

Effects of Land Fragmentation on Agricultural Production in Girei Local Government Area of Adamawa State, Nigeria

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Abstract

Land is a key resource particularly in rural areas where a number of significant resources for livelihood and other activities were derived, but due to traditional systems of inheritance of land and property and individual access to large agricultural land is becoming difficult. This study examines the impact of land fragmentation on agricultural production in Girei Local Government Area (LGA) Adamawa State, Nigeria with a view to improve farming productivity. The study used primary data which were generated from the respondents through the administration of 120 copies of structured questionnaire. The combination of stratified and systematic random sampling was used to administer the questionnaire. Correlation analysis and frequency counts were used to analyzed the generated data and to test the relationship between Fragmentation and agricultural productivity. The result indicated that 53%, 52% and 7% pattern of land ownership. The study further reveals that $R=0.3$ which is a weak correlation meaning that other factors affect agricultural production. The study concludes that there is no relationship between number of farm lands and crop yield and that land fragmentation tends to increase production costs and have negative impact on crop yield. The study recommends that policies and agricultural programmes in Nigeria should take into cognizance the existing land tenure systems and the problems that emanate from them.

Key-words: Land, Fragmentation, Agriculture, Land Tenure, Production.

Introduction

Land is a finite productive resource held as a source of livelihood and a financial security transferred as wealth across generations. Land becomes very important because all forms of human activities are performed on land (Kakwagh *et al.*, 2011 and Rahman *et al.*, 2009). Land fragmentation refers to farmers operating two or more geographically separated tracts of land, taking account of the distances between those parcels (Bizimana *et al.*, 2014). Land fragmentation is alternatively named pulverization or scattering and is a situation where a farming household possesses several non- contiguous parcels of land often scattered over a wide area (Bentley *et al.*, 1987., Bello *et al.*, 1980., Awotide *et al.*, 2010., and Austine *et al.*, 2012) Land fragmentation as a phenomenon is very common in Nigeria, especially north-eastern Nigeria where agricultural lands are continually fragmented and shared among children as inheritance. The rational use of agricultural land is influenced by land use limitations. One of the obstacles for agricultural development is land fragmentation (Austin *et al.*, 2012), Land fragmentation is considered as an obstacle to agricultural development because it hinders mechanization, causes inefficient production and involves large cost to alleviate the adverse effects resulting in a reduction in farmers net income (Dijk., 2007). Dominant problem associated with land fragmentation is the small size, irregular shape, and Dispersion of parcels (Demetriou, *et al.*, 2013). Land fragmentation harms land productivities in a number of ways; fragmented land holdings can increase transport cost and might also cause difficulties to grow certain crops, and prevent farmers from changing to high profit crops, other costs that are linked to fragmentation is the hindering of economies of scale and mechanization. For instance, (Bentley., 1987) argued that many different plots allow farmers access to land of different qualities when it comes to soil, slope, micro climatic variations etc. Land fragmentation according to him equally allows

farms with scattered plots to benefit from risk management through the use of multiple eco-zones and the practice of crop scheduling. Tan (2005) and Gasiorowski *et al.*, (2014) have opined that land fragmentation negatively affects agricultural productivity in the following ways: hindering agricultural modernization, making it costly to modify adverse effects of consolidation schemes, there is also a problem of investment on the part of individual farmers. Population growth is one of the major factors triggering land fragmentation. Though not directly related to land fragmentation, Malthus's principle of population can be considered as the first effort made to link implications of steadily growing population on land. Malthus thought if uncontrolled, population growth would accelerate pressure on land resources thereby undermining the livelihood of the people (Okunmadewa, 2002., and Olayiwola *et al.*, (2006).

The problem of land fragmentation emanating from steadily growing population has been reinforced by the tradition of land inheritance. According to Maasikamäe, (2005), fragmentation of land should be understood first as a spatial phenomenon and treated as a multi-level phenomenon described as external land fragmentation, and mutual location of the kinds of land uses within the land parcel is described as internal fragmentation. Land holdings and parcels gradually get smaller and dispersed when they are fragmented which could then lead to sub-optimal usage of factor inputs and thus lead to lower overall returns to land which can be attributed to extra travel time, wasted space along borders, inadequate monitoring and inability to use certain types of machinery such as harvesters (McPherson *et al.*, 1983; and Thapa *et al.*, 2005). When farm plots are fragmented, development of agricultural infrastructures such as irrigation and canal and development of farm roads incur high cost; sometimes even construction of such may be constrained (Oluwasola, 2012). Furthermore, various researchers have empirically tested the effects of land fragmentation in different aspects of agricultural production; For example, (Tan, *et al.* 2010) investigated the effects of land fragmentation on the productivity of major crops, crop output of rural households, and the technical efficiency of rice producers.(Kawasaki., 2010) evaluated both the costs and benefits of land fragmentation in rice production in Japan. (Corral.,*et al*, 2011) have also analyzed how land fragmentation affects the profits of Spanish dairy farms. In most of these researches, land fragmentation is represented by the number of plots and their size. These two variables are employed, either directly or indirectly by the use of more elaborate measures such as the Simpson index (SI) which is given in equation 1;

$$SI = \frac{4\pi A_i}{P_i^2} \quad (1)$$

Where: A = Area
i = parcel
Pi = Perimeter of parcel
4 = Constant

Due to traditional systems of inheritance of land and property, individual access to large agricultural land is becoming difficult. Past works on the effects of land fragmentation have argued that as population increases, the size of holdings fall, and are progressively fragmented into small plots, dispersed over a wide area, for residential purposes. Evidence from the survey of Nigerian land tenure system revealed that the per- capita land holdings of small farmers declined from 1.53 hectares in 1968 to 0.8 hectares per-capita in 2010 (Gasiorowski *et al.*, 2014). Austin., *et al.*, (2012) have investigated the persistence of small farms, land fragmentation and small farm productivity. Most of the researches conducted at the local and state levels have identified the structure of land fragmentations at the local and state levels respectively. Girei being proximate to the state capital couple with the phenomenal increase in settlements is expected to have increased demand for land for various uses leading to land fragmentation. A number of large communal and family land holdings also appear to being fragmented. the study will ascertain the nature and extent of land fragmentation and its impact on farming in the study area.

Study Area

Girei Local Government Area is located between Latitude $9^{\circ} 11' N$ and $9^{\circ} 39' N$, and Longitude $12^{\circ} 21' E$ and $12^{\circ} 49' E$. It has a total land mass of about 2,186.59959 km (PHA, 2016). Girei is bordered by Song at the North, Fufore at the East, Demsa at the West and Yola North to the south. The relief and topography of Girei is generally regarded as low land area with 80% of the entire area being less than 500m above sea level (Adebayo., 2020). The Climate experience distinct dry and wet season with temperature and relative humidity varying with season (Adebayo, 2021). The wet or rainy season is between May to October. It is characterized by maxima in August. The area has an average of 162 raining days while average amount of rainfall recorded in the area is 972mm, the dry season which is the harmattan period engulf by dry and dusty north-east trade winds that blow over the area from the Sahara Desert. The ambient temperature is relatively high almost all over the year round with average ranges from a minimum of $28^{\circ} C$ to a maximum of $40^{\circ} C$ (Adebayo., 2021). The hottest month being April with an average of $38^{\circ} C$, while the coldest period is between December and January with the mean average temperature of $28^{\circ} C$. Girei has a population of 178,031 with male constituting about 53% and female accounting for 47% of the total population (NPC., 2007). Agriculture is the main economic activity in the area, the flat fertile low land area with the numerous streams and rivers support large scale agriculture. The farming activities in the area are mainly grain produce, fishing is also carried out on the River Benue and other smaller rivers.

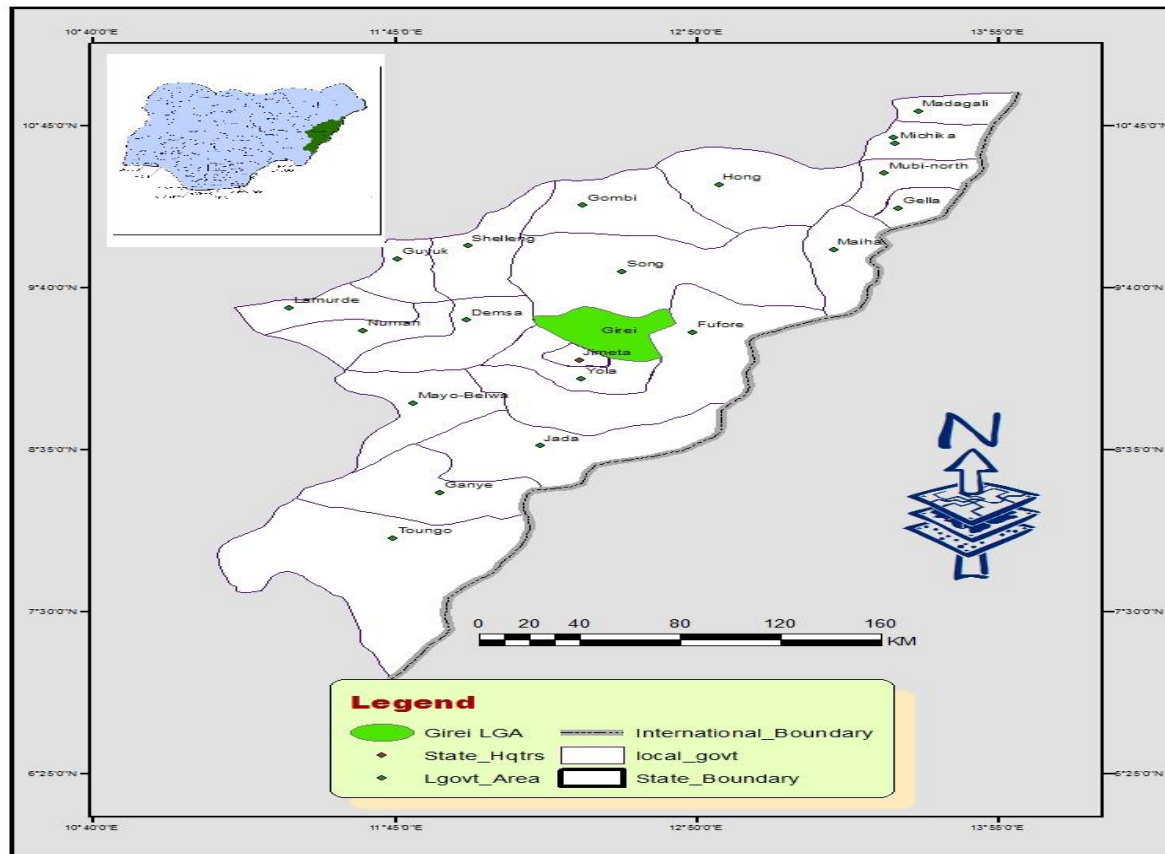


Figure 1: Map of Adamawa State Showing Girei Local Government Area
Source: Author's GIS., 2022

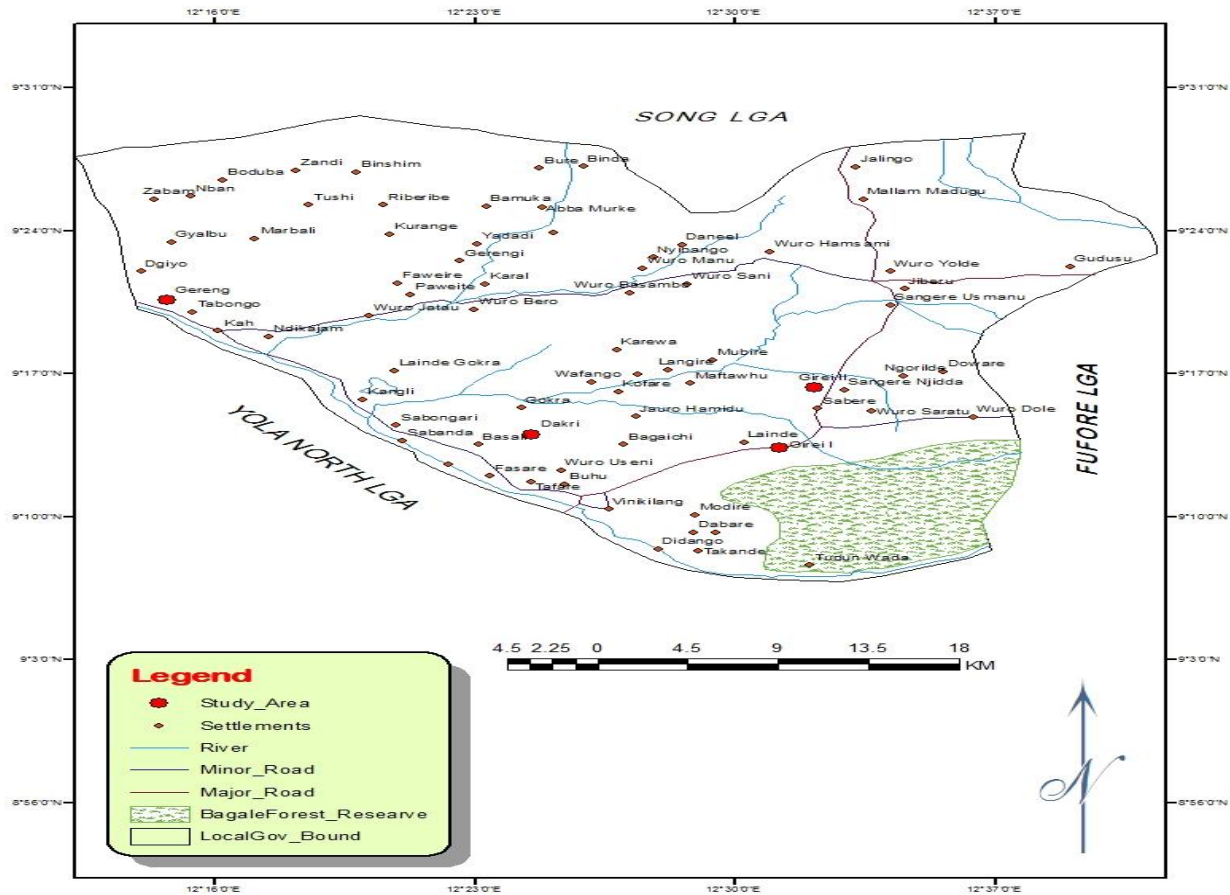


Figure 1: Map of Girei Local Government Area showing the Study Area
Source: Author's GIS., 2022

Materials and Methods

The study used primary data which was obtained through administration of 120 copies of structured questionnaire in which socio-economic characteristics and the mode of land acquisition of the respondents were sought. The questionnaire used comprised of closed-end and an open-end questionnaire which allowed the respondents to freely express themselves without being subjected or restricted to alternatives already provided as in the case of the closed-end questions. The combination of stratified and systematic random sampling was used, in which the number of wards selected for questionnaire administration was based on stratified sampling method, simply because the number of populations of the wards differs greatly. The first household sampled was selected randomly in each of the ward while systematic sampling was used to select every fourth household in the wards for the subsequent sampling. Data collected were subjected to simple frequency count and correlation analysis to assess the impact of land fragmentation on agricultural productivity.

Results and Discussion

Table 1 present results on the variation in land ownership pattern in the study area. The result of the findings revealed that, land ownership through purchase, lease or rent is lower in Dakri 7% and Gereng 8% which are in a rural setting as compared to Girei I 52% and Girei II 53%. This indicated that sales of land in rural areas are rear because most families see it as an inheritance and legacy that must be preserved in the family. The result further revealed that there is a high percentage of land ownership through inheritance especially in Dakri 66% and Gereng 69%. This is in line with a result of Islam 2014,

where he reported the higher percentage of land ownership through culture and traditions. The land holding pattern also reflects the socio-economic activities of the people; being that agriculture is the main economic activity of these rural areas, farming households will for instance experience family breakdown due to generational change.

Table 1: Method of Land Acquisition in Girei Local Government Area

Land ownership	Dakri (%)	Gereng (%)	Girei I (%)	Girei II (%)
Inheritance	66	69	52	53
Purchase	7	8	17	12
Rent	7	8	17	23
Lease	7	10	11	12
Communal	13	5	3	-

Table 2 present result on the educational status of the respondents. The result revealed that few female respondents have attained tertiary education, where majority of the female respondents have received no formal education. This is because women in the area are seen as home keepers and opportunities to attain tertiary education is not given to them because its seen as irrelevant since they will end up as house wives.

Table 2: Educational Status of Respondents

Educational status	Dakri	Gereng	Girei I	Girei II
No formal education	12	9	6	3
Primary education	9	16	18	5
Secondary education	6	14	6	5
Tertiary Education	2	0	5	4
Female educational status	-	-	-	-
No Formal Education	5	5	1	3
Primary Education	3	2	3	1
Secondary education	1	2	6	2
Tertiary education	0	0	1	1

Table 3 present result on the gender and marital status of the respondents, the result indicated that there are more married male 75% and single men accounting for 15%. This result is not surprising considering that women marry earlier than their male counterparts who must first find a source of sustenance and in most cases become self-reliant before settling down.

Table 3: Gender Distribution and Marital Status of the respondents

Marital Status	Male	Female
Single	15	6
Married	75	68
Divorced	5	20
Widowed	5	6
Total	100	100

The result on the causes of land fragmentation (table 4) revealed that population growth is certainly one of the main causes of land fragmentation 43%, reason been that if the population stabilized, the number of land holdings and parcels would not increase rapidly under the influence of other factors. Thus, growing population is the main reason then followed by urbanization 27% and increased nuclear family 16% and immigration accounting for 14% respectively. Irrespective of the landholding size or economic

status, eligible household members tend to have a share from their paternal and maternal property, as it does not incur any cost to them.

Table 4: The Causes of Land Fragmentation

Causes of Land Fragmentation	Frequency	Percentage (%)
Population growth	49	43
Urbanization	32	27
Increased nuclear family	18	16
Immigration	16	14
Total	115	100

Results presented on Table 5 shows the relationship between Education and Occupation of the respondents, the result indicated that the level of education influences the choice of occupation, those without any formal educations account for 35% and 60% respectively and therefore engages in farming and craft activities. According to Pafili, (2011) the employment of individuals, in all societies and all times reflect their social structures and education level. In particular, the distribution of various professional roles and developments over time identified the character of each society.

Table 5: Educational Status and Choice of Occupation

Educational Status	Trader (%)	Farmer (%)	Civil Servant (%)	Craft (%)
No Formal Education	31	35	14	60
Primary Education	34	52	19	30
Secondary Education	18	10	19	10
Tertiary Education	07	03	48	-
Total	100	100	100	100

The result of correlation analysis on the relationship between number of farmlands and the crop yield (productivity) of farmers (Table 6) revealed a weak correlation where R = 0.3.

Table 6: Yield of Farmers and Number of Lands

Number of lands	2	4	3	1	4	5	3	1	5	2	4	3	3	2	2
Yield (bags)	12	8	6	5	2	9	10	14	4	6	4	3	13	8	7

Hypothesis:

H₀ = There is no significant relationship between the number of lands and yield of farmers.

H₁ = There is significant relationship between the number of lands and yield of farmers.

$$R = \frac{\frac{\sum XY}{n} - \bar{X}\bar{Y}}{\sqrt{\left(\frac{\sum X^2}{n} - \bar{X}^2\right) \left(\frac{\sum Y^2}{n} - \bar{Y}^2\right)}} \quad (2)$$

R = 0.3, Degree of freedom = n-2, DF = 15-2 = 13 and the table value at 5% level of Significance is 0.514. Therefore, since the table value is greater than the calculated value, we accept null hypothesis (H₀) and reject the alternative hypothesis (H₁). We therefore conclude that there is no relationship between the number of farm lands and yield. The above result implies that although there may be a relationship between the number of farm lands and yield, the relationship is not significant. By implication, other

factors such as rainfall, soil fertility, fertilizer and even climate itself plays a role in the yield or productivity of farmers.

The result on the relationship between farm yield and distance to farm lands (table 7) have revealed that Farmers whose agricultural lands are located more than 5km away from their place of residence are seen to have more yield, this is associated with factors such as; availability of fertile soil, presence of large agricultural lands which will invariably allow farmers to practice mechanized farming more conveniently. This study further reveals that most farmers whose farms are less than 5km away produce mainly for individual and family consumption while those whose farms were in distant locations either produce strictly for commercial purposes or for both commercial and subsistence.

Table 7: Average Distance to Farm and Yield of Farmers (Bags)

Distance in Kilometer	Farm and Yield of Farmers (Bags)			
	1 - 4 (Bags)	5 - 9 (Bags)	10 - 14 (Bags)	>15 (Bags)
< 1	2	3	5	7
1-3	4	5	9	4
4-5	7	5	6	16
>5	6	3	9	28
Total	19	16	29	55

Table 8 present result on gender variation and method of land acquisition, the result revealed that land acquisition in the study area is mainly by inheritance 62% for male and 59% for female, and this may not be disconnected with the fact that female children equally inherit land from their deceased parents. But however, in the course of sharing the land, there is a laid down religion and traditional rule or pattern, in most cases, the female child does not get the same size as the male children in the family.

Table 8: Gender Difference and Method of Land Acquisition in Girei Local Government Area

Method of Land Acquisition	Male		Female	
	X	%	X	%
Inheritance	49	62	24	59
Purchase	7	9	2	5
Rent	9	11	4	10
Lease	11	14	6	14
Communal Land	3	4	5	12
Total	79	100	41	100

Conclusion

The study concluded that land ownership 53%, 52% and 7% gave an irregular pattern in the area, while system of inheritance is more pronounced 66% and 69%. The study further concluded that there is no relationship between the number of farm lands and crop yield ($R=0.3$). Best on the findings of this study, it was concluded that, land fragmentation tends to increase production costs as well as negative impact on crop yields. In addition, land fragmentation also tends to reduce the revenue and profitability of the farm. It is recommended that the new advances in agricultural practices should be encouraged to cushion the effect of land fragmentation. Government policies and agricultural programmes that would pay particular attention to land holding patterns should be put in place. Furthermore, practical steps should be taken by government at federal, state and local Government levels to address the problem of land fragmentation. In addition, farmers' small-sized farms should be made more productive by providing them with agricultural inputs, services and technical advice at affordable prices to farmers.

The Land Fragmentation used in this research work, namely the number of plots and the average of plot size, may not reveal the full set of significant relationships with farm performance because they do not capture all the dimensions of land fragmentation as they exclude distance considerations. In this respect, the grouping index used seems to be powerful. But however, circumventing the absence of information regarding the location of the farmsteads by computing distances relative to the farm barycenter, as we have done in this paper, may introduce some bias that would be worth investigating.

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