016) were theoretically based but this study statistically related land use/ land cover change with armed banditry and found no significant relationship.

Conclusion

There is growing armed banditry in Gusau Local Government Area Zamfara State that cannot be explained by changes in land cover alone. Data from the survey showed that there are changes in the pattern and sizes of different land cover among the years (2013, 2015, 2017 and 2019). Built –up and agricultural land are increasing while forest land, water body and barren lands are decreasing. Though, agriculturing is still on the increase the pace is drastically reducing unlike

the built-up that is rapidly increasing. There is no significant relationship between changes in land cover classes and occurrence of armed banditry at 95% confidence level.

Recommendations

The following recommendations were made based on findings of this research:

I.   Gusau Local Government Council should strive for sustainable development which relates to positive socio-economic change that does not undermine the ecological and social systems on which a society is dependent.

II.   Afforestation should be practice by community members to prevent climatic anomalies that will result from reduction in forest land.

III.   Community members should form vigilante groups to protect its members.

IV.   Government at level should promote skill acquisition and create jobs to engage youths.

V.   There should more research on other possible factors that trigger armed banditry such as political activities.

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