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Comparison of Food Insecurity among Agro-Pastoralists and Pastoralists Communities in Pastoral-Livelihood Zone of Longido District, Tanzania

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Abstract This paper challenges the rationale for adopting agro-pastoralism as a means of improving food security in a fragile ecosystem such as that existent in Longido District, a semi-arid zone where food availability depends on interrelated factors such as environmental conditions, food production practices, and coping mechanisms. As such, it tested the hypothesis that: *there is no significant difference in the degree of food insecurity among families that merely practice pastoralism and those combining pastoralism with cultivation in pastoral zones*. To this end, the study administered a semi-structured questionnaire on 165 respondents so as to examine food sources, abundance, severity of food insecurity, and coping mechanisms. Respondents were randomly selected in three strata of the study area, i.e., Lowlands, which are dominated by pastoralists, Hills mainly occupied by agro-pastoralists, and the Mountains, where farming is predominant. The study reveals that while both pastoralists and agro-pastoralists do indeed face food shortages there is, however, no significant association (X^2 = 8.8, p = 0.0653) between the magnitude of severity of food insecurity with any particular livelihood type thereby validating the hypothesis. The implication of this result is that as far as food insecurity is concerned in Longido, there is no added advantage in agro-pastoralism particularly where maize and beans are the main crops and cultivated under rain-fed situation. In view of this finding, the study suggests that it would be appropriate to promote pastoralism as a long-term food security in Longido District Council by protecting and establish permanent grazing area and preventing further cultivation. Further, it would be proper if strategies aimed at reduction of food insecurity in the area which considered food crops that are tolerant to climatic conditions as those in Longido such as sorghum, millet, sweet potatoes, cassava, etc.

Keywords: *food insecurity, pastoral-livelihood zone, pastoralism, agro-pastoralism, food production*

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1. Introduction

This study provides evidence that agro-pastoralism, as practiced in its present form, does not provide better food security than pastoralism in Longido district, a semi-arid area in north-western Tanzania. A sustainable food production system support food security and is cultural and economical affordable while practicing environment protection [4]. The evidence of this study is essential for long-term planning to improve food security in pastoral environments as those in Longido, which is a new district that is in the process of making development strategies. The need for such long-tem planning is necessitated by several factors.

First, most often pastoralism is considered as an unsustainable system for development, hence it is replaced by other activities like cultivation [16]. However, cultivation under semi-arid or arid conditions has environmental impacts such as soil erosion because it reduces vegetative cover by uprooting the rhizome grass which recovers during short rains. Contrary to this impact, pastoralism allows the use of arid and semi arid areas as an asset in food production through herding, which allows quick regeneration of vegetation during short rains [18]. Pastoral livelihood zones, which are mainly arid and semi arid grasslands, provide important services not only as ecosystems that serve as carpets to protect soil from erosion by wind and surface runoff, but they also store up to 8% of global carbon [13]. Replacing pastoralism with other systems, therefore, can increase the risk of food insecurity and result into missing the services that semi-arid zones provide [3]. Instead, pastoralism should be viewed as a strategy that can simultaneously provide livelihood to secure food, support wildlife and ecosystem conservation, while honoring cultural and traditional values [22].

Second, irrespective of risks associated with cultivation in the pastoral zones, communities continue to cultivate as a means to increase food availability. This option is costly to farmers in terms of inputs such as labour, seed, and

fertilizer, yet grazing by livestock as the appropriate land use is prevented. Fences made from branches of *Acacia* trees are used to protect the cultivated land to control crop damage by domestic or wild animals. Another way of preventing crop damage is to move livestock to other areas, but in the course of doing so conflicts with farmers arise because herders' sometimes tend to traverse cultivated land [27].

Third, Longido district frequently experiences food shortages, the worst years being 2007, 2008, and 2009 due to persistent drought [10]. It must be noted that pastoralism was not the reason for such food shortages, but rather lack of knowledge on environmental conditions, suitable crops, and production methods. However, the food shortages are often attributed to pastoralism because the perception is that pastoralists are rigid; they refuse to sell their cattle in exchange for cereals when such events occur. As a response to the food shortages, the Government of Tanzania has been providing food aid every year. However, the food aid reduces the capacity of the community to build resilience to food shortage because they fail to identify the level and the root cause of food-shortage [11]. This study contends that provision of appropriate knowledge on food management and food production system is a more rational approach in a fragile ecosystem as those of Longido than food aid.

In view of the situation described above, the study examined the hypothesis that: there is no significant difference in the degree of food insecurity among families that practice merely pastoralism and those combining pastoralism with cultivation in pastoral zones. The evidence from this study is essential for food security strategy through appropriate food production and management practices that match arid and semi arid conditions to complement range management and herding practices.

2. Methods

Longido District, covering an area of 7,782 km^2 [10], is located in the north-eastern corner of Tanzania (Figure 1) in Arusha Region, on the leeward sides of Meru and Kilimanjaro mountains. Geographically, the district lies south of the Equator between latitudes 2° 20' and 3° 10' South, and between longitudes 36° 00' and 37° 3' East of Greenwich. It was formed after dividing Monduli District into two (Monduli and Longido). It borders with the Republic of Kenya in the North, and districts of Monduli the west, to the South borders Siha on the eastern side, Rombo to the north-west, Arumeru to south-east, and Ngorongoro in the West.

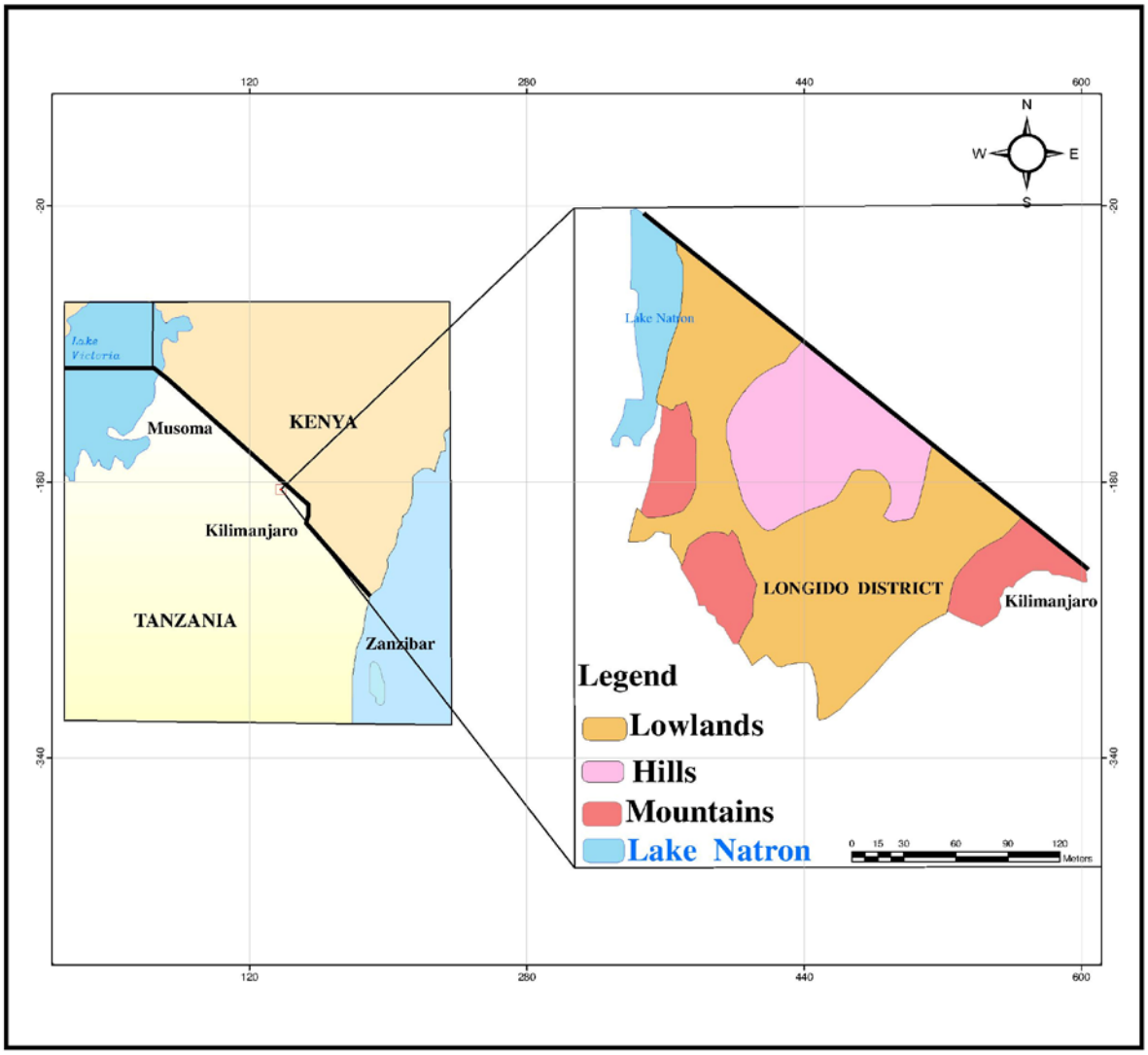

Figure 1. Ecological zones of Longido District in Northern Tanzania

Administratively, Longido District has three divisions which are Longido, Ketumbeine, and Enduimet, 16 wards, 41 villages and 136 sub-villages suitable for herding activity [31]. The local community is predominantly Maasai, who live as a clan in a structure called *boma*, which on average has 6-9 households with 5-8 members of the family. The total population in Longido is 123,152 [31] giving an arithmetic density of 15.8 persons/sq km with a growth rate of 3.8%. The amount of arable land, according to Longido District Authority is about 102,390 ha, thereby giving an arable or nutritional density of 1 person ha^{-1} of arable land. Arable density is a measure of a nation's self-sustainability in terms of food [14,24] a more refined measure of population pressure on land than arithmetic density. When compared with the nutritional density of Tanzania of about 4 persons ha^{-1}, the pressure on land is lower in Longido, implying that the area should be more self-sustainable in terms of food. However, as stated earlier on, that is not the case.

Sarwatt and Mollel [26] stated that, in Tanzania soil types are mainly influenced by climate and topography. Volcanic soils, which are of high agricultural potential are mainly located on the eastern highlands of Longido, i.e., the mountain slopes of Kilimanjaro between 900-1200 m above sea level. This ecological zone is where crop yield are high while agriculture and grazing is predominant on the hills with elevations of between 600 and 900 metres. Pastoralism mainly takes place in the lowlands (300-600 m). Out of the Longido total land area of 7,782 km^2, 82.14% (6,392.35 km^2) is under grazing [31].

In terms of rainfall, Longido has two rainy seasons like any other district in Tanzania. Long rains season start from February to April while short rains begin towards the end of October and end in December. The rainfall is highly influenced by relief. Being on the leeward side of Meru and Kilimanjaro mountains, Longido is the driest district in Arusha region. Precipitation averages 341 and 890 $mmyr^{-1}$ in semi-arid lower elevations and higher elevations close to Mt. Kilimanjaro respectively [21]. In terms of temperature, Longido is one of the hottest areas in Tanzania; it ranges from 20 to 35°C whereas the average temperature in Tanzania is 30°C [21]. This environmental condition gives Longido an advantage over other districts in terms of examining the relationship between food insecurity and pastoralism.

2.1. Data Collection

The study area was stratified into three strata based on its topography, namely Lowlands, Hills, and Mountains. Data were collected from respondents in each stratum using a structured and open-ended questionnaire which was designed while considering content, wording, and format, as recommended by Parfitt [23]. A questionnaire survey was preferred over other techniques, for example the Rapid Rural Appraisal (PRA) and Participatory Rural Appraisal (RRA) because it is considered to be more appropriate for such studies [23]. The structured questions were useful on issues where a specific range of known responses was expected. Such questions allow easier interpretation and analysis than open-ended ones. On the other hand, the open-ended questions were included so as to allow interviewees to construct their own accounts of experiences because the explanatory power of structured questions is limited [32]. We used the stratified random sampling method was used, whereby 165 respondents were interviewed. The sample size was determined from the 27,367 households in the whole district of Longido. Random sampling was conducted because although each stratum has a dominant socio-economic activity, e.g., agriculture, pastoralism, and agro-pastoralism, it does not mean that the activities are entirely absent. Random sampling, therefore, was used so as to give respondents in each socio-economic category an equal probability of being sampled. The formula used to calculate sample size is as follows:

$$Ss = Z^2 * (p) * (1-p) / c^2 \quad (1)$$

Ss is the sample size
Z represents the Z value (e.g., 1.96 for 95% confidence level)
p percentage picking a choice, expressed as decimal (0.5 used for sample size)
c represents the confidence interval, expressed as decimal (e.g. 0.04 = ±4).

Using the sample size calculator [8], and "equation (1)"at a confidence level of 99%, and 10% confidence interval, the representative sample of 165 households was derived. This sample size was divided by 3 (number of strata) to come up with an equal number of 55 respondents for each stratum. The questionnaires were administered in Swahili, the *lingua franca* of Tanzania. Prior to the survey, a pilot study of 20 respondents was undertaken to check a number of questionnaire design aspects, such as clarity, appropriateness of the questions, and respondents' willingness to participate in the survey.

2.2. Data Analysis

Out of 165 (87%) questionnaires, only 144 were analyzed because the rest were from respondents that acted suspiciously; hence these responses were considered unreliable. It is believed that the exclusion of the questionnaires from suspicious respondents didn't influence the final results because the difference between the calculated and achieved sample sizes was minor. Analysis focussed on 3 of the following parameters considered to be the most pertinent to proving the hypothesis:

i) respondents' profile had an insight into the demography and socio-economics of the community in the pastoral livelihood zone;
ii) severity of food insecurity; and
iii) strategies to cope with food insecurity.

2.2.1. Respondents Profile

To determine the profiles of the respondents, variables such as age, level of education, main socio-economic activities, household income, and residential status were examined. Age was considered to determine the demography of the population in the study site, while level of education influences farmers' attitudes and practices [12, 5, 28]. Main economic activities typify a livelihood type, e.g., pastoralism or agro-pastoralism according to stratum. Household income was also examined so as to determine the capability of households to buy food as a coping strategy, and residential status because it is an indication of whether a household is nomadic or not, which influences the choice of food-production system. For instance, pastoralists

are nomadic; their livelihood involves movement of owners with their animals in search of forage, while semi-nomadic cattle owners settle permanently, but trek their animals to distant grazing and watering areas [26]. In contrast, farming normally requires that one settles where the activity is undertaken, while agro-pastoralism tends to be semi-nomadic. Although Household food insecurity is intricately linked with poverty [9] this study did not look into level of poverty but rather economic activity employed by the respondents.

Age categories were defined according to the of Life Cycle Grouping [29] i.e., children = 0-14 years of age, youths = 15-24, adults = 25-65, and seniors = > 65. The level of education attained by the respondents was classified as Not at all = no education, Primary = grades 1-7, Secondary = grades 8-12, and Tertiary = colleges and universities. The residential status was defined as Settled = not nomadic or semi-nomadic, and Not settled = nomadic. Main socio-economic activities were grouped as Pastoralism = those predominantly grazing livestock, Farming = growing crops, and Agro-pastoralism = a combination of farming and pastoralism, and Other = petty trading and employment. Income was calculated in millions of Tanzanian Shillings (TZS)[1] and categorized as < 0.10, 0.11 – 0.50, 0.51-1.0, and 1.1-5.0 per annum. For each variable, sums of the number of respondents by category and stratum were calculated. Where appropriate, statistical tests were done in order to determine if differences in response probabilities were statistically different between the respondent categories or stratum. All tests were conducted in the JMP IN Start Statistics software version 3.2.1 [25].

2.2.2. Food Insecurity

According to the United States Development Agency (USDA) [32] food insecurity is a situation whereby a household has limited or uncertain availability of nutritionally, adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways. Based on these definitions, this study considers food insecure households as those who run out of food, and cannot afford to acquire it through normal means, i.e., production or purchasing. As such, food insecurity was assessed in terms of main sources of food, its abundance, and severity of food insecurity as described in the succeeding sub-sections.

2.2.2.1. Main Sources of Food

To determine main sources of food, food sources were categorized as crops, livestock and purchasing. Sums of responses by main sources of food from each stratum were calculated and Correspondence Analysis test was used to determine if there was an association between the two variables. This test is similar to the Chi-square, but more useful for data with many levels [25] in this case 3 strata, and different sources of food.

2.2.2.2. Abundance of Main Source of Food

In pastoral livelihood zones, livestock are principally kept as asset, not as a food source. This being the case, when assessing abundance of the main food sources in terms of yield, livestock were not included. The common food item from livestock is milk, rarely meat. As such, this study did not consider it worthwhile to quantify the amounts consumed but rather ranked them in relation to other food items such as maize, beans, rice, etc., according to the perceived preferences of the respondents.

Maize and beans are the crops that are commonly grown by the respondents. The average yield of each crop per hectare in each stratum was determined and compared with the average from Arusha region for the year 2012. This region is one of the four with the highest yield of maize and beans in the country, hence it was considered as the best representative in terms of productivity. Records of yield for 2012 were used because they were the only data available from Arusha at the time of data analysis. Assessment of yield considered all agronomic practices such as early field preparation, timely planting, correct plant spacing, fertilizer-application rates, weeding, etc., as recommended by the Ministry of Agriculture and Livestock.

2.2.2.3. Severity of Food Insecurity

According to literature [19], analyzing food insecurity at household level can be virtually an impossible task in a situation where household composition is variable, and the household itself is subject to varying interpretation, e.g., with more than one provider. Although there are indicators that can be used to predict food insecurity at household level, for example asset ownership, household size, and dependency ratio [19] there are, however, complexities such as intra-household dynamics, culture, age hierarchy, etc., that affect their measurement. Moreover, these are indirect indicators of food insecurity [11]. In view of such complexities, this study did not use such indicators in this study. These indicators do not contribute much in the assessment of food security [19]. To get around the complexity of use the indicators of food insecurity, the magnitude of food insecurity was determined in terms of the period when a household indicated that it ran out of food (maize or beans) after harvest season. A scale of severity of food insecurity was determined ranging from None to Very severe, where None = 0 months, Low = ≥ 9 months after harvest, Moderate = 6-8 months, Severe = 3-5 months, and Very severe = 1-2 months. Numbers of respondents in each severity category was calculated by stratum and applied and the X^2 test was used to detect if there is any significant difference in the magnitude of severity between the Lowlands and Hills, which are dominated by pastoralists and agro-pastoralists respectively.

2.2.3. Strategies to Cope with Food Insecurity

As stated before, means of dealing with food insecurity in Longido involves food aid, but there are also different strategies such as selling of livestock to buy food, and borrowing food from friends or relatives. The number of respondents that use each means in each stratum were determined to identify the commonly used coping mechanism. Literature show that, stealing and abandoning family is also coping mechanism, but extreme ones[19]. For this reason and the fact that it would be impossible for any respondent to admit using such strategies, they were excluded in the questionnaire. Skipping meals and changing eating behavior, e.g., eating less than normal or

[1] 1.00 US$ was equivalent to TZS 2120.00 by October 2015.

eating non-preferred foods are other strategies, but used more at family than community level [5]. Considering that any plans for improving food security in Longido will be implemented at community more than family level, these strategies were also excluded in the questionnaire. The Dunnett's Method of Means Comparison with the Control was used to examine if responses under each coping mechanism were specific to a particular stratum [25]. In this context, the comparison was between the Hills (agro-pastoralists) and Lowlands (pastoralists). The Mountains were the Control because neither agro-pastoralists nor pastoralists are dominant in this stratum.

3. Results and Discussion

3.1. Respondents Profile

The profile of the respondents suggests that the decision to settle in a particular location is not random, neither was it made by immature or ignorant individuals, but rather by mature, knowledgeable persons with some education. A majority (84.7%) of the respondents are settled or considered semi-nomadic (Table 1). They comprised mostly adults and seniors (about 60 and 35% respectively), which is not surprising considering that in the Maasai culture, only men or heads of families are allowed to talk in any gathering. The respondents have attained formal education, at least up to primary school level; only 36.8% do not have any formal education. Just like elsewhere in Tanzania, the main economic activities are practiced in different topographic areas, e.g., agriculture is dominantly practiced in mountainous areas because of good rainfall and soils while pastoralism, agro-pastoralism, are dominant in the Lowlands and Hills respectively. The correspondence analysis test revealed that there is a highly significant association between main economic activities and strata (X^2 = 107.9, p = <0.0001). This association may reflect the suitability of each stratum for a specific economic activity. The implication of this relationship is that farming, as a way to increase food supply, is merely being forced into the areas where pastoralism is the most suitable economic activity, e.g., the Hills. Under such circumstances, its contribution to food security is questionable.

Table 1. Profile of Respondents

Variable	No. of Respondents by Stratum			Total	%
	Mountains	Hills	Lowland		
Age Category					
15-24 (youths)	5	1	0	6	4.2
25-65 (adults)	27	32	28	87	60.4
>65 (seniors)	18	15	18	51	35.4
Total	50	48	46	144	100.0
Highest Level of Education					
None	13	20	20	53	36.8
Primary	29	13	22	64	44.4
Secondary	7	12	2	21	14.6
Tertiary	1	3	2	6	4.2
Total	50	48	46	144	100.0
Residential Status					
Settled	40	43	39	122	84.7
Not settled	10	5	7	22	15.3
Total	50	48	46	144	100.0
Main Economic Activity					
Farming	27	9	0	36	19.0
Pastoralism	5	3	40	48	26.0
Agro-pastoralism	18	36	6	60	32.0
Other	13	17	14	44	23
Total	63	65	60	188	100.0
Income from All Main Economic Activities (TZS '000,000) per Annum					
<0.1	2	14	8	24	11.9
0.11-0.50	20	28	17	65	32.2
0.51-1.0	24	23	13	60	29.7
1.1-5.0	18	13	22	53	26.2
Total	64	78	60	202	100.0

Considering that apart from agriculture or pastoralism, some respondents indulge in more than one economic activity, e.g., employment or petty trading, there are multiple responses (202) with regard to sources of income (Table 1). The highest earning respondents (TZS 1.1-5.0 million) are in the lowlands, where pastoralism is the mainstam, which is not surprising considering that livestock has higher returns than crops such as beans and maize For example the price of beef is TZS 7,700.00 kg^{-1} [2] while maize and beans fetch TZS 600.00 and TZS 1400.00 kg^{-1} respectively [28]. Again, the Correspondence Analysis indicates that there is a significant association between strata and level of income (X^2 =15.16, p = 0.01), implying that of the three communities, pastoralists are the most suited to buy food not as a mere coping strategy in times of food shortages, but a way of life. Farmers, on the other hand, tend to rely on crop production, although they will also buy food as a coping strategy.

3.2. Food Insecurity

3.2.1. Main Sources of Food

The main sources of food are livestock, crops, and buying from markets or shops (Figure 2). Crops make the major source of food in all the three strata, but especially in the hills and mountains. Livestock keeping is highly associated with the Lowlands and Hills, while buying food is mainly done by the farmers in the Hills and Mountains. The correspondence analysis test shows that there is a significant association between strata or livelihood type and main source of food (X^2 = 9.26, p = 0.05).

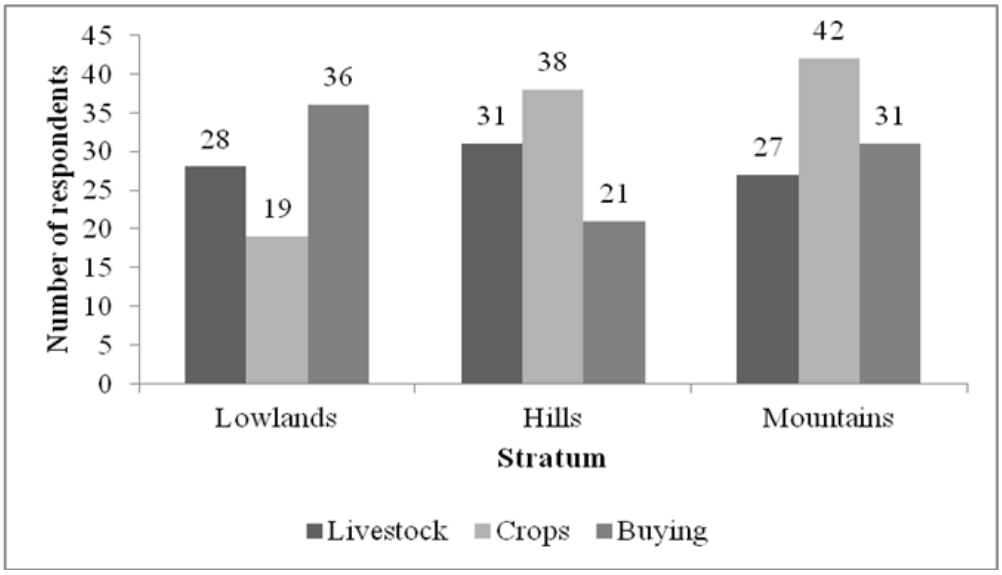

Figure 2. Main Sources of Food

Maize and milk is the main food consumed daily, rice is consumed by a minority of the respondents (Figure 3). Considering that it is not one of the crops grown in the area, rice must be one of those food items that are bought. The Pearson's Chi-square test shows no significant difference in the main food consumed in the three strata (X^2 = 11.82, p = 0.06), an indication that there is no food segregation or preference, which can lead to food insecurity [15]. Food insecurity in Longido, therefore, cannot be due to food preference.

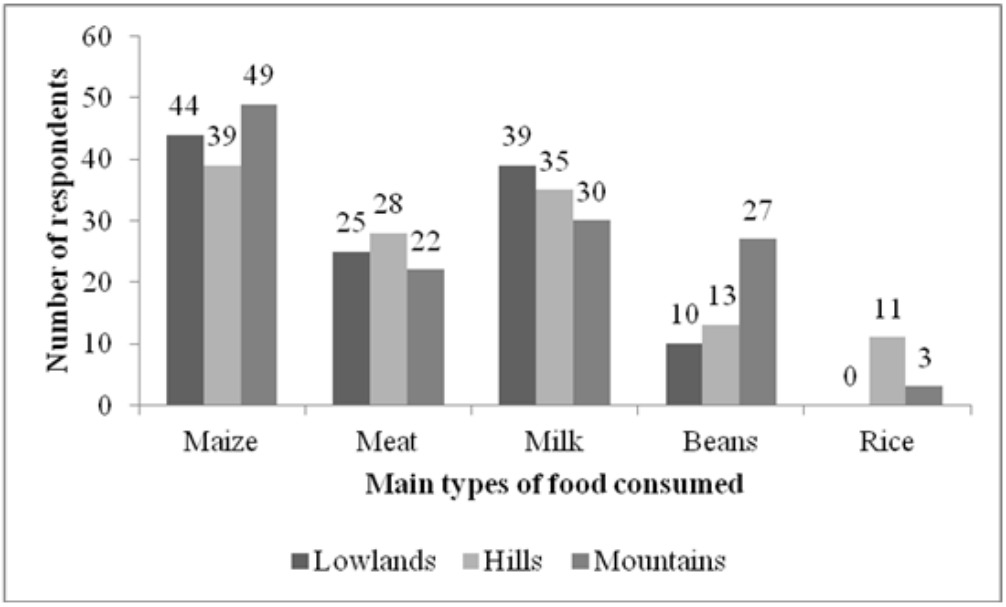

Figure 3. Main Type of Food Consumed Daily

3.2.2. Abundance of Main Food

The average yield of maize and beans in Longido is 5 and 4 times respectively lower in Longido compared to Arusha region respectively (Table 2) From these results, it is evident that food is short supply in Longido, and hence it is clear that soon after harvest, the households are food insecure. The differences in crop yields between Arusha and Longido could be a result of climatic conditions, not agronomic practices. An assessment of the latter, e.g., fertilizer application, is enough reason for this assertion. Almost 80% (115 out of 144 respondents) apply 0-50 kg ha^{-1} of Urea as top dressing, yet the yield is low. This is further evidence of the inappropriateness of practicing agro-pastoralism, particularly growing of maize and beans as main crops in such an environment.

Table 2. Average Yield (Kg Ha^{-1}) of Crops Grown Longido District Compared to Those from Arusha Region

Site	Crop	
	Maize	**Beans**
Lowlands	76.3	134.7
Hills	7.4	178.1
Mountains	36.2	555.8
Average for Longido	40.0	290.0
Average for Arusha Region 2012*	2,000.0	1,200.0
Yield Difference	**(1,960.0)**	**(910.0)**

*Source: Food security portal Tanzania (2012).

In semi-arid areas crops of choice are millet, sorghum, cassava, sweet potatoes, etc., which are tolerant to such climate. These could be cultivated as food crops, while sunflower or cotton could be cultivated as cash crops, earnings from which can be used to purchase food [7]. Sweet potatoes are mostly treated as a snack in most African communities, which could be the reason it may not be cultivated as a main food crop in Longido, but there is no good reason for not cultivating cassava. In the case of sorghum and millet, they are avoided because of damage by pests such as the Red-billed Quelea birds, *Quelea quelea*, which feed on the grain. However, there are cost-effective and environmentally friendly pest control methods for quelea, e.g., the "Impact" trap, mist nets, roost or basket traps as done in Zimbabwe [17] and Tanzania [19], which the Local Government in Longido or even central government could employ, through TANAPA (Tanzania National Parks), or the Game Division in the Ministry of Natural Resources. TAWIRI (Tanzania Wildlife Research Institute), which is already involved in human-wildlife conflict research in the area, is another institution that could be approached. The birds can be utilized as an additional food resource through cooking and preserving with salt [20]. In Zimbabwe, it was reported that traditionally *quelea quelea* have been sold on the black market, but several applications for permits to harvest large numbers have been processed by the government for export and local consumption[17]. A similar approach could be tried in Longido to encourage harvesting of birds to control crop damage.

3.2.3. Severity of Food Insecurity

All communities experienced varying degrees of severity of food insecurity (Figure 4), especially from low to moderate, which is obvious considering that crop yields are low (Table 2). However, more than half of the respondents stated that the food insecurity was not severe, most of them in the Mountains, but almost an equal number in the Lowlands and Hills (Figure 4). The Pearson's Chi-square test showed that the no significant difference in the degree of association between severity food security and pastoralism or agro-pastoralism (X^2 = 8.83, p = 0.06). This is evidence that the hypothesis is correct.

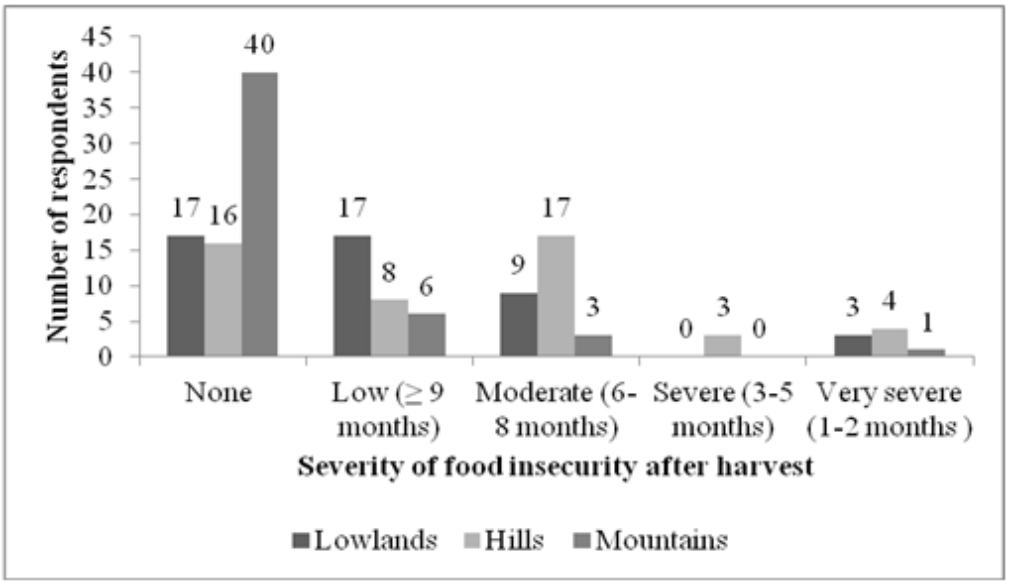

Figure 4. Severity of Food Insecurity

3.3. Coping Strategies

Almost an equal number of agro-pastoralists and pastoralists sell livestock, but also depend on food aid as coping mechanisms in the Hills and Lowlands (Fig. 5). Storing and buying food are the commonest coping strategies by farmers in the Mountains. Storing food helps to reduce dampen demand when there is a surplus and bolster supply when there is a shortage. In either case, it helps to stabilize prices, which maintains farmer's income and consumer access to food. In the absence of storage facilities, there are seasonal price fluctuations [1]. Borrowing from friends or neighbours is the least preferred coping strategy in all the strata.

The Dunnett's Methods of Comparisons of Means with the Control shows no significance in the number of respondents using similar coping strategies between the Hills and Lowlands (d = 2.22, p = 0.05). However, there are significant differences (d = 2.22, p = 0.05) between the Hills and Mountains, and also the latter and Lowlands, confirming that livestock is mainstay of agro-pastoralism, just like pastoralism. Agriculture, which is practiced in agro-pastoralism, is merely a supplementary activity that is not adding value to reduction of food insecurity, as had been stated before. As such, it would be appropriate to promote pastoralism as a long-term food security in the newly-established Longido District Council by protecting and establish permanent grazing area and preventing

further cultivation. This observation renders further credence to the validity of the hypothesis. Considering that food is not abundant because crop yields are low, the study contends that it must be these coping strategies that enable almost half of the respondents not to experience food insecurity (Figure 4).

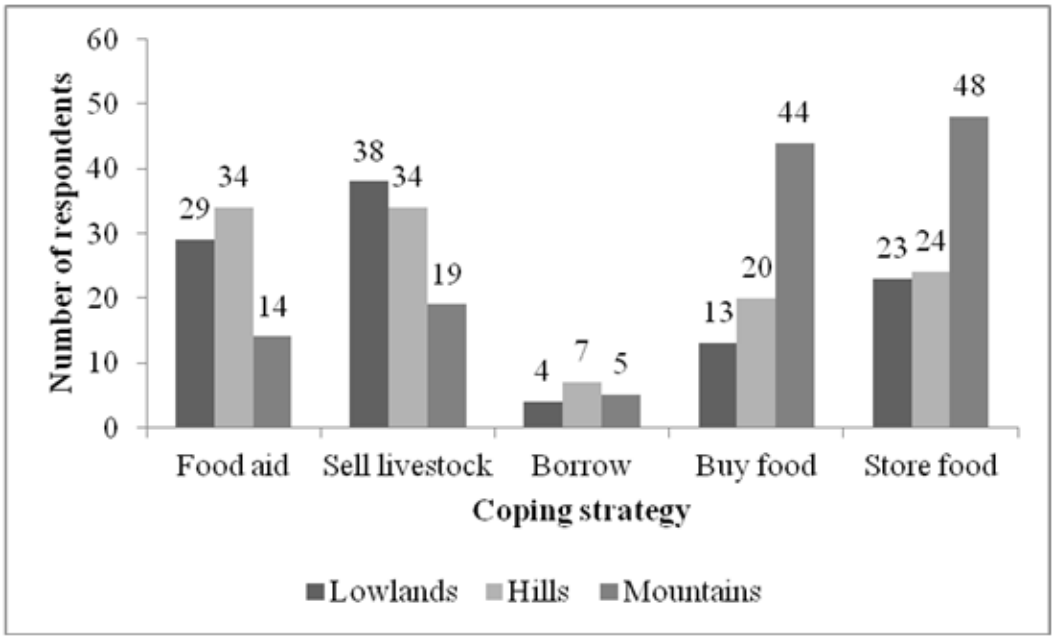

Figure 5. Strategies to Cope With Food Insecurity

4. Conclusions and Recommendations

The study validates the hypothesis that there is no significant difference in the degree of food insecurity among families that practice merely pastoralism and those combining pastoralism with cultivation in pastoral zones, thereby suggesting that there is no advantage in cultivating in semi-arid areas, which are considered as fragile ecological systems, not suitable for such livelihood practice.

It would be appropriate if the Longido District Council used these findings for long-term planning not only to improve food security, but proper land-use in environments such as those in the study area. As such, the study suggests that it would be proper to promote pastoralism as a long-term food security in the newly-established Longido District Council by protecting and establish permanent grazing area and preventing further cultivation. Further, it would be fitting if strategies aimed at reduction of food insecurity in the area considered food crops that are tolerant to climatic conditions as those in Longido such as sorghum, millet, sweet potatoes, cassava, etc.

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Statement of Competing Interests

The principle author is a self-financed PhD student at the Open University of Tanzania. The other authors declare that they have no competing interest.

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