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LAND FRAGMENTATION AND RURAL SUSTAINABILITY IN BADE LOCAL GOVERNMENT AREA, YOBE STATE, NIGERIA

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Abstract:

Land is one of the major factors in agricultural and other production activities which its accessibility and utilisation affect the outcome, especially in rural areas. This paper analyses land fragmentation and Rural Sustainability in Bade LGA, Yobe State, Nigeria. Identify rural social sustainability factors in the study area and examine the relationship between land fragmentation and rural sustainability to recommend the best possible land-based rural sustainability practice. The survey method was administered to a random sample of household heads in the study area. Simpson Index, Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and Partial Least Square-Structural Equation Modelling (PLS-SEM) was used to analyse the data. Thus, the results revealed the extent of land fragmentation in the study areas (β=-0.076, t=1.074; p > 0.05). The results of Exploratory Factor Analysis (EFA) showed that all the 18 causes of the extent of land fragmentation have factor loadings ranges from 0.760- 0.978. Hence, these analysis factors are considered the key causes of land fragmentation in the study area. PLS-SEM findings highlighted a significant alignment between land fragmentation, causes, and rural sustainability, all of which formed the basis for developing the conceptual framework for mitigating land fragmentation challenges. The conceptual framework provides effective land management and land use planning, thus enhance rural sustainability in the Yobe state, Nigeria. The study recommends review land inheritance laws and other laws regarding communal land allocation and ownership to resolve land fragmentation and population control in Yobe state.

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Introduction

Globally, land as a resource is one of the significant factors of production. In contrast, the worlds' population is increasing at an alarming rate, thereby affecting the acquisition and land use processes, resulting in land fragmentation. Fragmentation of land is noted to be a worldwide phenomenon (Demetriou et al., 2012; Iheke, O. R. and Amaechi, 2015; Reuben et al., 2017). Therefore, achieving countryside sustainability encompasses the three major components known as environmental Sustainability, Social Sustainability and Economic Sustainability. It requires endless efforts to mitigate all sorts of unsustainable practices such as land fragmentation (Nigerian National Population Commission. 2010 & Reuben et al., 2017; Sangeda et al., 2014). Concisely, land fragmentation leads to low productivity, thereby causing poverty, whereas sustainability is a continuous effort to meet the present-day requirement without jeopardising the future requirement of the yet unborn generations. Agriculture has been positioned as a more environmentally sustainable alternative to industrial monocultures (Kremen et al., 2012). Agricultural practices and landscapes that intentionally include functional biodiversity at multiple spatial and temporal scales in order to maintain ecosystem services that provide critical inputs to agriculture, such as soil fertility,pest and disease control, water use efficiency, and pollination" (Kremen et al. 2012). These have been greatly affected by land fragmentation in Yobe state (Saleh (2019).

The occurrence of fragmented farmland holdings is one of the distinctive characteristic of less developed nations through their cultivation practices Nigeria inclusive. It is, therefore, a substantial impediment to the mechanisation of agriculture, causing various agricultural productivity inefficiencies and requires a substantial cost to improve its effects (Alemu, Ayele, & Berhanu, 2017; Balogun, Akinyemi, & Adam, 2017). Reuben et al. (2017) & Sikk & Maasikamäe (2015) asserted that globally, Land fragmentation poses numerous detrimental effects on agricultural mechanisation efficiency and productivity, subsequently leading to abject poverty, thereby affecting rural sustainability. According to Balogun et al., 2017; Emeka & Chinemeze (2017), countries with traditional agricultural structures like Nigeria, where 73 per cent of its arable land is fragmented land and has a significant impact on agricultural productivity and the country's overall economic development at large. However, an in-depth study of the relationship between land fragmentation and the rural sustainability of the rural communities in Nigeria is neither determined nor fully documented. The study by Iheke & Amaechi (2015) and Osuji (2017) highlights that while Nigeria is embarking on transforming her traditional agricultural practices and eradicating abject poverty as spelt out by goal number one of SDGs. This initiative and the agricultural sector's overall reforms are not adequately informed by research findings, especially on existing land tenure issues and land fragmentation. Noteworthy is that over 80% of Yobe State's population depends on agriculture for their daily sustenance in the generic term.

However, Nigeria's northeastern states, such as Yobe, are located in a fragile environment where poverty is higher than the national average. Protracted under-development, food insecurity as well as general poverty, illiteracy and unemployment characterise the social and economic fabric of this State (WFP, 2016). Furthermore, a proper and in-depth situation

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analysis of the state's rural sustainability faces an acute shortage of critical data. It is worthy of notice that the land tenure system that encourages land fragmentation does not encourage the mechanisation of agriculture. Moreover, subsequently, the use of the traditional method of production leads to low productivity, low income and make farming becoming unattractive to young people (Emeka & Chinemeze, 2017; Eze, Konkwo, Orebiyi, & Kadiri, 2011; Nwankpa, 2017; Yobe State Government & Draft, 2016; Zemba et al., 2018). Therefore, it is pertinent to extending the boundary of knowledge beyond the impact of land fragmentation on agricultural productivity by examining the impacts of land fragmentation as it affects the rural Sustainability in Yobe State. The land constitutes one of the Yobe State initiative's significant resources toward transforming the agricultural sector from small scale to medium and large scales. While there is some empirical evidence on the influence of land fragmentation on the rural economic sustainability which increases rural poverty in various part of the world especially in the rural areas such literature are not readily available in Yobe state (Kurylo, Pantaliienko, Bogdanets, & Ovcharuk, 2017; Ndirangu, Mbogoh, & Mbatia, 2017; Niukkanen & Niukkanen, 2015; Sikk & Maasikamäe, 2015). In Nigeria also, the evidence provided by these studies contain negative impacts of land fragmentation on rural economic Sustainability (Abbas, 2016; Afolayan & Tunde, 2014; Iheke, O. R. and Amaechi, 2015; Johnson, 2014; Manjunatha, Anik, Speelman, & Nuppenau, 2013; Reuben et al., 2017; United Nations, 2017b). Conversely, despite the significant accomplishment of the land reform process, land fragmentation occurred as a side effect with adverse effects for public and private investments, sustainable economic development and social improvement. Less-favoured and least developed regions with economies that still depend on agriculture are witnessing undesirable growth rates, soaring unemployment, mounting rural poverty, and severe socio-economic disintegration and widespread disappointment among local actors stakeholders. Yobe State's average farm size for over 70% of the farmers is between 1hactres and 2hactres and is among the lowest in the country. There is no current literature on the effect of land fragmentation on rural sustainability; in other words, rural sustainability is not research in respect of land fragmentation or characterised in any study conducted in the study area (Campus & Campus, 2010; Tan, Heerink, Kuyvenhoven, & Qu, 2010a). Therefore, the nature and level of land fragmentation are combined rather than isolated influences of supply and demand-driven factors. Therefore, the study evaluates the nature of land fragmentation and its impact on rural sustainability since fragmentation affects agricultural productivity while agriculture is the primary occupation of Yobe State's people (Djurfeldt et al., 2017; WFP, 2016).

Measurement of Land Fragmentation

There were attempts to quantify land fragmentation, resulting in proposals for collecting metrics to describe the phenomenon. The easy ones use the average plot area and plots in a specific area and every farm. Blarel et al., (1992a) note that Simpson index and the Januszewski index are the standard metrics that commonly consider land diversity. The form of individual agricultural farms takes into account other indicators. Average form factor Gónzalez et al., (2007) and average plot shape weighted index Akkaya Aslan et al., (2018) included this group. A related indicator topic may also be a thorough calculation of a single plot (Demetriou et al., 2013). Even the geometric characteristics of a single plot, expressed as they can influence the cost of cultivation Janus & Markuszewska, (2017), are also a synthetic index portion (Demetriou, 2013a). The purpose of a different set of indicators is to determine the distribution's correctness in two-dimensional object space. The range is significant to methods of land fragmentation measurement. The first is the nearest average distance index to the neighbouring standard (Evans, 1954). It is a measure of a ground-element group (in this case,

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plots). Its limited agricultural research means that it does not consider the location of the farm's economic nucleus. That is why the studies performed on farms are not reliable and well satisfactory. Indicators considered farms more useful than forms in evaluating agricultural economic aspects, as they allow for the indirect accounting of transport costs in the study. In 'Spatial Discontinuity Measurement Analysis' Babalola et al., (2015), attempts to address the phenomenon where the author proposed a relative index of land fragmentation that used a measurement method based on the total distance required to drive, including the field, to each farm's parcel. In general, this metric faced many challenges; Burton & King (1982) & Wang et al., (2020) challenged it to overestimate the importance of distance in its overall importance, among other things. The most commonly used fragmentation metrics, accounting for variety, include average hectare index size, index grouping, and structural index (Latruffe & Piet, 2014). In this case, the partial index associated with the distance consideration (DoP-plot dispersion) depends on the distance between the centre of the plot and the centre of the plot cluster belonging to the area in question (Demetriou, 2013, b).

Constructing these metrics allows for some widely used simplifications of the method of evaluating them. The limited availability of accurate numerical data and the time-consuming nature of creating detailed models of the examined areas are due to the limited data availability. The first of these simplifications is adopting the farm hub's rough position, decided to be the barycenter of all its parcels of components Latruffe & Piet, (2014) & Demetriou, (2013, b). The second simplification relates to the distance determining process. The most widely used rectilinear distances between the farms 'barycenter's and the plots' geometric centres. Given the distance determining process simplifications, three variables could introduce inaccuracy in evaluating it. The first is the difference between the centre of the farm's accurate coordinates and its property's barycenter. Because of the road network's real shape, the second aspect is the difference between the rectilinear distance and the one measured. The last is due to variations between the actual entry point and the centroid coordinates of that plot from the adjacent road to the plot location. The purposefulness and even the need to use the actual distance from the plots to the farmstead were observed and requested in researching the land fragmentation phenomenon (Deininger et al., 2017; Tan et al., 2010). Demetriou et al., (2013a) noted barriers to the widespread use of more accurate measurement methods, indicating a lack of available data identifying the farms' actual economic centres. However, modern methods of obtaining and processing spatial data might permit the estimation of exact values for large data sets. Demetris Demetriou et al., (2013a) The differences between the fragmentation rates calculated using various distance assessment methods reflect the need for individual values to be taken into account.

Existing Indices

All the variables, such as the number of farmlands per household, size, shape, distance from the settlement and distance between the farms, optimally lead to land fragmentation. For the proper presentation of the problem, it is pertinent to consider a detailed and reliable index. However, none of the current indices combines all these variables into a single equation, and there is no particular test for land fragmentation (Bentley, 1987; Van Hung et al., 2007). Most authors who attempted to measure fragmentation used a simple average number of parcels per holding (regional or national), an average holding size, and average plot size. Edwards, (1978) estimated a fragmentation index as the percentage of the land of a holding that is not adjacent to the farmstead, and by measuring the distance that a farmer would have to travel to reach each of his parcels, Heston & Kumar, (1983), determined fragmentation, returning to his

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farmstead after each visit. Each represents only one aspect of land fragmentation, despite the usefulness of these independent indices.

Simmons Index (1964)

Some indexes, on the other hand, contain several variables. According to Demetriou et al., (2013a), Simmons (1964) proposed a land fragmentation index, which considers the number of holding parcels, the relative size of each parcel, and the holding size. For Simmons, the term for the land fragmentation (FI) index is:

$$FI = \frac{\sum_{i=1}^{n} \alpha^2}{A^2}$$

N is the holding parcels, n is the holding size, and A is the total holding size. An FI value of 1 means that only one parcel consists of a keeping, and values closer to zero means more fragmentation. The Simmons table becomes the Simpson index is subtracted from 1 (Shuhao, 2005).

Januszewski Index (1968)

Demetriou et al., (2013a) note that another land fragmentation index K, proposed by Januszewski (1968), relating the number of parcels per holding with the dispersal of their size as follows:

$$K = \frac{\sqrt{\sum_{i=1}^{n} \alpha}}{\sum_{i=1}^{n} \sqrt{\alpha}}$$

K values differ between 0 and 1, with a high degree of variability indicated by values leaning towards 0. This index has three main features: the degree of fragmentation increases proportionally to the number of parcels; when the number of parcel sizes reduced, fragmentation increases; and when the area of large parcels increases and that of small parcels decreases, fragmentation decreases. Sikk & Maasikamäe, (2015) & Blarel et al., (1992b) noted that Januszewski and Simmons's indices are the most frequent indices used to measure land fragmentation.

Gbozurike Index (1974)

According to Igbozurike, (1976), Igbozurike (1974) proposed a 'land fragmentation basing on size index.' This measure depends on the average size of the plots and a farmer's travel time to visit all of his sequential parcels (i.e., one round trip) instead of the indexes above. This Fragmentation index, P*i*, is for holding *i* using:

$$P_i = \frac{1}{\frac{S}{100}} Dt$$

Where S is parcel size, and *Dt* is the cumulative round trip distance for all parcels. Burton & King (1982) criticised this index because of the lack of specified and overemphasised by the researcher and ignored the number of parcels. An example cited relates to a holding with two parcels of size a and a distance of 10 km apart, which would give a *Pi* twice as high as a holding with 10 parcels of size a per 1 km from its neighbours.

Schmook Index (1976)

Loogaa et al., (2018); & Sikk & Maasikamäe, (2015) note that Schmook (1976) defined another index of fragmentation, known as Po; it is the ratio between the area of a polygon that demarcates all parcels of a holding and the area of that holding. This index's values are often

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above 1, and an extreme fragmentation implies a high value of Po. This approach has the benefit of taking into account both the size of the holding and the distance.

Materials And Method

Study Area

The study was conducted in Bade LGA of Yobe State, which comprises 3 political wards. It is within latitude 11^{o} north and longitude 13.5^{o} East with a total land area of 47,153KM^{2} (Yobe State Government, 2016; Zemba et al., 2018). To the east and southeast shares common boundaries with Borno state, while Jigawa state to the northwest, whereas to the south-west it is bounded by Bauchi and Gombe states. The north that stretches over 323km also shares a common international border with the Niger Republic. The population of Yobe state, according to the National HeadCount conducted in 2006, is 2.321 million, while the population estimate in 2011 reveals that there are 2,757,000 million people in the state(National population Commission, 2010). Yobe state is multi-ethnic, thus, comprising the following ethnic groups: Kanuri/Manga, Bade, Ngizim, Fulani, Bolawa, Ngamo, Kare-Kare, Babur/Maga and Hausa constituting the main ethnic groups in the state. Hausa is the generally spoken language in the state. The official language of communication in schools in the State is English. The blend of all these features makes Yobe state a state with diverse culture and ethnic composition. The most colourful celebrations in the state include the Bade annual fishing festival, which occurs annually at Alkamaram River in Gogaram District of Bade Emirate Council in Bade Local Government Area. The Machina annual Cultural Festival in Machina Local Government Area, Barakau Festival, Durbars and installation ceremonies. These cultural events contribute immensely to attracting both local and international tourists, which significantly contribute to the state's economic activities (Abbas, 2016; WFP, 2016; Yobe State Government, 2016).

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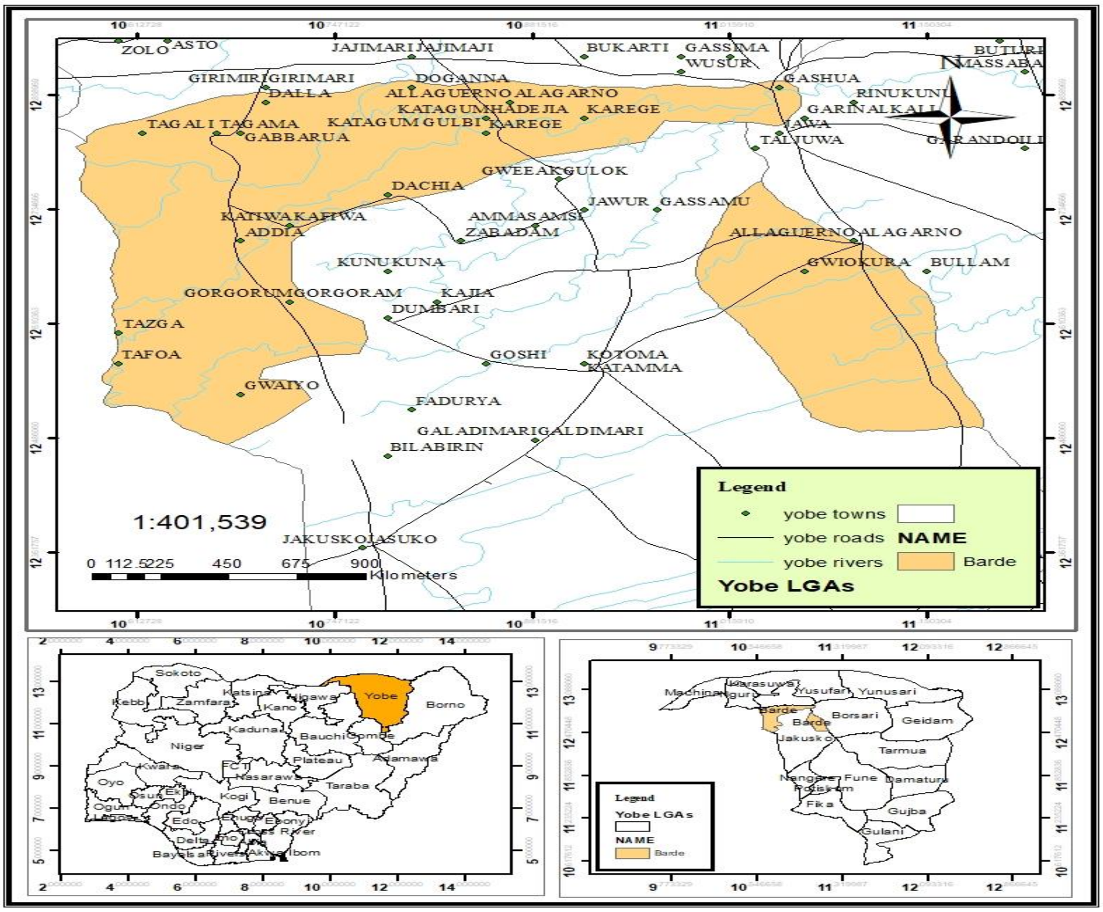

Methods

The study employed a survey method, which enabled the researcher to collect data at a single point in time using a questionnaire administered randomly selected sampled population. The adoption of a survey method is to obtain quantitative information on the various aspects of the research. The study drew samples from Bade Local Governments, which suffers severe land fragmentation because it is a relative location along the river Yobe from which the state obtained its name. Bade Local Government is located next to those local governments severely hit by the recurrent drought and desertification, thus attracting most people from these nearby local governments for their livelihood. The 300-sampled population constituted households undertaking agricultural activities in the six randomly selected villages. The study used the list of households undertaking agricultural activities in the 2019/2020 cropping season as was provided by the village leaders, and the selection of the sample households from the village registers was conducted randomly. Household as a unit of household analysis refers to a person or group of individuals who live, eat together and share common living arrangements. The analytical techniques employed in the study include descriptive statistics, such as frequency tables, percentages, means and standard deviations and farm budget model to analyse farmers' socio-economic characteristics, land fragmentation and rural sustainability indicators.

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Main Results

Result, Discussion and Finding

This section focused on the demographic information, data analysis and presentation of results. The present chapter results of the analysis carried out to determine the extent of land fragmentation. Followed by the results to determine the causes of the extent of land fragmentation. Next, the results identify rural sustainability factors. Lastly, the results examine the relationship between land fragmentation and rural sustainability. Data analyses employed include Google map survey, Simpson index, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

The Household Heads Ages and Farming Experience

The household heads ages and farming experience classification is in three categories based on their ages, as shown in Table 1. Table 1 represents the three common age groups, namely youth, middle group and elders. Age is an essential parameter in the social analysis since people of different age groups perform different sets of activities in most societies (Overholt, 1991). Age is also a function of an individual's knowledge, experience and maturity. The majority, 50%, were between 20 and 50 years old. By implication, the respondents' ages show that most farmers actively engage in production activities with their family and society's role and responsibility. Household heads with age above 30 years old and below 50 years are likely to have more land access than 30 years old or younger. When household heads grow older, family work decreases when children leave home and start their own lives, exposure to land declines to around the same level as at the age of 30 (Jayne et al., 2003). About half of the household heads had more than ten years of experience in farming (Table 6.3.1). Years of experience in farming used to determine their experience of land fragmentation.

Table 1: Age and Farming Experience of Household Heads (n = 300)

	Age	**Frequency**	**Percentages (%)**
1	Young (20 – 35 years)	81	27.0
2	Middle (36 – 50 years)	114	38.0
3	Old (51 – 80 years)	105	35.0
	Total	**300**	**100.0**
	Years in farming		
1	1 – 10	63	21.0
2	11 – 20	149	50.0
3	21 – 51	88	29.0
Total		**300**	**100.0**

Fragmentation of Farms

Farm holdings are more fragmented in Dagona and Usur/Dawayo ward of Bade Local Government as presented in Table 2 than in Gwio Kura ward in Usur/Dawayo ward. River Komadugu Yobe, which passes through Dagona and Gwio Kura wards. It attracts farmers to invest in agriculture, leading to the present land fragmentation situation. Although, land allocation to heirs (inheritance) and land sale has been the main causes of farm fragmentation in the Dagona ward in Bade Local Government Area. The Dagona ward in Bade Local Government Area is highly fragmented and associated with the cultivation of cash crops and vegetables in small parcels/farmlands. While, Gwio Kura ward had the least scattered farms of the three Local Government areas with a median number of 1.0, a mean plot size of 4.5 and a

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mean Simpson Index of 019522 as presented in Table 2. In Table 2, 93.3% of households owned parcels of less than 1 hectare in the Dagona ward, Bade LGA, while many farmers owned parcels of less than 1 hectare in the Dagona, Usur/Dawayo, and Gwio Kura wards (65%, 40% and 39% of households respectively).

Table 2: Land Fragmentation in The Sample Wards (%)

Measure of fragmentation	Dagona	Usur/Dawayo	Gwio Kura	Total
Number of parcels				
1	21.7	53.3	20.0	28.0
2	48.3	30.0	33.3	40.0
3	20.0	13.3	33.3	22.0
4	6.7	3.3	10.0	5.3
Over 4	3.3	0.0	3.3	4.7
Mean	2.25	1.6667	2.4333	2.1867
Median	2.00	1.0000	2.0000	2.2000
Average parcel size				
0.08 – 0.41	20.0	13.3	10.0	21.3
0.41 – 0.54	20.0	10.0	10.0	18.7
0.54 – 0.82	25.0	6.7	30.0	20.7
0.82 – 1.73	20.0	20.0	30.0	19.3
1.73 – 3.72	6.7	23.3	13.3	10.0
Over 3.75	8.3	26.7	6.7	10.0
Mean	2.9833	4.1000	3.4667	3.0800
Median	3.0000	4.5000	3.5000	3.0000
Simpson Index				
0 – 0.42	35.0	73.3	46.7	40.0
0.42 – 0.5	35.0	10.0	30.0	24.0
0.5 – 0.66	15.0	16.7	16.7	16.7
0.66 – 0.88	15.0	0.0	6.7	19.3
Mean	0.4242	0.1952	0.3683	0.4097
Median	0.4742	0.0000	0.4307	0.4642

Variation in Household Annual Income

ANOVA was used to examine the difference in annual household income between and within divisions. Therefore, To determine the size effect, the size of income, the variance was calculated by measuring the degree of Variation (Eta squared) and comparing it to the values given in Richardson (2011), as shown in Table 3 and 4. The low values observed were an indication that the significant difference in annual household income, 91.1 %, was due to variables within divisions, and the differences within divisions were caused by just 8.9 %. This form of income variance within divisions suggests that small parcels of farms are households. Other research carried out elsewhere in other African countries have shown unequal income distribution within society (Jayne et al., 2003).

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Table 3: Results of Analysis of Variance for Annual Household Income (TAS)

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between division	1.529E13	2	7.644E12	7.174	0.001
Within division	1.566E14	147	1.066E12		

Table 4: Variation of Annual Household Income

Source of Variation	Size of variation (%)	Eta squared	Effect size
Between division	8.9	0.089	Medium
Within division	91.1		

Relationship Between Land Size and Household Income

This research showed a positive association between land size and annual household income (r = 0.181). The results of the study showed that with the holding of land, revenue decreased. The implications are that households with insufficient land ownership were unable to boost their livelihoods by alternative sources such as labour sales, small enterprises, or through increasing the productivity of the small land, they possessed. This result defines the main role that landholdings play in household income. The findings of this report, however, contradict what some authors have found in various African settings. For example, Lipton (1993) argues that while the amount of land appears not to be associated with income, access to at least some land is important in deciding the well-being of households.

Relationship Between Land Size and Household Income

The initially EFA was conducted to examine the factorability of the 23 items, as shown in Table 6.7. The criteria for the factorability of a correlation recommended in Hooper (1999) is used. Firstly, all 23 items correlate at more than 0.3 with at least one other item, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin (KMO) measure of overall sampling adequacy is equal to 0.901, well above the recommended value of 0.5, and Bartlett's test of sphericity is significant with the p-value of < 0.05 (Hair et al., 2009).

Table 5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.901
Bartlett's Test of Sphericity	Approx. Chi-Square	12094.225
	df	210
	Sig.	.000

Thirdly, each item's communality is set to be above 0.4 (Leimeister, 2010) to confirm that each item shares some common variance with other items. However, three (3) items show commonalities below 0.4. Thus, the three items were deleted one by one, and the factor analysis is repeated each time. The initial round of the analysis found that the items meet the minimum requirement of items correlation, KMO, and Bartlett's sphericity test. However, three items

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have commonalities below 0.4 with low factor loadings of less than 0.4. Therefore, the three (3) items were deleted one by one, and the factor analysis is repeated each time. With 20 items remaining in the list, the new factor analysis shows stronger results than modified EFA.

Table Error! No text of specified style in document.**: Total Variance Explained**
Extraction Method: Principal Component Analysis

	Initial Eigenvalues			**Extraction Sums of Squared**		
Component	**Total**	**%**	**Cumulative %**	**Total**	**%**	**Cumulative %**
1	14.616	81.200	81.200	14.616	81.200	81.200
2	.828	4.599	85.798			
3	.590	3.276	89.074			
4	.455	2.530	91.604			
5	.337	1.874	93.478			
6	.280	1.556	95.034			
7	.211	1.173	96.207			
8	.169	.936	97.144			
9	.146	.810	97.953			
10	.096	.532	98.486			
11	.074	.410	98.895			
12	.060	.331	99.226			
13	.048	.265	99.491			
14	.034	.186	99.677			
15	.023	.131	99.808			
16	.018	.102	99.910			
17	.015	.083	99.993			
18	.001	.007	100.000			

Table 6 indicates that each item's load factor in the component, the number of items for the factor (component), and the factor's range load factor were examined.

Table 7 indicates that each item's load factor in the component, the number of items for the factor (component), and the factor's range load factor were examined.

Table 7: Component Matrix

SN	**Item/Factor1**	
1	CLF8	**.978**
2	CLF7	**.971**
3	CLF9	**.967**
4	CLF2	**.942**
5	CLF10	**.939**
6	CLF4	**.936**
7	CLF15	**.935**
8	CLF6	**.932**
9	CLF14	**.927**
10	CLF12	**.913**
11	CLF5	**.910**

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12	CLF18	**.891**
13	CLF13	**.869**
14	CLF17	**.868**
15	CLF16	**.855**
16	CLF19	**.803**
17	CLF25	**.788**
18	CLF22	**.760**

Extraction Method: Principal Component

a. 1 components extracted.

The results in Table 6.10 showed the Exploratory Factor Analysis result using Varimax with Kaiser Normalization. The rotated component matrix indicated the loadings and number of items valid for each component/factor. The results showed that Factor 1 contained 18 items as reported on a 5-Point Likert scale; these 5 items have an eigenvalue of 14.616 and explained 81.20 % of the factor structure with factor loadings 0.760 0.978. This factor provides more information on factors that characterise the cause of land fragmentation in the study area. Thus, this analysis's factors are considered the key causes of land fragmentation in the study area.

Moreover, factors/causes identified were further validated in a Confirmatory Factor Analysis using Structural Equation Modelling by applying the Partial Least Square Structural Equation Modelling principles. Thus, this EFA serves as the first stage for identifying and confirming the valid measurement model to develop a framework for mitigating the challenges of land fragmentation and rural sustainability.

Descriptive Analysis

Additionally, descriptive statistical analyses supported the above findings and revealed that eighteen (18) factors were considered causes of the extent of land fragmentation. The finding is presented in Table 8 below;

S/N	**Causes**	**N**	**Mean**	**SD**
1	Law of Inheritance of Paternal Property	300	3.62	0.59
2	Land Tenure System	300	3.61	0.56
3	Infrastructural Development	300	3.58	0.59
4	Heterogeneous Land Quality	300	3.60	0.57
5	Rapid Growth of Population	300	3.60	0.57
6	Conversion of Land Use	300	3.60	0.57
7	Drought	300	3.59	0.58
8	Desertification	300	3.59	0.58
9	Soil Erosion	300	3.60	0.56
10	Land Boundary Dispute with Neighbours	300	3.59	0.57
11	Communal Land Boundary Disputes	300	3.54	0.71
12	Poor Accessibility	300	3.59	0.59
13	Conversion of Land for Large-Scale Irrigation Schemes	300	3.62	0.59
14	Lack of Support and Ineffective Land Use Planning	300	3.64	0.55
15	Value of Land (land Speculation)	300	3.64	0.54
16	Lack of Progressive Tax on Inherited Land	300	3.60	0.61
17	Acquisition by the Immigrant	300	3.62	0.69
18	Conversion of Land Use:	300	3.62	0.67

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The result presented in the above table revealed that the 18 factors presented were the respondents' agreements that they are the factors responsible for land fragmentation in Yobe state, Nigeria. Looking at the mean and standard deviation of the causes. The mean of all the 18 causes are 3.00 and above, meaning that the respondents agreed that these 18 factors are the causes of Land fragmentation in Yobe state, Nigeria.

Exploratory Factor Analysis

Initial Exploratory Factor Analysis (EFA)

The initially EFA was conducted to examine the factorability of the 31 items as presented in Table 6.12. The criteria for the factorability of a correlation recommended in Hooper (2012) is used. Firstly, all of the 31 items correlate at more than 0.3 with at least one other item, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin (KMO) measure of overall sampling adequacy is equal to 0.668, well above the recommended value of 0.5, and Bartlett's test of sphericity is significant with the p-value of < 0.05 (Hair et al., 2009).

Table 9: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.668
Bartlett's Test of Sphericity	Approx. Chi-Square	7620.771
	df	465
	Sig.	.000

Thirdly, each item's communality is set to be above 0.4 (Leimeister, 2010) to confirm that each item shares some common variance with other items. However, fifteen (15) items show commonalities below 0.4. Thus, the 15 items are deleted one by one, and the factor analysis is repeated each time. The initial round of the analysis found that the items meet the minimum requirement of items correlation, KMO, and Bartlett's sphericity test. However, three items have commonalities below 0.4 with low factor loadings of less than 0.4. Therefore, the 16 items are deleted one by one, and the factor analysis is repeated each time. With 15 items remaining in the list, the new factor analysis shows stronger results than modified EFA.

Thirdly, each item's communality is set to be above 0.4 (Leimeister, 2010) to confirm that each item shares some common variance with other items. With these conditions' satisfaction, the extraction method of principal component analysis is examined to determine the factors' analysis. The EFA results presented are; the factor loadings, eigenvalues, and percentage (%) of variance explained are presented. The results are presented in Table 8 and 9; the eigenvalues results and percentage of variance explained by the components shown in Table 10 indicated components 3 with eigenvalues greater than one (1) components 3 cumulatively explained 70.724% variance in the factor structure. Thus, with the results and the variance explained with the eigenvalues results, the EFA presented 3 factors in the data structure that explained the larger percentages of the model variance. The identification of components 3 provides enough information to understand the factor structure.

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Table 10: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	**Total**	**%**	**Cumulative %**	**Total**	**%**	**Cumulative %**
1	3.854	25.696	25.696	3.854	25.696	25.696
2	3.694	24.627	50.323	3.694	24.627	50.323
3	3.060	20.401	70.724	3.060	20.401	70.724
4	.800	5.332	76.056			
5	.684	4.562	80.619			
6	.624	4.162	84.780			
7	.531	3.543	88.323			
8	.413	2.754	91.077			
9	.404	2.695	93.772			
10	.357	2.378	96.150			
11	.270	1.797	97.947			
12	.161	1.073	99.020			
13	.117	.780	99.800			
14	.022	.147	99.947			
15	.008	.053	100.000			

Table 10 shows that the factor loads were examined for each component item, the number of items for each factor (component) and the range of factor loads for each component item. The results in Table 11 shows the Exploratory Factor Analysis result using Varimax with Kaiser Normalization. The rotated component matrix indicated the loadings and number of items valid for each component/factor. The results showed that Factor 1 contained 5 items as reported on a 4-Point Likert scale; these 5 items have an eigenvalue of 3.856 and explained 24.626 % of the factor structure with factor loadings 0.730 0.909. This factor provides more enough information on factors that characterise rural sustainability in the study area.

Similarly, Factor 2 comprises 5 items with an eigenvalue of 3.694 and explained 24.627% of the factor structure's variance with factor loadings ranging from 0.795 to 0.913. This factor provides enough information and is the second factor that characterises rural sustainability in the study area. Factor 3 contained 5 items with an eigenvalue of 3.060 and explained 20.401% of the factor structure's variance with factor loadings ranging from 0.725 to 0.857. This result showed that this factor is the third important factor that characterises rural sustainability in the study area.

Table 11: Rotated Component Matrix

Item/Factor	Social	Economic	Environmental
RS6	**.909**		
RS7	**.905**		
RS4	**.880**		
RS9	**.850**		
RS8	**.730**		
RS32		**.913**	
RS31		**.908**	

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RS30	**.830**	
RS29	**.823**	
RS28	**.795**	
RS20		**.857**
RS21		**.838**
RS19		**.808**
RS18		**.781**
RS22		**.725**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

This exploratory factor analysis identified the three (3) factors that characterise rural sustainability in the study area. Thus, the factors identified in this analysis can be considered as the key dimension of rural sustainability in the study area.

Moreover, the 3 factors identified will further be validated in a Confirmatory Factor Analysis using Structural Equation Modelling by applying the Partial Least Square Structural Equation Modelling principles. Thus, this EFA serves as the first phase for identifying and confirming the valid measurement model to develop a framework for mitigating the challenges of land fragmentation and rural sustainability.

Descriptive Analysis

Additionally, descriptive statistical analyses supported the above findings and revealed three (3) factors considered the rural sustainability factors in Yobe state Nigeria. The finding is presented in Table 6.16 below;

The result presented in the above table revealed that the three (3) factors presented were the respondents' agreements that they are the rural sustainability factors in Yobe state, Nigeria. The mean and standard deviation of social sustainability, economic sustainability, and environmental sustainability factors confirmed that these three factors are the rural sustainability factors. The mean of all the 15 items measuring the three sub-factor of rural sustainability factors is 3.00 to above, meaning that the respondents agreed that these 3 factors are the key rural sustainability factors in Yobe state Nigeria.

Initial Measurement Model of LF, CLF and RS

To validate the initial measurement model, the factor loadings of the 41 items measuring 3 constructs/factors that characterise land fragmentation, causes of Land fragmentation, and rural sustainability factors in Nigeria were evaluated. The measurement model is represented in Figure 6.13, and the detailed parameters are presented in Table 6.17. Based on the analysis, results presented measuring the constructs of land fragmentation, causes of Land fragmentation, and rural sustainability factors, and the 40 of the 41 items measuring the constructs showed loadings 0.7 and above, indicating satisfactory loading. However, 1 item (LF9) showed factor loadings of less than 0.7, which violate the model requirement of 0.7 (Hair et al., 2009). Although the items in all the factors overall showed satisfactory composite reliability (CR) of higher than 0.70, the convergent validity measured by examining the average variance extracted (AVE) value of all the seven factors showed an AVE greater than 0.5. However, with this minimal requirement's satisfaction, the model has not presented a good fit

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due to the 1 items (LF9) with loadings less than 0.7. This item with poor loadings is removed from the measurement model to obtain a clear and final modified measurement model with a satisfactory fit.

Conclusion

Conclusively, the study revealed that most of the farmers have between 2-4ha, and few have less than 1ha as most purchased their lands. The study shows that social sustainability indicators such as access to social amenities, life expectancy at birth, and education level are influenced by land fragmentation in the study area. It is evident that despite issues of land fragmentation in Bade LGA Yobe state, farming sustainable in the area.

References

Abbas, A. I. (2016). Between policy expectations and realities of poverty reduction efforts: An assessment of National Poverty Eradication Programme (NAPEP) in Yobe State, Nigeria. *Journal of Social Science for Policy Implications*, *4*(1), 37–62. https://doi.org/10.15640/10.15640/jsspi.v4n1a3

Akkaya Aslan, S. T., Kirmikil, M., Gündoğdu, K. S., & Arici, I. (2018). Reallocation model for land consolidation based on landowners' requests. *Land Use Policy*, *70*(January 2017), 463–470. https://doi.org/10.1016/j.landusepol.2017.11.028

Babalola, S. O., Abdul Rahman, A., Choon, L. T., & Van Oosterom, P. J. M. (2015). POSSIBILITIES of LAND ADMINISTRATION DOMAIN MODEL (LADM) IMPLEMENTATION in Nigeria. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *2*(2W2), 155–163. https://doi.org/10.5194/isprsannals-II-2-W2-155-2015

Bentley, J. W. (1987). APPROACHES TO LAND FRAGMENTATION : In Defense of a. *Ann. Rev. Anthropol. 1987. Copy16:31-FJ7*, *16:31-fJ7*(16:31-fJ7).

Blarel, B., Hazell, P., Place, F., & Quiggin, J. (1992a). *The Economics of Farm Fragmentation : Evidence from Ghana and Rwanda The Economics of Farm Fragmentation : Evidence from Ghana and Rwanda*. *May*. https://doi.org/10.1093/wber/6.2.233

Blarel, Hazell, P., Place, F., & Quiggin, J. (1992b). The economics of farm fragmentation: Evidence from Ghana and Rwanda. *World Bank Economic Review*, *6*(2), 233–254. https://doi.org/10.1093/wber/6.2.233

Burton, S., & King, R. (1982). Land fragmentation and consolidation in Cyprus: A descriptive evaluation. *Agricultural Administration*, *11*(3), 183–200. https://doi.org/10.1016/0309-586X(82)90115-7

Deininger, K., Monchuk, D., Nagarajan, H. K., & Singh, S. K. (2017). Does Land Fragmentation Increase the Cost of Cultivation? Evidence from India. *Journal of Development Studies*, *53*(1), 82–98. https://doi.org/10.1080/00220388.2016.1166210

Demetriou, D. (2013a). LACONISS: A land consolidation integrated support system for planning and decision making. *ZFV - Zeitschrift Fur Geodasie, Geoinformation Und Landmanagement*, *138*(2), 119–131.

Demetriou, D. (2013b). LACONISS: A land consolidation integrated support system for planning and decision making. *ZFV - Zeitschrift Fur Geodasie, Geoinformation Und Landmanagement*, *138*(2), 119–131.

Demetriou, D., Stillwell, J., & See, L. (2013). A new methodology for measuring land fragmentation. *Computers, Environment and Urban Systems*, *39*, 71–80. https://doi.org/10.1016/j.compenvurbsys.2013.02.001

EISSN: 0128-178X
Volume 7 Issue 27 (March 2022) PP. 231-248
DOI 10/35631/JTHEM.727018
Edwards, C. J. W. (1978). The Effects of Changing farm size upon levels of farm Fragmentation: A Somerset Case Study. *Journal of Agricultural Economics*, *29*(2), 143–154. https://doi.org/10.1111/j.1477-9552.1978.tb02409.x

Evans, P. J. C. and F. C. (1954). Die Forstwirtschaft der Ostmark und ihre Beziehungen zur gesamtdeutschen Volkswirtschast. *Ecological Society of America*, *60*(17), 445–453. https://doi.org/10.1007/BF02315373

Gónzalez, X. P., Marey, M. F., & Álvarez, C. J. (2007). Evaluation of productive rural land patterns with joint regard to the size, shape and dispersion of plots. *Agricultural Systems*, *92*(1–3), 52–62. https://doi.org/10.1016/j.agsy.2006.02.008

Hair, E. C., Anderson Moore, K., Hadley, A. M., Kaye, K., Day, R. D., & Orthner, D. K. (2009). Parent marital quality and the parent-adolescent relationship: Effects on adolescent and young adult health outcomes. *Marriage and Family Review*, *45*(2–3), 218–248. https://doi.org/10.1080/01494920902733567

Heston, A., & Kumar, D. (1983). The persistence of land fragmentation in peasant agriculture: An analysis of South Asian cases. *Explorations in Economic History*, *20*(2), 199–220. https://doi.org/10.1016/0014-4983(83)90022-0

Hooper. (1999). *ARROW @ TU Dublin*. 1 to 57.

Igbozurike, M. (1976). *FULLTEXT01.pdf*.

J. Loogaa, Jürgenson, J., E. Sikk, K., Matveev, E., & Maasikamäe, S. (2018). Land fragmentation and other determinants of agricultural farm productivity: The case of Estonia. *Land Use Policy*, *79*(August), 285–292. https://doi.org/10.1016/j.landusepol.2018.08.021

Janus, J., & Markuszewska, I. (2017). Land consolidation – A great need to improve effectiveness. A case study from Poland. *Land Use Policy*, *65*, 143–153. https://doi.org/10.1016/j.landusepol.2017.03.028

Jayne, T. S., Yamano, T., Weber, M. T., Tschirley, D., Benfica, R., Chapoto, A., & Zulu, B. (2003). Smallholder income and land distribution in Africa: Implications for poverty reduction strategies. *Food Policy*, *28*(3), 253–275. https://doi.org/10.1016/S0306-9192(03)00046-0

Latruffe, L., & Piet, L. (2014). Does land fragmentation affect farm performance? A case study from Brittany, France. *Agricultural Systems*, *129*(40), 68–80. https://doi.org/10.1016/j.agsy.2014.05.005

Leimeister, J. M. (2010). Collective Intelligence. *Business & Information Systems Engineering*, *2*(4), 245–248. https://doi.org/10.1007/s12599-010-0114-8

Lipton, M. (1993). Land reform as commenced business: The evidence against stopping. *World Development*, *21*(4), 641–657. https://doi.org/10.1016/0305-750X(93)90116-Q

National population Commission. (2010). *Population Distribution by Sex and Class-size of Household*. *VIII*.

Overholt, D. H. (1991). Environmental Protection in the Antarctic: Past, Present, and Future. *Canadian Yearbook of International Law/Annuaire Canadien de Droit International*, *28*, 227–262. https://doi.org/10.1017/s0069005800004124

Richardson, J. T. E. (2011). Eta squared and partial eta squared as measures of effect size in educational research. *Educational Research Review*, *6*(2), 135–147. https://doi.org/10.1016/j.edurev.2010.12.001

Shuhao. (2005). *Land Fragmentation and Rice Production :A Case Study of Small Farms in Jiangxi Province, P. R. China*. Wageningen University.

Sikk, K., & Maasikamäe, S. (2015). Impact of agricultural landholding size on the land fragmentation. *Research for Rural Development*, *2*, 301–306.

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 7 Issue 27 (March 2022) PP. 231-248
DOI 10/35631/JTHEM.727018
Tan, S., Heerink, N., Kuyvenhoven, A., & Qu, F. (2010). Impact of land fragmentation on rice producers' technical efficiency in South-East China. *NJAS - Wageningen Journal of Life Sciences*, *57*(2), 117–123. https://doi.org/10.1016/j.njas.2010.02.001
Van Hung, P., Macaulay, T. G., & Marsh, S. P. (2007). The economics of land fragmentation in the north of Vietnam. *Australian Journal of Agricultural and Resource Economics*, *51*(2), 195–211. https://doi.org/10.1111/j.1467-8489.2007.00378.x
Wang, Y., Zang, L., & Araral, E. (2020). The impacts of land fragmentation on irrigation collective action: Empirical test of the social-ecological system framework in China. *Journal of Rural Studies*, *78*(May), 234–244. https://doi.org/10.1016/j.jrurstud.2020.06.005
WFP. (2016). *Emergency Food Security Assessment in Gujba and Gulani LGAs, Yobe State, Nigeria Emergency Food Security Assessment Emergency Food Security Assessment in Yobe State, Nigeria*. *October*.
Yobe State Government, (YBSG). (2016). *Yobe State Socio-Economic Reform Agenda (Yosera-IV) 2016-2020*. 2016–2020.
Zemba, A. A., Umar, Y., & Binbol, N. L. (2018). Climatic information as evidence of desertification processes in northern Yobe State, Nigeria: Implications for agriculture and ecosystem. *Global Journal of Pure and Applied Sciences*, *24*(1), 117. https://doi.org/10.4314/gjpas.v24i1.14