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The sway of land available for farming activities and diversification among smallholder farmers in Rungwe district, Tanzania

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ABSTRACT

Availability of productive land provides a pivot role in crop production among the farming households and in determining the farming systems. Better access to productive land increase productivity and crop production as it forms the main part of the production resources. The study used a survey method for collecting both secondary and primary data. The secondary data collected through reviewing relevant and up to date existing document information related to the study from the internet, survey reports, library and institutional documents. Beside the Primary data were collected through the key informant interviews (KI), focus group discussions (FGD), household survey, Field observation and in-depth interviews. The results indicate that farmers owned small size of land ranging from 0.25 or less to 10 acres within a range of 9.75 at a mean of 2.46 with Std of 2.01. The Pearson Chi-Square results signify that the total size of owning land within the village had a value of 65.816 with df 44 and Asymp. Sig. (2-sided) 0.018, total land borrowed had a value of 17. 355, with df of 14 and Asymp. Sig. (2-sided) 0.238. These results indicate that land ownership and land use are not normally distributed inferring the land fragmentation and high land pressure in the area. Land fragmentation has effects on crop intensification, mechanization and commercialization. Diversification, development of innovative, improved technologies and enhancing climate resilience among farming communities suggested in the formation of an important option for future situations. Doing so needs to include long-term and concerted efforts to improve land access and management strategies and promote understanding of agricultural production, interactions between socio-political structures and functions as well as ecosystem attributes.

Keywords: Land fragmentations, farming, diversification and smallholder farmers.

1. INTRODUCTION

Smallholder farmers engage in agricultural production to sustain their livelihood. Access to productive land is among the challenge of sustaining production in

areas with limited agricultural diversification. Agricultural diversification has been recognized in achieving food security, improving human nutrition and increasing rural employment. It can favourably also impact on soil fertility, pest incidence and adaptation to climate variability. Smallholder farmers experience challenges stemming from population growth, urbanization, income disparities, land degradation, decreasing farm size and productivity compounded by the uncertainty of climatic patterns (Leliveld et al., 2013; Chen et al., 2018). To realize significant agricultural production access to land plays a crucial role in conjunction with socioeconomic, technical, political and environmental conditions. Through, in many parts of the world, productive land is not available for agricultural production, thus, people who want or need to farm and make a living have little opportunities to access and improve production (Darnhofer *et al.,* 2012; FAO, 2012).

Higher contributions in the food basket to feed a large population in developing countries are from the smallholder farmers. They determined cropping pattern by household-food needs and food crops being the priority, however, due to the shortage of land, larger proportionate allocations can be made to higher-value crops (Gwambene 2018). Shortage of productive land has implication for intensification and commercialization of small-farm and rural enterprises (Singh et al., 2002). It is, therefore, more profitable - to diversify and make frequent changes in crop choices in order to enhance food crop production and increase income among smallholder farmers. It is well recognized that future increases in agricultural production accrue essentially through increased production per unit land area. To realize and achieve higher production and income and enhanced the livelihoods of smallholder farmers and communities there is a need to empower the smallholder farmers to access the crucial production resources.

The small percent of the total cultivated land is owned and used by smallholder farmers for crop production to sustain household food security and income generation. It is postulated that as the population increases, so does the number of smallholder farmers, leading into further land fragmentations among households (Singh et al., 2002). For the household operating small size farms in the rural poor, low productivity constitutes a major constraint as they strive to achieve household food security. Smallholder farmers adopt agricultural practices through intensification that involve adopting more practices and diversification involving adopting different practices (Chen et al., 2018). Intensification and diversification strategies are on-going activities on the farm (Gwambene, 2011; Chen et al., 2018). However, the strategies may change in response to changing environments, including access to crucial production resources. These resources are land, water, energy, appropriate technologies, and opportunities to develop the skills and to access the information wherewith to use them (Singh et al., 2002; Liwenga *et al.,* 2009, IFPRI, 2012; URT, 2009). Thus, a need for a better understanding of agricultural intensification and diversification is likely to increase resilience in crop production.

Agricultural diversification is an important mechanism for economic growth depending on opportunities and response to those opportunities. Agricultural diversification can be facilitated by technological breaks-through, by changes in consumer demand or in government policy or in trade arrangements, and by the development of irrigation, roads, and other infrastructures (Liwenga *et al.,* 2009, IFPRI, 2012; URT, 2009). Conversely, it can be impeded by the low access to mechanized farm equipment, for example, results in low agricultural productivity, especially, in smallholder farming system whereby they handle their crops, primarily by hand (URT, 2007a; Gwambene, 2011; URT, 2015). The market and production cost to be invested may cause farmers to adjust their activities to meet the needs of consumers and this can have an impact on agricultural production (Nyunza and Mwakaje, 2012). Intensification and diversification are highly tentative and have been expressly promoted by government policies and facilitated by improved technologies. Strengthening smallholder farmers' role to facilitate higher productivity, stability, and sustainability of agricultural crop production and enhance food security.

2. METHODOLOGY

The study was conducted in the three agro-ecological zones (Lowland, Midland and Highlands zones) of Rungwe District in the Southern Highlands from October 2012 to 2018. It employed a combination of multi-stage, purposive and random techniques in selecting zones, wards, village, key informant and household in the study. A four-stage sampling technique, apply. The first stage sampling used to select the district specifically all the three agroecological zones. These zones have been selected on the basis that they are characterized with diverse type and variety of crops and its potentiality in agricultural production. The second stage involved a selection of a number of administrative wards from the already selected first-stage sampling units. Isongole, Kiwira and kambasegela wards in highland, midlands and lowlands zones were selected for the survey. The criteria for selection include its potential in agricultural production, accessibility and geographical location to represent all three zones that include lowland, midland and highland zones. The third stage sampling involves a selection of two villages in each of the units in the second-stage sampling. The first criterion explained under stage two above applied in the selection of the Mbeye 1, Kikota and Kapulampunguti villages. The fourth stage was a sampling of an individual from the selected villages. Purposive and simple random techniques

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used in selecting individuals and household for interviews. Both primary and secondary data were collected. The collection of secondary data involved reviewing existing documents or literature relevant and with up to date information related to the study of different sources including the internet, survey reports, library and institutional documents. Beside the Primary data were collected through the key informant interviews (KI), focus group discussions (FGD), household survey, Field observation and in-depth interviews. Multivariate, factor and cluster analysis were used in organizing and analyzing the data collected through different methods. The quantitative data were organized and analyzed using Statistical Package for Social Science (SPSS) and Microsoft Excel software. The qualitative data were analysed by using trend and content analysis. The results displayed in the form of Tables, description and Figures.

3. RESULTS AND DISCUSSION

3.1. Land acquisition and agricultural production intensification

The land owned in the study area is acquired through inheritance, redistribution by household heads of other family members who need it, buying, and also as a gift to close relatives or friends. Inheritance was the substantial mode of land acquisition among the surveyed respondents whereby about 66% of respondents acquired land through inheritance (See Figure 1). This result was partly attributable to cultural practices where pieces of land have to be allocated to children with a large percent being in the highlands zone. Same results revealed in the study by Tilumanywa, (2013) who found that inheritance is a dominant mode of land acquisition in the southern highlands. In many parts of the southern Highlands, the land of a father/ parents is divided between his/ their children leading to the breaking up of already small farms into smaller units which are uneconomic to farm. Such results indicate that land sales are uncommon in the area because of its shortage, as most farmers own less than three acres. However, due to the decrease in crop productivity in the area, land exhaustion, change in the weather pattern and low household income some farmers sell their land.

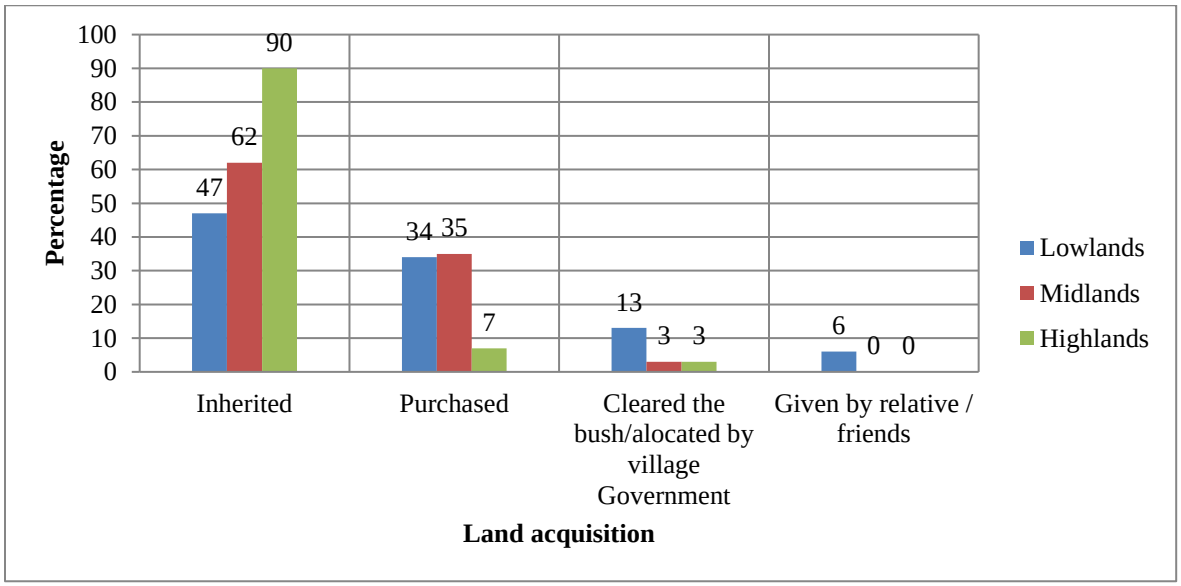

Figure 1 Land ownership and acquisition of farms

The results in Figure 1 indicate that most of the respondents acquired land through inheritance as reported retain (90%) in the highland, (62%) in the midlands zones and (47%) in the lowland zone. These results imply the high fragmentations of land, as each family/ household has to distribute land among the family members. The statistical test results indicate that the results are not by chance by X^2 =18.396; df = 8; and P= 0.018. Based on FGD, land fragmentation is among the factors that affect intensifications, mechanization and commercialisation of crop production. For example, in the midland zone crop diversification in which farmers used to grow the main crop and set aside a plot or plots for producing other crops and used to grow bananas and other crops near the homesteads has been reduced due to the small size of land. In addition, commercialization and intensifications of crop production are limited due to land fragmentations and ownership. Due to land shortage and increased production cost borrowing land commonly used as an alternative for landless farmers that provides an opportunity to stay in farming activities and improve livelihood (Figure 2).

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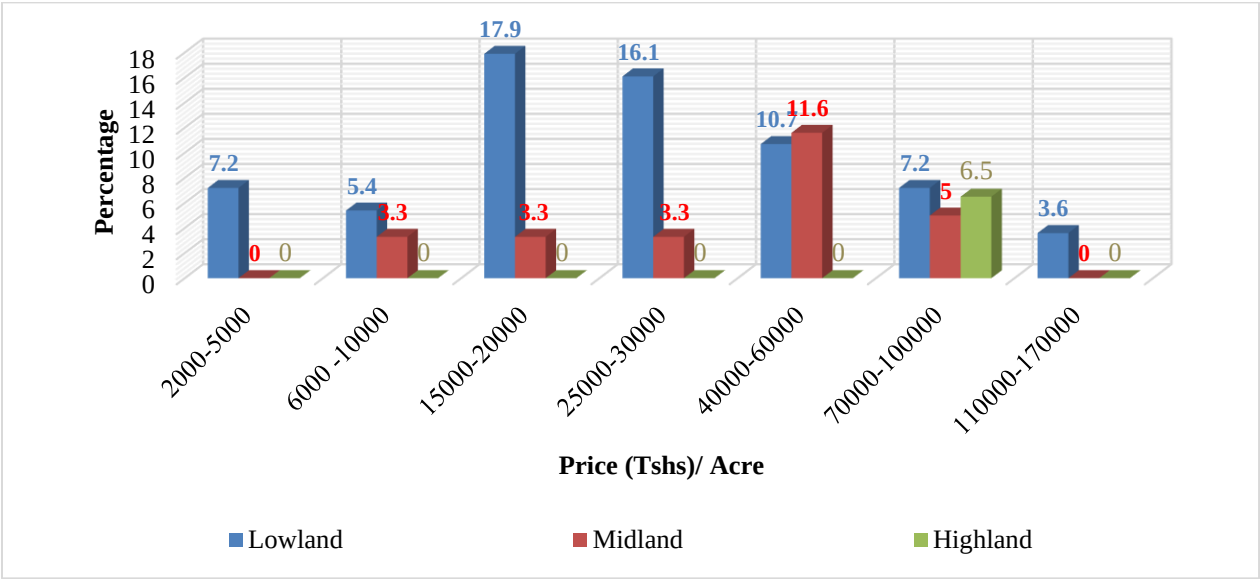

Figure 2 Price of land borrowed for crop production

The result in Figure 2 indicates the price variation for leasing the land for crop production across the zones. Based on FGD, household survey and key informant interviews land are borrowed either for free, cash or in kind. The amount paid for renting land range from Tsh 2,000/= to 170,000/= in the lowland zone, Tsh 6000/= to 100000/- in midland and in the highland it ranges between Tsh 70,000/= to 100,000/= (Figure 2). The price of renting land depends on the location and productivity of the land. For example, in the lowland, the price of renting land for rice production under irrigation, especially in Kasyabone (a neighbouring village) was higher as compared to land under rain-fed farms in other locations. When farmers in the lowland zone were asked about the reason for the high leasing price, they claimed that in the irrigation schemes, farmers are assured of production due to availability of water that increases security in agricultural crop production and enabled them to harvest twice a year. This was also the case in the highland zone where the booming growth of round potatoes had increased the leasing price of land.

Land ownership and borrowing affect the intensification of crops production and management practices. Thus, the need for diversification of livelihood and crop production through mechanization (use of improved seeds and fertilizer) and commercialization (improving market) and reduction of production cost. Farmers with smaller field size applied fertilizer to intensify production and maximize output. The use of fertilizer was high especially, in the midland and highland zones due to the limited farm in the area. Field observation showed a reduction of the fallow period in all zones. For example, in all zone fallow is not practised due to land scarcity and rented land for commercial production of potatoes having to be squeezed hard for as much annual production as possible. Such a situation increased the need and use of fertilizers to enhance soil fertility.

3.2. Land sizes and allocation for crop production

Land scarcity due to exhaustion and increase in population characterises agricultural production. In all study zones, farmers own small pieces of land. For example, in lowland and midland zones farm areas are small, ranging from 0.25 to 3 acres as indicated in Figure 3 for land owned within the village.

The results in Figure 3 indicates a small size of land owned with the smallest size be in midland and lager size in highlands zone. The disparity among the zones was due to biophysical characteristic. For example, the midland zone is more favours to grow many types of crops that attract more population. Smallholder farmers used to own many small size fields within and outside the village as the way to reduce the risk of crop failure and also due to land shortage in the area. This study revealed that most farmers own land or rent, land outside the village because they have access to land either through inheritance from their relatives or buying land because of fertility and conducive climate for agricultural crop production in the area. A few bought land as an asset in the place of origin or other nearby places.

There is a significant difference between the numbers of plots in the various zones. Across the three zones, farmers own many plots with larger sizes in the highland zone as compared to fewer plots owned in midland as indicated in Figure 4. Farmers own 1-3 plots in the lowlands, 1-3 in the midland zone, and 1-5 plots in the highlands. This may be attributed to limited access to agricultural land in the lowland and midland zones. The midland zone characterized by the production of diverse types of crops

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including tea that is either owned by tea estates, village government or individuals. Tea as a pure stand crop is not used for intercropping with any other crops, which reduces chances of using the land for other crops. It was reported, however, that some farmers have uprooted the tea plantations for opening the land for other agricultural crop production and or for settlement.

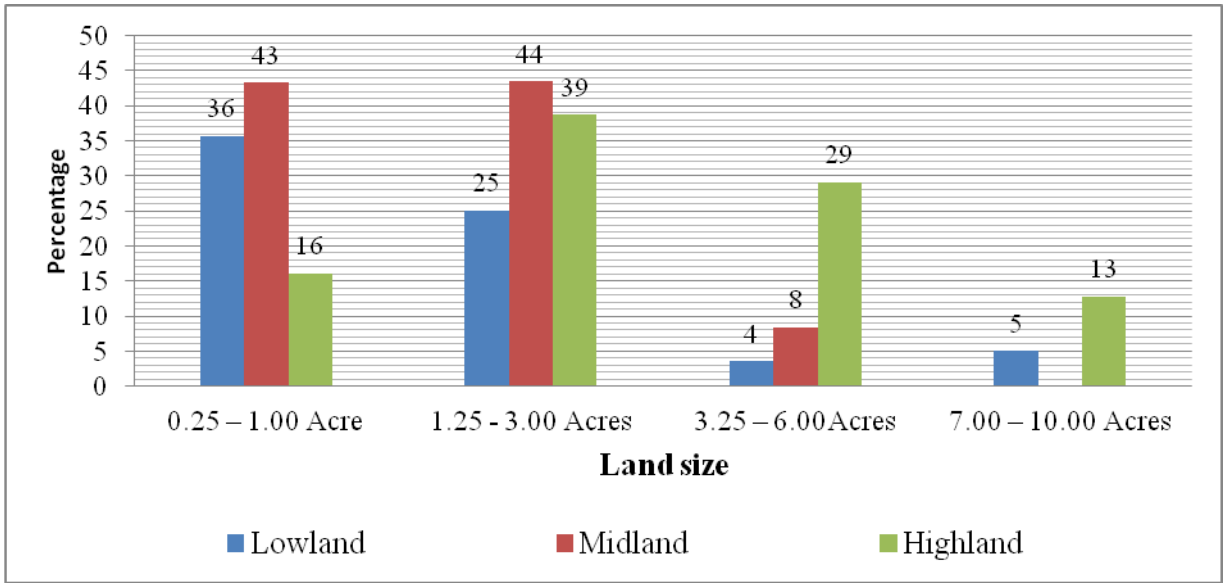

Figure 3 Land owned for crop production and other use within the village

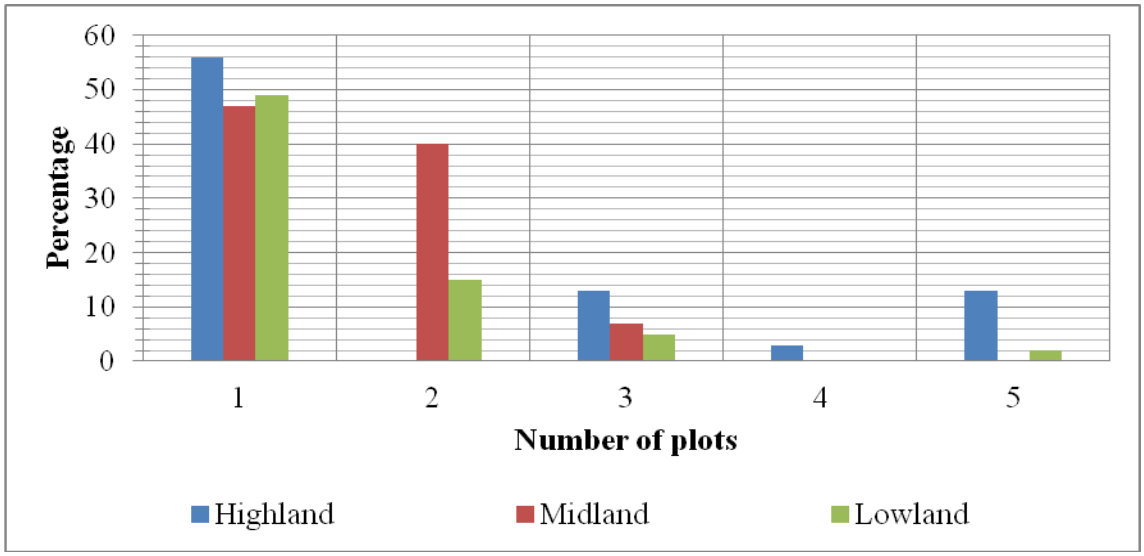

Figure 4 Number of plots owned within the village

The results showed that most of the respondents own one plot with few owning up to three plots in the lowland and midland while in the highland zone respondents owned up to five plots. It was further revealed that farmers owned more than one plot as the way of crop diversification to avoid loss during extreme weather events. Land fragmentations of the already small area have affected the crop diversification and intensification. The small size land also affects the estimation of cultivation of different crops because crops are grown on very small, secluded and scattered fields whose exact dimensions are unknown (Sokoni, 2013). It is common for a number of crops to be inter-cropped, and use the same field for the same or different crops, 2 or 3 times within the same year (Sokoni, 2013) discerned by seasons. The mixed cropping system in the district is mainly due to land scarcity, high population density and productivity of the arable land which allows mixing of different crops, banana spacing in this area was widely practised to meet farmers' production objectives.

The owned land is used for producing other crops in the area, while bananas are also mixed with some other crops such as beans, maize and tubers. This type of land use helps farmers to have a range of crops in a small piece of land. According to the FGD

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and Key informant interview, most of the crops produced under this system are mainly subsistence. This is partly due to the small size of the land on which commercial production is not common and difficult to practice. Based on key informants, such practice is common in the midland zone and is used as a way of crop diversification, which is important for food security and household income among smallholder farmers. Similar results were revealed in the literature (Bisanda *et al.*, 1998; USAID, 1999; Gwambene, 2012; Leliveld et al., 2013), where a range of crop types and varieties grow in different locations so as to diversify crop production and reduce the risk.

Agro-ecological zones and type of crop analysis indicated a significant interplay between cropping seasons and agro-ecological zones. Land allocation for particular crop varieties was linked to agro-ecological zones. The type of crops to be produced in all zones were determined and adjusted according to their characteristics and constraints across the agro-ecological zones. The highland zone is more devoted to round potatoes and maize production, the midland bananas receive high priority as compared to other crops, while in lowland zone, most farmers are involved in rice production. Based on the agro-ecological zones, farmers in the highland zone allocate more land for crop farming as compared to the lowland and midland zones. This was due to a lower population density and few crop varieties/ types in the highland. The average land owned and borrowed for agricultural production in all zones is indicated in Table1.

Table 1 The average size of land used for crop farming across the agro-ecological zones

Statistics	Lowland		Midland		Highland	
	Owned	Borrowed	Owned	Borrowed	Owned	Borrowed
N	39	38	57	19	30	3
Range	8.50	2.75	5.75	3.75	9.50	3.00
Minimum	0.50	0.25	0.25	0.25	0.50	1.00
Maximum	9.00	3.00	6.00	4.00	10.00	4.00
Mean	2.05	0.99	1.65	1.18	3.67	2.33
Std. Deviation	1.99	0.79	1.16	1.19	2.45	1.53

The largest average areas planted of the household are in the highland zone with an average of 3.67 acres, followed by lowland with an average of 2.05 acres, while the smallest area in the midland zone with an average of 1.65 acres. Increase of population in the area increased demand on land for agricultural production, as the available land has to be subdivided among the members/heirs of households. This observation is in line with Tilumanywa (2013) who also reports that issues of access to and use of land in Nyakyusa culture are still favoured by the traditional rules of inheritance. Such traditional land access has an influence on land size for different use.

3.3. Land size and access challenges for agricultural intensification

In the study area, respondents reported limited access to land as most farmers own or rent small pieces of land that are less than 2 acres. For example, the results from questionnaire survey indicated that an average farm size owned and used for agricultural production in the lowlands was about 2 acres, while in the midland zone and the highlands had an average farm size of 1 and 3 acres, respectively as indicated in Table 2. In the highland, there is more land than in lowlands and midland since the population density was still low. The small size of land in all zones resulted in subsistence farming with less incentive for commercial farming. Such situation results in the need for producing the most valuable with high yield crop types/ varieties so as to maximize the outputs.

Based on the results of a household survey the minimum size of land owned within the village is 0.5 acres in lowland, 0.25 acres in midlands and 0.5 acres in the highland, while the maximum size is 9 acres of low land with a range of 8.5, mean of 2.05 with a Std of 1.98. In the midlands, the maximum total size of land owned is 6 acres with a range of 5.75 at a mean of 1.65 with Std of 1.59. In the highland zone, the maximum size of total land owned is 10 acres with a range of 9.5 at a mean of 3.67 with Std 2.45. These results indicate land fragmentation and high land pressure in the area. This can affect crop diversification and implementation of adaptation measures, especially which involve utilization of large pieces of land. To complement these small sizes of land farmers own land outside the village or borrow the land. The size of land owned outside the village or borrowed is also small. It ranges from 1 - 6 acres for owned and 0.25 – 3 acres for borrowing in lowland, 0.25-4.00 acres of owned and 0.50 -2.00 acres borrowed in midland while in highland it ranges from 1-4 acres for owned and 0.5 – 3 acres for borrowing land with a mean of 2.33, 1.17 and Std of 1.52 and 0.98 respectively.

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Table 2 Number of plots and size of land owned/ borrowed within and outside the village

Agro-ecological zone	Land owned/ borrowed	N	Range	Minimum	Maximum	Mean	Std. Deviation
Lowland	Total acres owned in the village	39	8.50	.50	9.00	2.05	1.99
	Number of plots within	39	4.00	1.00	5.00	1.46	.854
	Total acres owned outside	11	5.00	1.00	6.00	2.23	1.69
	Number of plots outside	11	2.00	1.00	3.00	1.18	0.60
	Total Land borrowed for agriculture (acre)	38	2.75	0.25	3.00	0.99	0.79
	Number of plots borrowed	38	2.00	1.00	3.00	1.18	0.46
Midland	Total acres owned in the village	57	5.75	.25	6.00	1.6535	1.16
	Number of plots within	57	6.00	1.00	7.00	1.6667	0.95
	Total acres owned outside	9	1.50	0.50	2.00	0.8889	0.49
	Number of plots outside	9	.00	1.00	1.00	1.0000	0.00
	Total Land borrowed for agriculture (acre)	19	3.75	0.25	4.00	1.1842	1.19
	Number of plots borrowed	19	.00	1.00	1.00	1.0000	0.00
Highland	Total acres owned in the village	30	9.50	0.50	10.00	3.6667	2.45
	Number of plots within	30	4.00	1.00	5.00	2.0333	1.45
	Total acres owned outside	6	2.50	0.50	3.00	1.1667	0.99
	Number of plots outside	6	1.00	1.00	2.00	1.3333	0.52
	Total Land borrowed for agriculture (acre)	3	3.00	1.00	4.00	2.3333	1.53
	Number of plots borrowed	3	.00	1.00	1.00	1.0000	0.00

The statistical test on land ownership and land use in the study area indicated the high fragmentation of land used for crop production. The results from Pearson Chi-Square signify that the total size of owning land within the village had a value of 65.816 with df 44 and Asymp. Sig. (2-sided) 0.018, total land borrowed had a value of 17. 355, with df of 14 and Asymp. Sig. (2-sided) 0.238, while the total size owned outside had a value15. 905 with df 14 and Asymp. Sig. (2-sided) 0.319. Such results indicate that land ownership and land use are not normally distributed. The frequency of the small size land is higher than the large size forming leaner distribution as divergent to the normal distribution.

Key informant interviews and household surveys also revealed that most of the land owned within and outside the village is located around the hill slopes in the highland zone, while in the midlands most of the fields are located on gentle slopes and valleys. Similarly, in the lowlands, most of the fields are on flat land with few fields on the gentle slopes. Most of the fields owned within the study villages were characterised with poor soil fertility that needs additional nutrients mainly through the application of fertilizers. Such factors characterize the farming systems and determine the farming practices and type of crops/ varieties.

There is a significantly higher average acreage owned than those used through borrowing/ renting. About 51.8% of farmers borrow/ rent 0.25 to 1 acres in lowland, 33.3% borrow/ rent 0.25 to 1 acres in midlands and 3.2% borrow/ rent 0.25 to 6 acres in highland zones as indicated in Figure 5. The number of plots borrowed in the highland zone range from 1 to 3, while in the lowland and midland zones borrowed only one plot. The main crops grown on borrowed/ rented land in low land include rice, maize, and groundnuts; in midland include eggplants, tomatoes, maize, beans and garden crops are grown in the borrowed land, while in the highland zone the borrowed land is mainly used to produce round potatoes and maize.

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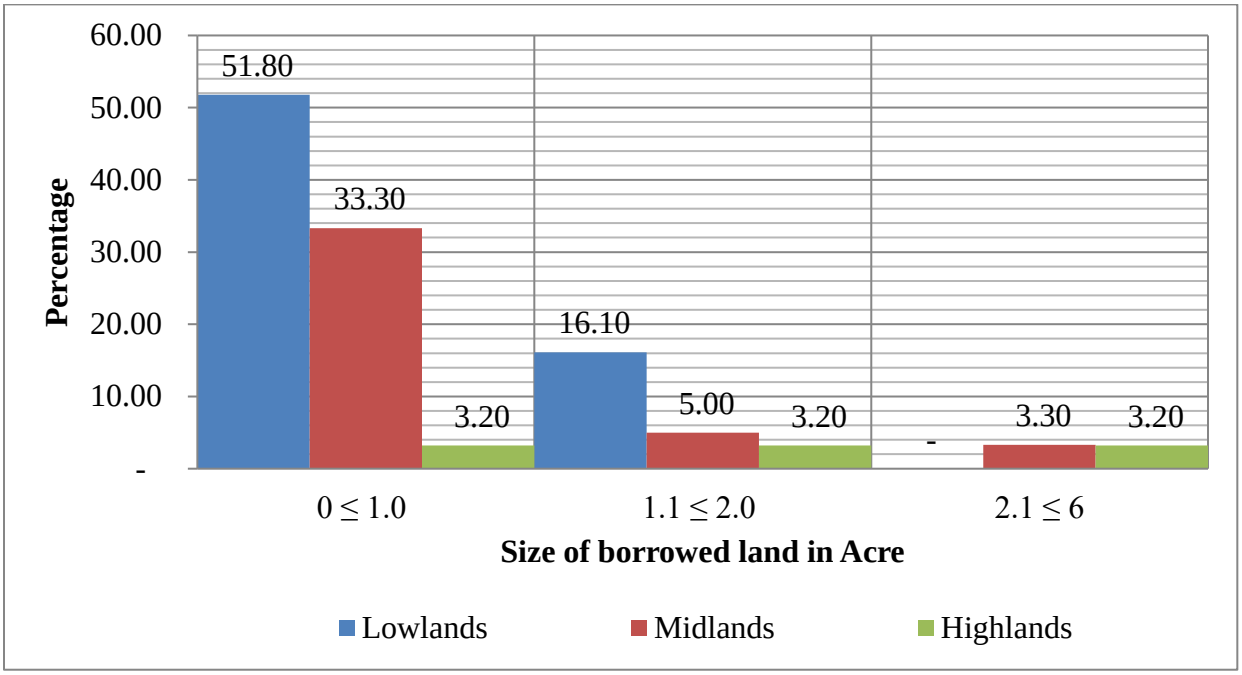

Figure 5 Total land size borrowed for crop production

The results from FGDs and key informant interviews further revealed that the borrowed land gets less management attention and thus result in low soil fertility and land degradation. It was revealed that farmers normally use borrowed land for a short time (one season or more) depending on the agreement with the landlord. Such a situation imposed challenges for long-term land management strategies and type of crops and varieties grown. The main challenges in land management include soil erosion, compaction, reduction of soil organic matter; a decline of soil fertility and loss of soil biodiversity (Gwambene, 2012). More soil degradation, observed in highland areas where there is an absence of policy incentives for good land management, high population density and shortage of land that place excessive pressure on land. Also, land ownership has an influence on land management for example rented land receives less management incentive, while the owned land can have long term management measures.

3.4. Socio-political implications on land availability and agricultural intensification

Intensification makes a substantial contribution, but in most cases, it is constrained by the size of the land and technology used. In the study area, productive land offers the most important potential for expanding food production. However, due to land fragmentation and shortage of productive land, farming productions among smallholder farmers depend on diversification and off-farm income. Farmers are more concerned with maximizing productivity in the small size area and income diversification. In this area, the agricultural intensification, mechanization and commercialization options are more restricted to land access, capital and technology. The study revealed that access to land, social and political factors have affected crop production. For example, the type of farming practised was related to the social structure that affected the type of crops grown.

These social factors can affect agriculture through access, and ownership of land (Tilumanywa, 2013). The government policies regarding land, irrigation, marketing and trade, etc., have a direct impact on agricultural production and development (Hassan and Nhemachena, 2008). The low access to mechanized farm equipment, for example, results in low agricultural productivity, especially, in smallholder farming system whereby they handle their crops, primarily by hand (URT, 2007a; URT, 2015). This involves an investment of more time, energy and money and also limits the total capacity of the land allocated for production (Gwambene, 2011). Increased pressure on land affects the type of farming practised and crops grown and impede management strategies.

Social and political factors affect farming in a number of ways. The type of farming practised is related to the social structure that has effects on the type of crops that are grown. These social factors can affect agriculture through ownership and inheritance of land (Tilumanywa, 2013), crop or food preference. For instance, in all zone maize are grown as an important crop, in the lowlands, rice production is more preferred because of culturally is a staple food and politically is among the main crops in the area. In the midland, the main banana is the cultural crop, whereas round potato being the cultural and main crop in highlands. The government policies regarding land, irrigation, type of crops/ varieties, inputs and marketing and trade have a direct impact on

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agricultural production and development (Hassan and Nhemachena, 2008). Similarly, subsidies, loan policy, purchase policies, agricultural marketing and international trade and tax policy of the government also have a direct impact on agricultural production and its development. Instability of input price and economies of scale with respect to inputs or technologies shape farmer production decisions and contributed to mixed crop farming, or planting more land in one crop than another (Bowman and Zilberman, 2013). Poor distribution network channels, high costs of certified seeds and poor infrastructure in rural areas affects agricultural production, especially in the already exhausted land. In recognizing the importance of agricultural inputs, the demand is increasing with low purchasing power.

Land fragmentation affected the use of mechanized farm equipment as a result low agricultural productivity, especially, in smallholder farming system whereby they handle their crops, primarily by hand. Such a situation has described as constrains for improving agricultural production in the Tanzania Climate Smart Agriculture Program 2015 – 2025. The use of poor equipment involves an investment of more time, energy and money and also limits the total capacity of the land to produce. In addressing land fragmentations, smallholder farmers use mechanized improved inputs such as fertilizer, seeds and chemical to increase production per small unity area. In the mechanised farming has become capital-intensive to a large extent, especially, for buying agricultural chemical, fertilizer and other inputs (Burton *et al.,* 2010). Besides the marketing challenges aggregation by production cost deprecate the crop production and investment in farming activities. These caused farmers to adjust their activities to meet the needs of consumers which impacts on agricultural production and food security.

4. CONCLUSION

Access to productive land is among the challenge of sustaining production among smallholder farmer. The study has shown that the small size of land posed constraints in farm intensification, mechanization and commercialization, especially in places where farmers own small size of land. The larger farm sizes encourage multiple cropping and allow farmers to diversify their crops and offer an option for livestock keeping, which spread the risks of loss connected with changes. It is apparent that land fragmentation and lack of access to the productive land for agricultural production affects opportunities to improve the production of people who want or need to farm and make a living. Thus, a need to address the livelihood needs and strengthening smallholder farmers through improved access to land, agricultural inputs and technologies. This includes diversification, development of innovative, improved technologies and enhancing climate resilience among farming communities suggested in the formation of an important option for future situations. In addition, planning for long-term and concerted efforts to improve land access and management strategies and promote understanding of agricultural production, interactions between socio-political structures and functions as well as ecosystem attributes. Investments in improving and sustain productivity through a synergistic blend of traditional and modern knowledge, tools and technologies and provision of fair markets for products and inputs and social services.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Bisanda S.W, Mwangi H, Verkuijl A, Moshi J and Anandajayasekeram P (1998). *Adoption of Maize Production Technologies in the Southern Highlands of Tanzania*. Mexico, D.F: International Maize and Wheat Improvement Center (CIMMYT), the United Republic of Tanzania, and the Southern Africa Centre for Cooperation in Agricultural Research (SACCAR).
2. Bowman M.S and Zilberman D (2013). Economic factors affecting diversified farming systems. *Ecology and Society* 18(1): 33. http://dx.doi.org/10.5751/ES-05574-180133

ISSN 2347–3819 EISSN 2347–386X | OPEN ACCESS

3. Burton I, Challenger B, Huq S, Klein R.J.T and Yohe G (2010). *Adaptation to Climate Change in the Context of Sustainable Development and Equity.* Barry Smit (Canada) and Olga Pilifosova (Kazakhstan) http://tinyurl.com/nabhhvt (Accessed July 24, 2010).
4. Chen M, Wichmann B, Luckert M, Winowiecki L, Förch W and Läderach P (2018). Diversification and intensification of agricultural adaptation from global to local scales. PLoS ONE 13(5): e0196392.
5. Darnhofer I, Gibbon D and Dedieu B (2012). Farming Systems Research: An approach to inquiry Draft of a chapter for the book. *Farming Systems into the 21st century: The new dynamic* (2012). http://preview.tinyurl.com/zmd8wcs (Accessed June 01, 2015).
6. Gwambene, B. (2018). Smallholder farmer's perspective to resilience: adaptation challenge in increasing crop production in the southern highlands of Tanzania, South Asian Journal of Development Research, 1(1): 1-8
7. Gwambene B (2011). *Climate Change and Variability Adaptation Strategies: Implication of adaptation strategies on land resources in Rungwe District, Tanzania*. LAP Lambert Academic Publishing, Saarbrucken Deutschland.
8. Gwambene B (2012). *Land Utilization for Agriculture and Environment Management, Soil Management in Rungwe, Tanzania. LAP LAMBERT Academic Publishing.*
9. Hassan R and Nhemachena C (2008). Determinants of African farmers' strategies for adapting to climate change: Multinomial choice analysis. *African Journal of Agricultural and Resource Economics (AfJARE)* Vol 2 No 1 p 83-104.
10. IFPRI (2012). *Increasing Agricultural Productivity and Enhancing Food Security in Africa: New Challenges and Opportunities.* Synopsis of an International Conference, IFPRI, Washington, DC.
11. Leliveld A, Dietz T, Foeken D and Klaver W (2013). Agricultural dynamics and food security trends in Uganda. Published on behalf of the Developmental Regimes in Africa Project by the Overseas Development Institute, 203 Blackfriars Road, London SE1 8NJ, UK. http://preview.tinyurl.com/hp3nrk8 (Accessed on October 12, 2016)
12. Liwenga E.T, Kangalawe R.Y.M, Sokoni C (2009). Climate change/variability and implications on agricultural production and livelihoods in the southern highlands of Tanzania. *Regional Conference on strengthening local agricultural innovations to adapt to climate change 24–26th August 2009*. Dar es Salaam, Tanzania.
13. Nyunza G and Mwakaje A.E.G (2012). Analysis of Round Potato Marketing in Tanzania: The Case of Rungwe District, Tanzania. *International Journal of Business and Social Science* Vol. 3 No. 23, pp 86-97.
14. Singh RB, Kumar P and Woodhead T (2002). Smallholder Farmers in India: Food Security and Agricultural Policy. FAO, Viale Delle Terme di Caracalla, 00100 Rome, Italy
15. Sokoni CH (2013). Analysis of Agricultural Change Using Field Allocation to Crops Technique: A Case of Uporoto Highlands, Southern Tanzania. *Journal of the Geographical Association of Tanzania, Vol.* 34: 63-75
16. Tilumanywa V.T (2013). *Land use and livelihood changes in the mount Rungwe ecosystem, Tanzania.* Stellenbosch University.
17. URT (2007a). *National Adaptation Programme of Action (NAPA).* Vice President's Office, Division of Environment, Dar es Salaam Http://www.unitar.org/ccp/napaworkshops .htm (Accessed June 23, 2007).
18. URT (2009). Investment potential and opportunities in agriculture (Crop sub-sector). Ministry of Agriculture Food Security and Cooperatives. http://tinyurl.com/zr9ymyn (Accessed September 01, 2014).
19. URT (2015). *Tanzania Climate Smart Agriculture Program 2015 – 2025.* Ministry of Agriculture Food Security and Cooperatives and Vice President's Office.
20. USAID (1999). *Analysis of the Comparative Economic Advantage of Alternative Agricultural Production Options in Tanzania.* Final report, Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture and Planning and Marketing Division, Ministry of Agriculture and Cooperatives, Tanzania. Technical Paper No. 102.

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