

Land Fragmentation and Food Security in Ugunja Sub-County, Siaya County, Kenya

Vincent Obonyo^{a*}, Dr.Charles Otieno^b, Prof.Francis Ang`awa^c

^aSchool of Humanity and Social Sciences Department of Geography, Jaramogi Oginga Odinga University of Science and Technology; Kenya, P.O Box 23 -40605, Sidindi, Kisumu, Kenya.

^bSchool of Humanity and Social Sciences Department of Geography, Jaramogi Oginga Odinga University of Science and Technology; Kenya, P.O Box, Kisumu, Kenya.

^cSchool of Humanity and Social Sciences Department of Geography, Jaramogi Oginga Odinga University of Science and Technology; Kenya, P.O Box, Kisumu, Kenya.

^aEmail: Obonyovincen6@gmail.com

^bEmail: Cotieno70@yahoo.com

Abstract

Globally, land tenure comes in different methods such as inheritance, renting, purchasing and land being offered as gift. Such practices have so far encouraged land fragmentation leading to small holdings which are uneconomical in terms of land use practices resulting into low yields. Such low food productions from small holdings in Ugunja coupled with poor food access from other sub-counties cannot sustain households up to the next harvest hence the problem of severe perennial famine which is an indicator of food insecurity.

The broad objective of the study was to investigate the relationship between land fragmentation and food security in Ugunja Sub-county, Siaya County. The study was guided by the specific objectives as follows; to determine causes of land fragmentation, to evaluate the effects of land fragmentation on crop farming and livestock production and to assess attitude of farmers towards land fragmentation on food production. The study aimed at finding out challenges of small holder farmers on land fragmentation and came up with strategies and policies that promote sustainable land use. The study was anchored on Schultz inverse relationship theory on land holding sizes and productivity that also helped to develop the conceptual framework.

* Corresponding author.

The study adopted descriptive research designs with both qualitative and quantitative approaches majoring on field observation, purposively interviewing Land and Agriculture Ministry officials and households clustered in their respective locations through questionnaires. This was done to make the researcher be in full contact with the study area and the respondents for collection of ample data. The target population of the study was 21,150 households, from which 378 households were obtained as the study sample size. The data collected was cross tabulated by employing a statistical package for Social Science (SPSS version 19) that generated both descriptive statistics and inferential statistics. The major findings were as follows; most lands in the area were under ancestral tenure at 66.8%, land inheritance is the main cause of land fragmentation at 68.3%, buying at 26.3%, leasing at 2.7% and lastly land offered as a gift at 1.5%. The second findings were as follows fragmented plots results into low farm acreages which at times are scattered leading to low food production. However, the last finding on farmers attitude indicated that majority of farmers at 67% oppose land fragmentation and only 33% have positive attitude towards land fragmentation. and are able to maximize food production through biotechnological approaches. The study further concluded that small acreages leads to low yields as analysed by chi-square test on farm sizes versus crop yields($\chi^2=1.16@d.f=2,p=0.05$). When Rank correlation coefficient of farm sizes versus number of livestock was analysed a strong positive relationship($R=0.99$) was established, meaning reduced farm sizes leads to reduced livestock. The study recommends; government policy makers should review settlement policy plans and come up with policies that encourage land consolidation in order to promote food production through modern agricultural practices. Secondly, sensitization strategies for family planning be done to reduce population pressure on the available land. Lastly, agriculture stakeholders to offer loans and incentives to help boost production.

Keywords: Land Fragmentation; Food Security; Kenya

1. Introduction

We live on land ,we plough lands, we mine lands, and we sell land and perform many other activities on land. It is an essential natural resource, both for the survival and prosperity of humanity, and for the maintenance of all global ecosystems as noted by author in [1]. A person may have a big parcel of land or a small parcel or even no parcel of land at all. People are so in need of parcels of land leading to so many means practised to acquire the said pieces of land for the many activities carried out.

History shows that land and agriculture have played the leading role in global socio-economic, political life and is still playing the lead role in meeting the daily needs of majority of the people around the world as claimed by author in [2]. In Kenya, about 20 percent of the total land is suitable for agriculture; however, the importance of land as a factor of production cannot be downplayed and that is why out of total households within the country, 78 percent are agricultural households with land parcels as cited by author in [3].

In Kenya, and many other places around the world, there is the scarcity of land for food cultivation and production as the number of people in need of land for building has increased so much so that most agricultural farmlands in Kenya are small spared portions of lands within people's homesteads. Author in [4] defines agricultural land as the land base upon which agriculture is practiced, therefore agricultural lands are the basis

for food production. The food production levels have been used as part of the poverty measuring paradigms. Globally, food availability is an essential function of cost of living. Conference report in [5] defines food security as the time when all the people at all times have access to sufficient, safe, and nutritious food to maintain a healthy and active life.

Food security is seen in the world over as an important principle in dealing with the food problems in society. It is the basis for ensuring healthy price levels, particularly in the developing countries. Ensuring food security should therefore be an essential component in development planning in all the countries as suggested by author in [6] and Kenya is not an exception.

Despite the great efforts and improved technologies presented mostly from the a developed country, food security has still not yet been achieved by the third world countries and poses a major problem to not only Siaya County but much also to Ugunja sub-county. According to author in [7] the precarious situation of food security is mostly due to subsistence farming characterized by the use of inefficient tools such as hoes and cutlasses, rain fed farming ,land tenure system to mention but a few. According to the World Hunger Education Services, more than 10% of the world's malnourished live in Asia and 26% in Africa. In effect about 1.02 billion people suffer from chronic hunger worldwide.

Access to land in Kenya has been the major source of livelihoods for small and medium farmers. But access to land is governed by the tenure arrangements such as land inheritance, leasing/renting, purchasing which in turn results into land fragmentation as noted by author in [8]. Land fragmentation is the practice of farming a number of spatially separated plots of owned or rented land by the same farmer and can be seen as common phenomenon in many developing countries.

From the historical context fragmentation in the past meant farmers needed to move from one land plot to other plot as opposed to being able to cultivate one farm as a continuous unit. This originates back from bush fallowing and shifting cultivation done by the pastoral communities like the Khoi-Khoi in south western coast of South Africa in the neighbourhood of Cape Town. The land fragmentation practice was common with traditional agriculture in Africa continent, Asia and Australia where ancestral or communal holdings were customary secured as claimed by author in [6]. Fragmentation is related to and often occurs in conjunction with the phenomenon of land sub-division which describes a process of dividing a single plot of land into two or more separate plots.

Land fragmentation has had various implications on agricultural practices with some studies indicating a positive outcome while others indicating a negative outcome as cited by author in [9]. In Ugunja sub-county, Siaya County, land sub division has always revealed negative outcomes i.e. excessive land subdivisions is commonly cited as an impediment to agricultural development because of the inefficiencies involved in owning several non-contiguous parcels in terms of travels and costs. In some cases, severe sub-division might be difficult in applying new agriculture techniques or use of tractors and productivity levels may tend to be threatened as confirmed by author no [3] in his studies in Mbeere, in the eastern regions of Kenya.

In Kenya presently, land fragmentation practices still being undertaken, come as a result of either population pressure or attachment to ancestral securities of holdings. Land fragmentation is still widespread and affects the farmers' decisions and impacts either negatively or positively on farm land production and performance. Author in [10] observes that, land ownership has always been an emotive subject and its ancestral ownership concepts has always been contested both nationally, regionally and even at family level.

Most communities have claims over certain sections of the Kenyan land on the basis of inheriting it from their great grandfathers and to some extent even use grave yards, symbolic sites and remnants homesteads of their ancestors to legitimize their ownership states author [11]. However, land inheritance due to customary practices maybe considered a major contributing factor to land fragmentation as cited by author in [2].

In the context of food security, most of the developing countries, owing to the ever increasing population size, this population has put a lot of pressure on the available land and the result has been numerous uncontrolled land sub-divisions due to ancestral inheritance and succession from their great parents to construct homesteads leaving very small parcels for food production or farming as stated by author in [8]. This trend impacts negatively on the agricultural activity and the food availability since whatever is produced from the farms cannot sustain the households up to the next season harvest meaning perennial famine in the region.

Majority of land owners in Ugunja sub-county still rely on ancestral land inheritance as a security ownership, leasing/renting, traditional agricultural practices and consequently, cases of food insecurity have been reported in the region. It is against this background that the present study seeks to investigate the effects of land fragmentation on food security in Ugunja sub-county.

1.1 Statement of the Problem

Land fragmentation, is a situation where a single farm consists of a number of separate land plots in one place or separate places. It is a common agricultural phenomenon in many countries, Kenya included. Land fragmentation is said to be a constraint to efficient crop production and agricultural modernization in several countries, this has resulted in the implementation of land consolidation programs in many parts of the world.

In Ugunja sub county, Siaya County within the lake region, farmers are operating on very smallholdings which are composed of numerous, spatially dispersed parcels as noted by author [8]. This has adversely affected food security and agricultural modernization in parts of Ugunja sub- County where the practise is pronounced. The small holdings or dispersed plots are uneconomical in terms of agriculture land use practises resulting into poor yields and low profits that cannot sustain households to the next harvest. This leads to perennial famine or food insecurity in the sub county and people have to access food deficit in other counties. However, little attention has been paid to understand the impact of land fragmentation on agricultural productivity, resource use efficiency and agricultural profitability/production efficiency.

Although there are empirical studies on how land parcel fragmentation affects agricultural productivity and profitability author in [10] claims that there is gap in the academic study as to whether and how this affects food security in the country. Worse still is inadequate or lack of conclusive research on the extent at which land

fragmentation interferes with agricultural practices and food security of a given area in the country. Therefore, the current study seeks to establish the causes of land fragmentation, its effects on crop and animal production and attitudes of the farmers towards the practice of land fragmentation.

1.2 Objectives of the Study

The broad objective of the study is to investigate the relationship between land fragmentation and food security in Ugunja Sub-county, Siaya County. The study was guided by the following specific objectives;

- i. To determine causes of land fragmentation in Ugunja sub-county, Siaya County.
- ii. To evaluate the effects of land fragmentation on crop farming and livestock production in Ugunja sub-county, Siaya county.
- iii. To assess the attitude of farmers towards land fragmentation in Ugunja sub-county Siaya county

1.3 Theoretical Framework

The study is anchored on Schultz inverse relationship theory on land holding sizes and productivity. Since the publication of the theory in 1964, more advocates and researchers have come up all over the world starting from Russia, Europe, Asia and Africa in support of the theory.

The theory believes that the number of plots due to sub divisions from one single holding May only reduce the plot sizes but not the production instead it should motivate the farmers into improving their farming techniques through increased use of fertilisers, certified seeds and zero grazing techniques for livestock production. This ultimately will improve the yields and profits acting as dependent variables. The theory works well when other intervening or confounding variables like the level of education of farmers are improved and even farmers are assisted with farm inputs or loans. Those who are opposed to the theory argue that the opposite may also arise where subdivision of farms leads to small acreages and low yields particularly when farmers are negative and not motivated about fragmentation. This might be so when little is done in terms of farmers level of education and improvement of technology, the farms may deteriorate to the extent that yields become lowered. The theory was known as inverse relationship or negative relationship since it went against empirical studies and theories which believed that increase in sub-division of farms will lower the farm sizes and violate the fundamental tenets of positive production and economies of scale hence production per unit would fall.

2. Materials and Methodology

2.1 Area of Study

Ugunja sub-county lies within the equator and is 40km south of the equator on latitude $0^{\circ} 10'52.97''N$ meaning equator equally divides the county into two halves. It also lies along the Eastern longitude that is longitude $34^{\circ} 17'47.04''E$ East of the prime Meridian.). The sub-county covers an area of 201.0 square kilometres with a population of 88,458 people represented by 21,150 households as in the report no [13]. The area is therefore densely populated with an average density of 440 persons per square kilometre, ranking among the most densely

populated regions of the sub Saharan Africa as reported in no [13]. The dense population implies that the high number of households may put a lot of pressure on the limited available land leading into land fragmentation and that may affect food security.

The topography of the area is generally low lying as it slopes towards the lake hence forming part of the lake basin with few ridges and gentle slopes. The River Nzoia and its streams such as Wuoroya, Huludhi all flow into Lake Victoria and provide the climatic and topographical situation of Ugunja.

Ugunja, Siaya County experiences the tropical climate throughout the year. It has the annual rainfall which ranges between 1,100mm and 1,700mm, temperature ranges 10⁰-15⁰ (climate-data organisation). It has a bimodal rainfall pattern with long rains falling between March and June and short rains between August and November.

Farming is the main occupation of the area, done mainly through mixed farming for subsistence purposes. Crops like maize, beans, millet, sorghum, sugarcane, fruits and vegetables are also grown. Despite most parts of the area receiving favourable climate. Subsistence crop farming and keeping of local breeds of livestock is common. This implies that the main source of food and income for the people of Ugunja comes from agriculture as noted by author in [14].

2.2 Research Design

The study adopted a descriptive survey approach in order to find out the relationship between land fragmentation and the food security situation in the sub-county. Descriptive survey was the suitable approach for the study since large groups of population was interviewed and a number of households were sampled purposively and randomly.

Descriptive survey further gave the state of affairs and facts as they existed since observation and direct administration of questionnaires formed part of tools for data collection and finally data collected was analyzed and described by both descriptive and inferential statistics such as Chi Square (χ^2) through use of SPSS software as cited in author[15].

Out of the 21,150 household heads, the study used 378 as the sample size, who were the household members of Ugunja Sub-County, and were administered with questionnaires for quantitative data. This group were sampled through stratified random sampling technique.

On the other hand, purposive sampling technique was used to select officials from the Ministry of Lands and Survey and Respondents from the Ministry of Agriculture and Livestock Developments who provided qualitative information on land sizes, Land registration, land sub-divisions and crop yields or produce respectively, through interview guides. Observation schedule/check list was also adopted to indicate areas of observation in the field and to take photographs.

3. Results and Discussions

3.1 Socio-demographic information of the respondents

In Table 1 respondents' age was very important since it helped in determining who were actively involved in the agricultural production. From the response, the mean age which was 38.4 was falling between the modal ranges of 31-40 years. This can be deduced that the productive age of 31-40 was actively involved in the acquisition and production of agricultural goods and it was followed by the age bracket 21-30 at 25.4 percent, with the youths below 20 years showing no much interest on agricultural activities. This was also a factor that greatly affected the food security, for instance in North Uholo location, South Ugenya location and East Uholo location, the study found that over 20.7% of the farming activities were only left to the aged above 50 years as the young and active leave for urban areas in search of jobs. When respondents were asked on their marital status, majority of them happened to be married at 76.3% while only 7.5% were single and the widows/widowers were 9.0 % as per table 4.1. This implies that married couples followed by widows/widowers are the most active group involved in agriculture as they most probably have dependants to support unlike the other groups such as single whom are majorly youths and have probably gone for white collar jobs in the urban. Though the assumption made for married couples was on the possibility of having dependants, the question by the questionnaire on the number of household dependants was poorly responded to as people answered by giving the number of everybody who depended on them including the extended families, something contrary to what the researcher needed which was the information on the immediate family of the respondent i.e. as sons and daughters who have hereditary rights to the land.

Based on gender Table 1 further depicts that there were more females than males in the study as depicted by majority of the respondents at 52%. This concurs with the statistics report in [13] which also found that the ratio of male to female in this region is almost equal, although there were more females than males.

On the question of land ownership, only 55.4% were sure to have got lands on their names, while 34.5% were not sure of owning land and were either staying at the land lords apartments or in their fathers land which had not been sub divided. 10.2% on the other hand were not sure whether they had lands to themselves or even needed the lands mainly the newly married women who believe in culture that land ownership is the preserve for men.

Table 1 also indicate level of education where the study found that majority of the respondents at 45.2% had only preliminary education. Based on specialization on the activities of farmers in the area, the study established that most of the residents of Ugunja sub-county practiced both livestock and crop production implying that land sub-division would influence greatly their agricultural production capacity

3.2 Causes of land fragmentation

The study found that causes of land fragmentation were dependent on method of land acquisition, land tenure systems, average size of land and the comparison of average size of land to the ancestral land.

3.3 Method of Land Acquisition in Ugunja sub-County

The study revealed that farmers used various methods of acquiring land , 68.3% of the farmers indicated that they inherited the land, 26.3% indicated they bought, 2.7% indicated they leased, while only 1.5% obtained the land as a gift from friends and relatives as shown in figure 1 below.

Table 1: Socio-demographic characteristics of the respondents from the households (n=334)

Characteristics	Frequency	Percentages
Age		
Below 20 years	11	3.3
21-30 years	85	25.4
31-40 years	99	29.6
41-50 years	64	19.2
50 years and above	69	20.7
Gender of the Respondents		
Male	174	52
Female	160	48
Level of Education		
None	69	20.7
Primary certificate	151	45.2
Post primary certificate	114	34.1
Area of specialization		
Crop husbandry	104	31.1
Horticulture	43	12.9
Livestock	66	19.8
Marital Status		
Widow/widower	30	9.0
Divorced	3	0.9
Married	255	76.3
Single	25	7.5
Separated	10	3.0
Family size /dependant		
0	52	15.1
1-5	119	35.6
6-10	92	27.5
11-15	36	10.7
Above 15	15	4.4

From the results, it is clearly evidenced that majority of the respondents acquired the land through inheritance which was a factor promoting land sub- division as all the off springs share the land they inherited from their

parents.

This response supports the findings by authors in [6] in their study on economics of farm fragmentation. According to their findings, most of the lands in African societies are acquired through inheritance, and that inheritance and customary practices led to land fragmentation as people divide their land to achieve equitable distribution among their heirs as customs demand.

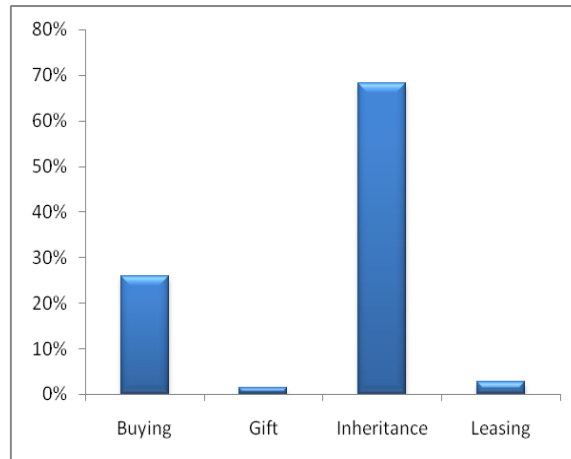


Figure 1: Methods of land acquisition in Ugunja sub-county

3.4 Land Tenure System

The study also found that majority of the respondents at 66.8% had acquired their land through ancestral tenure (Table 2).

Table 2: Land tenure system in Ugunja sub-county

Variable	Percentages
Ancestral Tenure	66.8
Leasehold	3.3
Private	18.0
Squatter	2.7
Total	100.0

This implies that land will continue to be fragmented to keep with the customary demand. Similarly authors in [16] in their study on land sizes and fragmentation in Southern Rwanda , found that most of the lands were under ancestral tenure hence could be passed on and inherited by the heirs on equitable distribution.

3.5 Average Size of Land

The study found that almost half of the respondents (44.0%) had land acreage between 0-1acres, 33.8% had between 2-3 acres, and 8.4% indicated 4-5 acres, while a paltry 4.8% had above 5 acres (Table 3).

Table 3: Average size of the current land within Ugunja sub-county, (n=304).

Variables	Percentages
0-1 acre	44.0
2-3 acre	33.8
4-5 acre	8.4

This shows that majority of the respondents had a mere 0-1acre, attest to land fragmentation practice that had been going on in the society. Author in [3] also found that due to the customary tenure in cultures, the father had the responsibility of dividing his holdings equally among his sons hence reducing the original size of the land.

Further findings added that the bigger acreages of 2-3 and 3-4 acres could only be found on the periphery locations of North Uholo and Ugenya South bordering Kakamega County where a bit of cash crop growing of sugarcane was practiced in addition to food production.

3.6 Effects of land fragmentation on Crop and Animal Farming

The effects of land fragmentation on crop and animal farming could be established through analysing size of land left for crop and animal production, staple food commonly grown, average yield, number of cattle kept and comparison of the yield of crops and livestock with the previous yield prior to land sub-division.

3.7 Size of Land left for crop and animal production

In finding out the actual size of land that was left for agricultural activities, the study found that, 64.4% had only 0-1acre for agricultural practice, while only 2.4% indicated had above 5 acres for agriculture as shown in Table 4.

Table 4: The actual farm size left for agriculture

Farm sizes	Percentages
0-1acres	64.4
2-3acres	17.1
4-5acres	2.4
above 5acres	2.4

This shows that the amount of land left for agriculture and food production was comparatively small, implying that food security in the area was also negatively affected. This response concurs with Laure et al (2007) who also found that size of the land influence crop yield and that small piece of land for agriculture meant low crop yield and low profitability.

3.8 Crops Commonly Grown

According to the study findings, 55.4% of the respondents indicated maize, beans, millets, 27.6% mentioned vegetables, and 12.9% indicated potatoes and cassava, while only 4.1% indicated sugarcane.

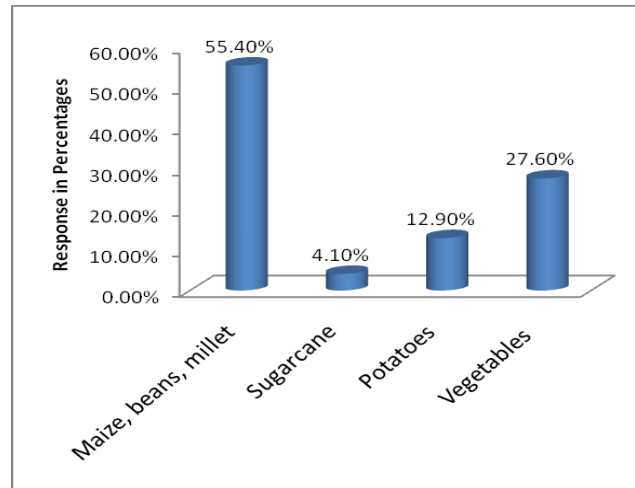


Figure 2: Crops Commonly Grown

Figure 2, Shows that only crops that require small size of land such as maize, beans, millet, potatoes and vegetables were majorly grown, while those that required big size of land such as sugarcane were not common. This response supports that of author in [11] in his study of African land tenure and agricultural production. In his study, he found that the excessive sub-division as an impediment of agricultural development because of inefficiencies that comes with owning a small unit which limits modern agricultural techniques.

3.9 Average Yield for Crop

Understanding the average yield for crops was crucial in order to find out the effects of land fragmentation on crop yield. According to the study findings, 67% indicated that they received 0-3 bags of crop yield, 21.5% indicated 4-5 bags, while only 11.5% could manage to obtain above 5 bags (Table 5)

Table 5: Crop Yield

Crop yields	Percentage
0-3 bags	67.0
s4-5 bags	21.5
Above 5 bags	11.5

This shows that majority of the respondents were recording low yields from their parcels of land, justifying the effects of land fragmentation on yields. In their study on relationship between land fragmentation and maize

farmers productivity, authors in [17] similarly found that there was a direct relationship between size of land and amount of crop produced. The findings are further justified by the chi-square test analysis to show the significant association between size of land tilled and yield produced, where it was found that (χ^2 d.f.2,=1.16, p=0.037), implying that there is a significant relationship between size of land tilled and yield produced.

3.9 Number of Livestock Kept in Ugunja sub-county, Siaya County

Table 4.5 below revealed the number of cattle which were the common livestock kept per household in addition to other livestock like goats, sheep's & poultry.

The study reveals that majority of the respondents at 44.0% had only 1-2cows, 33.8% had 3-4 cows, 8.4% had between 5-6 cows, while a paltry 4.8% had above 7 (Table 6)

Table 6: Number of Livestock Kept

No. of cattle	Percentage
1-2cattle	44.0
3-4 cattle	33.8
5-6 cattle	8.4
above 7 cattle	4.8

This shows that most of the residents in this area had few number of herds kept and one of the possible justification for this could be small size of grazing field that cannot sustain large number of cattle. This response concurs with the results obtained by author in [1] who also in their study on effects of land fragmentation on firm profitability found that due to land sub-division, crop and livestock produce decreased as there was no sufficient land to grow fodder for animals or to be left as grazing land, while in terms of crops, limited land limits proper practice of crop production.

3.10 Crops and livestock yields compared with previous yield prior to land sub-division

Respondents were also asked to compare their yield with the previous years before land sub-division took place. According to the table findings, it is revealed that majority of the respondents at 63.4% indicated that yields for the previous years were more compared to the current, 24.1% indicated that yields were less; while 12.5% indicated that there were no change in the yields.

Table 7: Comparison of current yields and previous yields prior to land sub-division (n=334)

Variables	Percentages
Yields were less	24.1
Yields were the same	12.5
Yields were more	63.4

This shows that land fragmentation reduces yields and the findings are also supported by that of authors in [9] in their study on land fragmentation in Uganda. According to their findings, rain fed agriculture and crop production reduced confirming similar effects and challenges of land fragmentation as reduced agricultural production, inefficiency and hindrance to modernization of agriculture.

3.11 Attitude of Farmers towards land fragmentation and Food Production

In establishing the attitude of Farmers towards land fragmentation and Food Production, the study found that generally, the agriculture officers were in agreement that their attitude towards land fragmentation is positive since in either of the cases of disadvantages and advantages of land fragmentation, all depends on how farmers maintain and sustain soil quality and drainage for the sake of good crop yields and stall feeding for livestock production.

When their opinions were sought on whether land should be further sub-divided, generally, 67% were opposed to the idea, while only 33% indicated otherwise. This shows that majority of the respondents did not approve land fragmentation practice as the idea could limit proper participation on agricultural activities.

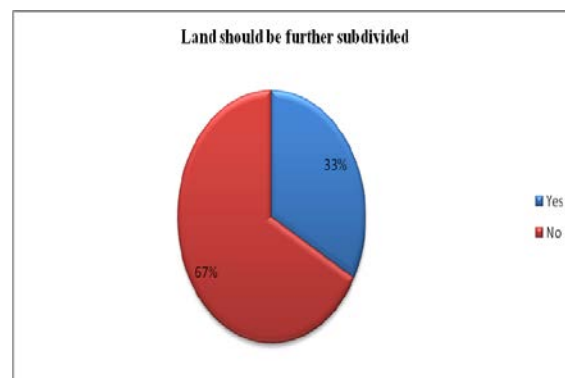


Figure 3: Whether land should be further divided

These findings concurs with the findings of author [6] who also found that although customary inheritance still persist in the contemporary society, most of the society members do not like the idea of since affects their decisions on farm land production and performance.

3.12 Problem of land fragmentation

The study findings reveals that majority of the respondents at 58.5% linked the problem of as the land being too small for settlement and agricultural production, 19.7% indicated that encouraged land conflict, 15.5% indicated that it encourages land inheritance, while 4.8% could not identify the problem associated with . This shows that land fragmentation was associated with various demerits which could be counterproductive to land productivity. These findings supported that of author in [18] who after investigating the effects of land fragmentation on production cost, crop output and technical efficiency of rice producers in China, found that this trend impacts negatively on the agricultural activity and the food availability since whatever is produced

from the farms cannot sustain the households.

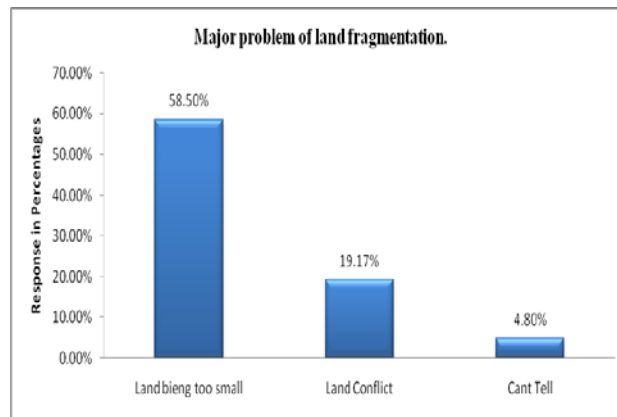


Figure 4: Major problem of land fragmentation.

3.13 General Perception on land fragmentation

Assessing the general perception on land fragmentation using likert scale shows that majority of the respondents at 67.8% agreed with the view that land fragmentation reduces farm land that could be meant for agricultural production hence lowering yields. This conforms with the findings of author in [9] who found that fragmentation and sub-division are frequently viewed as detrimental to agricultural productivity and obstacle to modernization of agriculture.

Table 8: Attitude and Perception of Households on Land Fragmentation

Statement	A	N	D
Fragmentation has lead to reduced farm land	67.8	10.0	22.2
Fragmentation has lead to reduced yields	57.8	12.0	30.5
Fragmentation has led to land dispute	57.3	11.3	31.7
Fragmentation has lead to peaceful coexistence	51.8	8.0	40.2

A=Agree; N=Neutral; D=Disagree

Table 8 also found that majority of the respondents at 57.3% viewed land fragmentation as a source of land disputes such views were supported by land disputes cases in land board and lands office. However, based on the positive effects of land fragmentation, the study found that majority of respondent at 51.8% agreed that land fragmentation had led to peaceful co-existence especially among family members who believed that once the land is sub-divided, then each and every benefactor could manage their land in his/her own way.

4. Conclusion

In conclusion, based on the study findings, it can be concluded that there are several causes of land fragmentation but majorly, land inheritance and land selling were some of the major causes. Land fragmentation was found to be having more disadvantages than its merits especially when it comes to its effects on crop and livestock production, given that it decreases amount of crop yield, livestock rearing and encouraged land conflicts. Based on these findings, most of the residents of Ugunja sub-county do not advocate for land subdivision but instead opted for buying of land elsewhere. It can also be concluded that through land consolidation, most of the farmers could practice modern agriculture such as tilling using tractors and sparing other land spaces for animal grazing and growing of fodder for animal feeds.

4.1 Recommendations

Based on the study findings, the study recommends that:

- The government policy makers should review settlement plan policies and come up with policies that encourage land consolidation with the view of promoting food production through modern agricultural practices. The community should be sensitized on the benefits of land consolidation with the view of promoting their food security.
- The Government and other stakeholders should offer incentives. These incentives could consist of tax credits, other government-supported schemes, improved access to credits or could be attached to other programs such as access to leasing of state-owned land or technical support from the extension service. These incentives would encourage modernization of agriculture for improved food production even on small parcels.
- General recommendation on family planning to reduce population pressure on the available land. Residence of Ugunja sub county needs to be sensitized to encourage population movement or migration to purchase land elsewhere where there is space to reduce the burden of land subdivision.
- The last recommendation to the people of Ugunja sub-county should include sustainable land management strategies to be put in place. Such sustainable approaches could improve food security even if the lands are sub divided as long as agriculture technology is in place.
- In general, sustainability refers to meeting the needs of the present generation without compromising the needs of the future generations. Sustainable development is improving people's material well being through the utilization of the resources at a rate that can be sustained indefinitely.
- Sustainable agriculture is indeed concerned with the proper natural resource management and abatement of land degradation, since land (or soil) is a basic factor in this sector. Proper soil management aiming at improving the condition of the soil by actively integrating soil
- conservation practices with strategic policies can enhance agricultural productivity, food
- Security and sustainability, and thus have positive impact up on growth perspective irrespective of whether land is fragmented or not.

Acknowledgement

I take this opportunity to acknowledge the great contribution of my lead supervisors, Dr.Otieno, A. Charles and Prof. Francis, O. Ang'awa of the Department of Geography and Social Development, school of Humanities and Social Sciences from Jaramogi Oginga Odinga University. Their continued support through this journey of research and immense contributions in terms of advice and focus was indeed great to the overall success of this work.

I acknowledge the support offered by the entire staff at the Department of Geography and Social Development, for their encouragement and moral support to soldier on despite the challenges.

I am indebted to the contribution of my fellow classmates and staff who shared their ideas and opinion through positive criticism concerning the overall approach in this study. I must appreciate the role played by the Ministry of Agriculture and Livestock staff at the sub-county and Ministry of Lands for both Ugunja and Ugenya sub-counties for their research findings.

To all of you, I say thank you for your support. However, errors and omissions if any, emanating from this work, are solely due to the author and not contributors of this work.

References

- [1] S.Rahman, and M.Rahman. Impact of Land Fragmentation and resource ownership on productivity and efficiency: the case of rice producers in Bangladesh. *Land Use Policy* 26, 95-103.2008.
- [2] O.Atieno the Historical Anthropology of an African Landscape Book by David William Cohen, Nairobi Kenya.1999.
- [3] H.N E, Njeru. Land adjudication and its implication for the social organization of the Mbeere; LTC Research Paper No. 73 Land tenure centre University of Wisconsin's, (1978)
- [4] E.Kenk, & I. Cotic. Land Capability Classification for Agriculture in British Columbia. MOE Manual 1. Surveys and Resource Mapping Branch, Ministry of Environment and Soils Branch, Ministry of Agriculture and Food. Kelowna, B.C. 68 pp. ISSN 0821-0640 April, 1983
- [5] World Food Summit. Declaration on World food Security. Rome 1996.
- [6] B. Blarel et al. The economics of farm fragmentation: evidence from Ghana and Rwanda, *The World Bank Economic Review* 6, 233–254. 1992.
- [7] Van Hung et al "The Economics of in the North of Vietnam", The University of Sydney.2006.
- [8] R.S Odingo. The Dynamics of Land Tenure and Agrarian System in Africa. Land Tenure study in Nakuru; Kericho and Machakos counties study prepared for United Nation Food & agric. Rome. FAO.

Jan 1985.

- [9] R.Mwabeza & R.Gaynor (2002). Land sector analysis Report. Government of Uganda .Grant no. P@/2002/2004.
- [10] G.S, Niroula. G.B Thapa. Impacts and causes of Land Fragmentation, and lessons learned from land consolidation South Asia. *Land Use Policy* 22: 358–372.2005.
- [11] O. H.W Okoth, "Africa Land Tenure Reforms" Judith Hayber J.K Martha and W.M Senga (eds) *Agricultural Development in Kenya, an economic Assessment* .Oxford University Nairobi. 1976.
- [12] Schultz. Impact of production intensity on the ability of the agricultural landscape to generate ecosystem services: an example from Sweden, *Ecological Economics*, 31:241-249.1953.
- [13] KNBS Kenya National Bureau of Statistics. Nairobi, Kenya. 2009.
- [14] T.Munyanga, Farm productivity in Rwanda: Effects of land size, erosion, and soil conservation investments. *Agricultural Economics* 15,127-136. 2003.
- [15] Mugenda and Mugenda, *Research methods; quantitative and qualitative approaches* Nairobi, Kenya Acts press.2003.
- [16] T. Bizimana and M. Feffer. Land sizes and economic efficiency in Southern Rwanda volume 42, internet. 2004.
- [17] D.O.Awotide & P.O.Agbola. Relationship between Land Fragmentation and maize Farming productivity in Northern Nigeria a case study Tiv land region in Benue, Nigeria. 2010.
- [18] Nguyen T, Cheng E, Findly C. 1996. Land Fragmentation and farm productivity in China in 1990's. *China Economic Review* 7(2): 169–180.

Appendix A:

The Questionnaire for heads of Households in Ugunja Sub-County on Land Fragmentation and Food Security.

This questionnaire is intended to gather information purely for academic purposes.

I am a masters student at Jaramogi Oginga Odinga University of Science and Technology (BONDO) currently undertaking a research on and food security in Ugunja Sub-county Siaya County. I am sincerely requesting you to spare your time and volunteer information on the theme listed on the questionnaire. The information provided will be treated with the necessary confidentiality and used for the intended purposes only. I want to thank you in advance for your co-operation.

Section A: Demographic or Personal Information

1.1 in the table provided below with personal information, Tick () in the box provided, where You fall in the boxes provided. In a case where yours is left out then indicate in the space left for you.

AGE RANGE	GENDER	MARITAL STATUS	EDUCATION LEVEL	WORKING EXPERIENCE	LEVEL OF TRAINING IN AGRIC.	AREA OF SPECIALIZATION
Below 20 years <input type="checkbox"/>	Male <input type="checkbox"/>	Single <input type="checkbox"/>	Primary level <input type="checkbox"/>	Below 5 years <input type="checkbox"/>	Certificate <input type="checkbox"/>	Crop husbandry <input type="checkbox"/>
21-30 Years <input type="checkbox"/>	Female <input type="checkbox"/>	married <input type="checkbox"/>	“O” level <input type="checkbox"/>	6-15 years <input type="checkbox"/>	Diploma <input type="checkbox"/>	Horticulture <input type="checkbox"/>
31-40 Years <input type="checkbox"/>		Divorced <input type="checkbox"/>	“4” level <input type="checkbox"/>	16-25 years <input type="checkbox"/>	Bachelor degree <input type="checkbox"/>	Livestock <input type="checkbox"/>
41-50 Years <input type="checkbox"/>		Separated <input type="checkbox"/>	Graduate <input type="checkbox"/>	26-35 years <input type="checkbox"/>	Masters degree <input type="checkbox"/>	Veterinary <input type="checkbox"/>
50 years and above <input type="checkbox"/>		Widow/widower <input type="checkbox"/>	Post Graduate <input type="checkbox"/>	Above 36 years <input type="checkbox"/>	PHD <input type="checkbox"/>	Others Specify <input type="checkbox"/>

(i) As head of household do you have a plot of land of your own?

Yes No

(ii) If NO above then your house is on whose parcel of land?

Father Grandfather Husband Land lord

(iii) As head of the household who are your dependants and specify the number.

No

Brothers	<input type="checkbox"/>
Sons	<input type="checkbox"/>
Daughters	<input type="checkbox"/>
Wives	<input type="checkbox"/>
Others specify	<input type="checkbox"/>

Section: B: Nature of Tenure and Land Sizes

2.1. As heads of household the land where your house is found was acquired through which method.

Buying Inheritance Leasing Gift

2.2 The method of your land acquisition above falls under which tenure?

Private Ancestral tenure Leasehold Squatter

2.3 Your total average land size falls under which bracket of acreage.

0-1 acre 2-3 acres 4-5 acres Above 5acres

Please specify land portion under agriculture _____ acres and land portion under homestead _____ acres.

2.4 Compare the total acreage of your fathers or grandfathers 5 years ago with your current land size after the sub-division.

My acreage size is smaller My acreage size is bigger
 My acreage size is the same I cannot tell

2.5 Give your opinion or comment on the effects of sub-division or fragmentation of the ancestral land. Comment whether you agree or disagree with these statements.

	Agree	Neutral	Disagree
• Fragmentation has led to reduced farm land	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Fragmentation have led to improved crop yield	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Fragmentation have led to land disputes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Fragmentation have led to peaceful co-existence among the family members	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section C: Land Sub-Division and Food Security

3.1 How big was your fathers` land parcel before any sub-division?
 0 - 2 acres 3 - 4 acres 4 - 6 acres more than 6 acres

3.2 Is the land still intact as it was 5 years ago or has there been any sub-division?

3.3 If there has been any sub-division then to how many heirs or beneficiaries?

3.4 And what has been average share acreage of one benefactor?
 0 - 2 acres 3 - 4 acres 5 - 6 acres Above 7 acres

3.5 What is the actual size of your farm?
 0 - 2 acres 3 - 4 acres 5 - 6 acres Above 7 acres

What portion is reserved for homestead _____ and what portion is reserved for farm land _____

3.6 What type of staple food do you grow or which crop do you plant in your farm?

3.7 Do you plant cash crop? _____
 If yes which cash crop? _____

3.8 What is the average yield in your farm from the staple food?
 0 - 1bag 2 - 3 bags 4 - 5 bags Above acres

3.9 Compare the yield currently in your farm and the yields that could come from your father's farm 5 years ago. Yields are the same Yields currently are less
 Yields are more I'm not sure.

Can the current yield from your farm sustain your family up to the next season?

YES NO

If no where do you get your surplus food? _____

4.0 If the current yields are low then can you guess any reason for the difference?

4.1 What types of animals do you keep?

4.2 If you keep cattle's, then what's the approximate number of cows in your herd?

1 – 2 cows 3 – 4 cows 5 – 6 cows Above 7 cows

4.3 Compare the number of herds of cattle your father or grandfather used to keep and the number you are keeping.

I keep many animals as before Keep few currently

I keep same number I am not sure

4.4 Give your opinion or comment on the effect of land sub-division or fragmentation of the family land with respect to food security. State whether you agree or disagree with the comment.

4.4 land fragmentations exists due to populated pressure

Agree Disagree Not sure

4.5 Small sub-divided parcels lead to low crop yield

Not true Agree Disagree Not sure

4.6 Farms now can use tractors better than before

Agree Disagree Not sure

4.7 Modern farming techniques can easily be applied

Agree Disagree Not sure

4.8 Number of cattle kept has gone down with

Agree Disagree Not sure

4.9 Land fragmentation has made people adopt new farming techniques and skills

Agree Disagree Not sure

5.0 Land Sub-Division and Attitude of Farmers.

5.1 State one advantage of land consolidation to a farmer.

Settlement Planting of one type of crop Use of tractor is possible Farmers can rent

5.2 Do farmers agree easily to their land parcels being further sub-divided?

Strongly agree Agree Don't agree Strongly don't agree

5.3 State one major problem of land fragmentation to a farmer.

Land available for settlement Land become too small Inheritance is possible Farmer can produce many crops

5.4 Would you like the traditional land inheritance practices to continue?

Yes or No

5.5 If NO above then what options should farmers adopt?

Allow sons to be squatters Buying Leasing land Settlement purposes