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Assessment of Food Security Status in Tanzania's Rural Context: The Case of Chamwino

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Abstract
Food security is emerging as a key focus in developing countries and a determinant of socio-economic development. Rain-dependent agriculture, rain irregularities and variability necessitate the need to study the current status of food security, especially in semi-arid areas of Africa. This paper assesses food security in the rural context of Chamwino District, Tanzania. It adopts the sustainable livelihoods framework as its main tool of assessment under a mixed-method design for qualitative and quantitative analyses. It employs a simple random sampling technique to draw 385 agro-pastoralist households out of 13595. Likewise, it also applies a stratified sampling technique to ensure that appropriate number of elements are drawn from the homogeneous subsets of the population. Focus group discussions, in-depth interviews, transect walk and situational analysis mapping techniques were employed to ensure validity. Quantitative analysis was supported by the IBM SPSS software, version 20, to establish values of existing patterns. Qualitative data were subjected to content analysis to explore functions, attributes and drivers. The results suggest that Chamwino District has a chronic food insecurity history recorded from 1837 up to 2020. Most of the rural agro-pastoralists are victims of food insecurity even when agricultural productions are in surplus due to a wide range of factors. The magnitude of this problem is comparatively higher than in other districts in Dodoma Region. The intensity of the food problem is influenced by cash economy, the lack of technical education, limited diversity in reliable sources of income, and inadequate public utilities. Also, there are field-based evidences about the failure of the regulatory system to stimulate agro-pastoralism.

Key words: *food security, food insecurity, agro-pastoralism, rural areas*

1. Introduction

Studies have been carried out worldwide to examine prevailing food security concerns. Reports show that the global food security situation remains unsatisfactory amidst excess food production because of social, economic, political and ecological limiting factors at various scales (Ahmadi et al., 2021). Arable lands are still available, and sufficient amounts of food are produced annually, capable of ending food insecurity (SDC, 2017). Today, about (98%) of those without food security in the world live in developing countries (Ahmadi Dehrashid et al., 2021). In this essence, food insecurity is viewed as a product of technical

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failures by responsible regulatory mechanisms. Studies on food security date back to the 1940s (Simon, 2017). The FAO organized its first world food survey in 1946, when it also introduced regulatory schemes for achieving food security (IFPRI, 2016). Reference is made to such initiatives as the global rise to address food concerns. However, most of these initiatives are remarked as solutions that only treat hunger symptoms (Bjornlund et al., 2020); hence, they have not been able to ensure food security. They have failed to institute better-quality legal layout based on viable food production systems (Pérez-Escamilla, 2017).

In Asia, India was able to reduce food insecurity through several deliberate solutions, including the enhancement of farmers' capacity to produce (Basudeb et al., 2007; SDC, 2017). This gives the reflection that food insecurity was a product of the lack of appropriate responses to hunger. In Africa, Sub-Saharan Africa (SSA) is the world's leading region with people troubled by chronic hunger (FAO et al., 2019; Ogujiuba et al., 2012; SDC, 2017). Food insecurity has not been eliminated because the food production system is not sustainable (Aogán & Peter, 2016; Duncan, 2015 ; Simon, 2017). According to FAO et al. (2019), there were 256m people in Africa in 2019, with almost one-fourth of them without food. Appropriate steps to stimulate efficiency in the food system have not been implemented, and the continent is characterized by an institutional vacuum and political neglect of the welfare of agro-pastoralists (Bjornlund et al., 2020; Dodo, 2020). The continent has failed to achieve food security, and evidence shows it will not make it even by 2030 (FAO et al., 2019; FEWSNET, 2021). Also, urbanization has transformed rural livelihoods into commercial agro-pastoralism; causing rural agro-pastoralists to be in constant need of cash to purchase food and finance other domestic expenditures. Most of the victims of food insecurity are the rural agro-pastoralists practicing rain-dependent farming (Candel, 2014; IFPRI, 2016). Yet, these agro-pastoralists are left unassisted to cope with new food production systems, making them handicapped in some other aspects of food production (Dodo, 2020).

Experience from East Africa shows that agro-pastoralists are food insecure because their food production system is not well managed (Ogujiuba et al., 2012). Agro-pastoralists are food insecure despite their countries being self-sufficient in producing and exporting staple crops (FEWSNET, 2018; Wilson & Lewis, 2015). This observation leaves behind a puzzle that calls for further research on food security. The Sustainable Development Goal No. 2 (SDG2) intends to achieve zero hunger and food security by 2030 (Alphonce, 2017). Following the SDG2, Tanzania instituted strategies to support the agricultural sector to positively influence the food security status of the country. Some of these initiatives are contained in the Tanzania Development Vision – 2025, implemented in five-year phases; District Agricultural Development Plans; and the National Multi-Sectoral Nutrition Action Plan. Follow-up initiatives include the Food Security and Nutrition Assessment, and *Mfumo wa*

Uchambuzi wa Uhakika wa Chakula na Lishe (Alphonce, 2017; URT, 2017). However, the requirements of the SDG2 in Tanzania can be challenging to achieve because the country lacks appropriate transformational strategies from traditional to modernized agriculture. Also, some of its plans appears to be non-existent: they just remain on papers.

The Dodoma region in Tanzania is characterized by unimodal rainfall seasons (URT, 2017), prolonged droughts, and low agricultural productivity: all of which lead to low access to food and vulnerability to food insecurity (Alphonce, 2017). The rural areas are entirely dependent on rain-fed agriculture (Gassner et al., 2019; Mwamfupe, 2016b). These rural communities exhibit certain features of interest to academic research because they show age-long characteristics on which agro-pastoral communities have survived (Mwamfupe, 2016b). Although historically the rural economy was purely for subsistence, nowadays it appears to have been commercialized (Tsuruta, 2016). This implies that rural residents have lost even their food sovereignty because of the commoditization of food. This new economic path leaves them without food even in few months after harvests (Duthie-Kannikkatt, 2016; Gysel, 2016).

Furthermore, rural livelihoods seen across rural Dodoma are supported by simple technologies and tools most of which are unimproved in terms of efficiency in food production (Tsuruta, 2016). A large part of the region, for example Chamwino district, are drought-prone and food insecure; and therefore, there is no guaranteed food assurance (Ally et al., 2017; Assenga & Kayunze, 2020; Tsuruta, 2016). To help reduce the problem of food insecurity, deliberate government interventions are encouraged to attract irrigation agriculture, and solve the problem of drought by using cheap irrigation technologies that are currently available in the market (AGRA, 2016).

Early studies report that, in Dodoma region, it is in Chamwino where households are most affected by the severity of food insecurity than in Kondoa, Chemba, Bahi, Kongwa and Mpwapwa districts (Benta, 2008; Saruni & Mutayoba, 2018; Sugimura, 2016). The cause of food insecurity in Chamwino is seen as more linked to the mismanaged of the food system than climatic factors because, even when it rains sufficiently, still food shortages are recorded. Even a more recent report (Kalumanga et al., 2020) shows that 79% of the studied households in Chamwino were food insecure compared to other districts in the same region. Also, studies by Mushi (2012a) and Assenga and Kayunze (2020), respectively report that 73% and 79% of the studied population did not have sufficient food. Although the major economy of Chamwino District is agriculture, this sector has failed to ensure food security to the people, most of whom are rural agro-pastoralists. During critical food shortages, food is bought from other districts and regions at comparatively increased prices (Mwamfupe, 2016a). Most of the publications on food security

studies—for example, Benta (2008), Mushi (2012a), Reincke et al. (2018), Msongaleli et al. (2015), Mayaya et al. (2015) and Graef et al., (2017)—attribute food insecurity to climate change. The focus of this article is to assess the food security status of the rural agro-pastoralists of the study area. It seeks to contribute to the understanding of the causes of food insecurity (climatic and non-climatic), and the current status of food security in the area. The input is expected to add to the available knowledge about this long-lasting condition of food insecurity, and to suggest appropriate solutions for its alleviation.

2. Theoretical Framework

This paper draws from two models: the governance efficiency theory (Torfing et al., 2013), and the political economy theory (Goodin, 2013); in assessing the food security situation. The sustainable livelihoods framework (SLF) (Scoones, 1998) is then used as the conceptual framework of the study. While the governance efficiency theory dwells on the importance of regulatory frameworks to positively influence food security, the political economy theory serves as a critical mechanism to identify governing processes and interactions, and the possible way(s) in which the society can be assisted in achieving food security. It is an approach that insists on considering previous experiences and the efficiency of incumbent administrative forces in influencing economic achievements, such as in agricultural establishments (Moroda et al., 2018).

The SLF model helped the authors to establish and explain various complex contexts (such as environmental conditions, economic trends, transforming structures, processes, and livelihood strategies) that shape rural agro-pastoralists livelihoods in their quest for food security. The SLF further provides guidelines to understand why food insecurity prevails amongst potential food production chances. Equally, it provides clues to understanding peoples' access to various assets and how such assets gain value through the prevailing social, institutional, and organizational environment at the rural level (Levine, 2014).

3. Context and Methods

3.1 Study Area

This paper draws data from a recent study that was carried out in 11 rural villages of Chamwino District, which is located between latitude 5° 0′ 0″ South and 7° 0′ 0″ South, and at longitude 36° 0′ 0″ East (Figure 1) (Mgoba & Kabote, 2020). The studied wards are distant from each other, and in some extent differ in terms of urbanization, remoteness from the city centre, and trading and agricultural patterns: factors that greatly influence the status of food security of the study area. Chamwino is a rural district with a population of 330,543 households (URT, 2013). The area is semi-arid, with a dry savannah type of climate characterized by low and unpredictable unimodal rainfall, which amounts to about 447mm per annum (URT, 2012a).

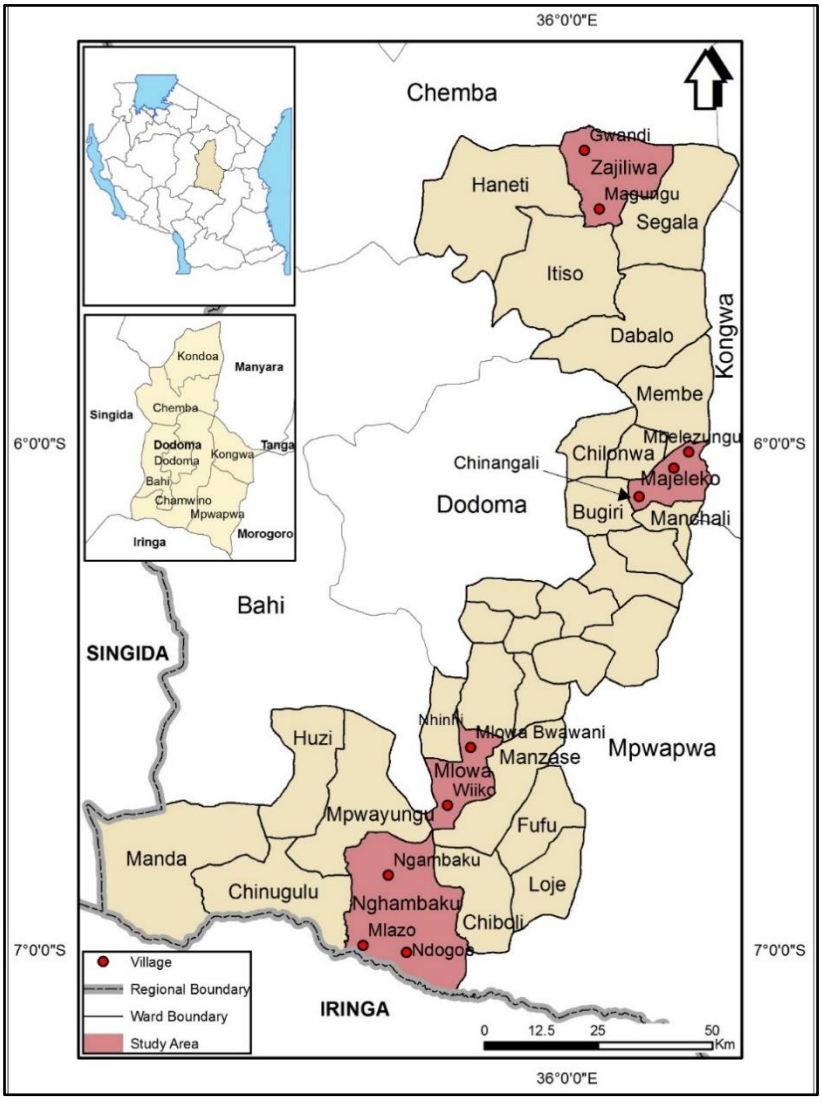

Figure 1: Location of the Study Area
Source: Cartographic Unit, University of Dar es Salaam, 2022.

Rural areas of central semi-arid zones of Tanzania are reported to be the most stricken by food shortages, although the Chamwino district is peculiarly reported with chronic food insecurity (Ally et al., 2017; Kalumanga et al., 2020; Mushi, 2012b; Sugimura & Mwamfupe, 2016). This area was chosen because of its significance in political and administrative roles, as the area also serves as the capital city of Tanzania. When compared to other districts, the human population of Chamwino is larger than in the other rural districts of the Dodoma region (URT, 2019). In this study area, farming remains the principal

means of survival; even though agricultural production is low and unstable (Tsuruta, 2018), characterized by a significant decline in productivity noted from 2012 to 2018 (URT, 2019). Since 2007, the Chamwino district has been working hard to eliminate food insecurity, but this has not been successful (URT, 2019). A question arises: why has food insecurity not been eliminated? The literature leaves behind a conundrum which justifies the need for more research to establish causes for this long-lasting status of food insecurity, and to suggest appropriate solutions for its alleviation/elimination.

The research for this paper was conducted in four wards constituting of eleven villages, namely: Zajilwa, Gwandi, Magungu, Ngambaku, Ndogoe, Mlazo, Chinangali-I, Majeleko, Mbelezungu, Mlowa Bwawani and Wiliko. Since this is a homogeneous population, distributed into several non-overlapping different clusters, a stratified sampling procedure was used to extract the proportional size of households to be selected from each village (Table 1).

Table 1: Sampling Households and Sample Size

Sn	Wards	HH	Villages	HH	Sampled HH
1	Zajilwa Ward		Zajilwa village	3638	103
		7968	Gwandi	3500	99
			Magungu	830	24
2	Ngambaku Ward		Ngambaku village	914	26
		1950	Ndogoe	682	19
			Mlazo	354	10
3	Majeleko Ward		Chinangali-I	618	17
		1528	Majeleko village	572	16
			Mbelezungu	338	10
4	Mlowa Bwawani Ward	2149	Mlowa Bwawani village	1265	36
			Wiliko	884	25
	Total	**13595**		**N=13595**	**n= 385**

Source: Village household surveys from Wards Executive Officers, 2018/2020.

3.2 Data Collection Methods and Analysis

Methods of data collection included household surveys, focus group discussions (FGDs), in-depth interviews, transect walk, and situational analysis. Household surveys were used to gather data about community living conditions such as socio-economic factors, social welfare, behaviour and demographic information. FGDs were used to get an in-depth understanding of social issues (Nyumba et al., 2018). Exploratory open-ended questions were asked to group members, followed by detailed discussions under the influence of a moderator on the 'probe, pose and reflect modality' (Nyumba et al., 2018). In-depth interviews were administered to key informants. The entire selection process of key informants considered their socio-political status, informed experience, and gender. The district administrative secretary, district executive director, district fisheries

and livestock officers, ward executive officers, village executive officers, agricultural extension officers, village chairpersons, and village informed elders formed the team of key informants. Overall, 36 key informants were interviewed.

The study used transect walk and situational analysis mapping in spatial, temporal, and relational analysis because they are appropriate visualisation media in qualitative research (Philipp, 2021; Sontakki et al., 2019; Whisker, 2018). These approaches simultaneously investigated the complex relations: the social-cultural and environmental situations about food related agro-pastoralists livelihoods in their natural settings. In relational mapping, elements of enquiry were identified, their social maps were theoretically constructed, and questions were asked about their relations as recommended by Whisker (2018). The researcher selected significant villagers to assist in plotting routes and selecting local analysts. The pre-arranged time for each transects route was 2 hours; designed for a minimum of 2kms walking distances to capture the richness of the landscapes' information, and to allow for diversity of observations. The researcher was able to identify the following: dominant economic activities, hunger survival strategies, rural agro-pastoral livelihoods, physical natural endowments, as well as strengths and challenges facing the people. In addition, farming patterns and incumbent agricultural production technologies were identified, observed and assessed. These methods also assisted in learning the cause and effect relations among the agro-pastoralists, and the available resources in their natural settings (Figure 2).

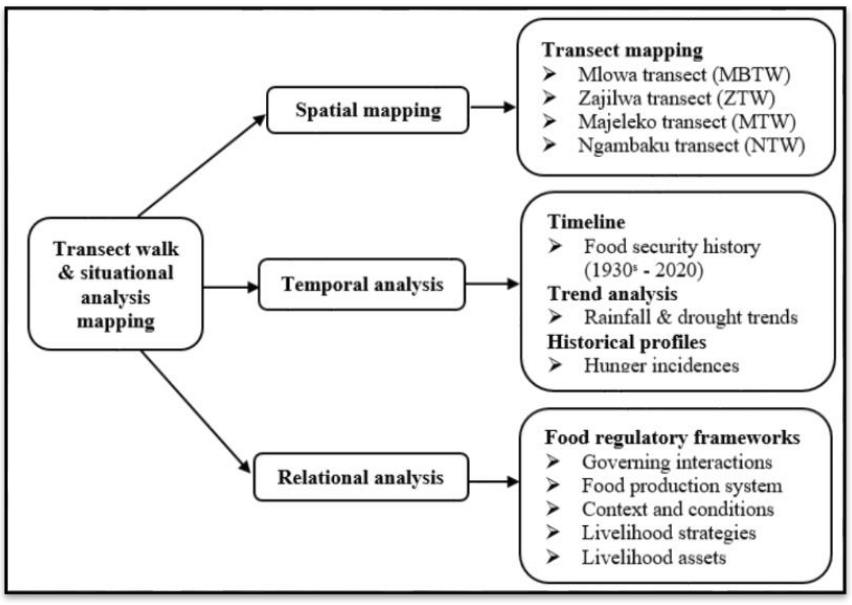

Figure 2: Transect Walk and Situational Analysis Mapping
Source: Adopted from Philipp (2021); Sontakki et al. (2019); Whisker (2018).

Collected data were processed using a mixed approach, whereas qualitative and quantitative analysis procedures were used. For quantitative data analysis, data editing, clearing, classification, manipulation and tabulation were done using Microsoft Word and Excel software. Data processing was done using the IBM SPSS software, version 20. Field responses were descriptively analysed using cross-tabulation to establish quantitative values of existing patterns, similarities and differences.

In qualitative data analysis, the content and context analysis method helped explore functions, attributes and drivers of food security. Since qualitative analysis is related to people's concepts, opinions, values, and behaviours, data were inductively analyzed. Respective social patterns were drawn from concepts and insights. Emphasis was made on participants' meanings, experiences, and views to produce representative results. In this paper, data presentation was done in percentages and frequency tables, figures and quotations. In addition, meanings extracted from descriptions of group consensus from FGDs were used to argue and present cases throughout the paper. Personal interviews are presented in the form of quoted narrations exactly from what was said by the respondents/informants.

4. Results and Discussion

The study noted the presence of food insecurity with a long history dating back to the 1830s. For three years (2017–2020), a significant number of the households were food insecure. The assessment of factors influencing food security were noted to be limited food access and choices, limited availability of food, food marketing, households' low-income levels, gender, livestock ownership, type of education acquired, soil fertility, land ownership, access to diversified income sources, and proximity to supportive environments such as along water sources or main roads to urban areas. Further findings revealed that drought was not the only cause of food insecurity because even if it rained sufficiently, there were still many food-insecure households. The magnitude of food insecurity problem was intensified by factors such as rainfall irregularities and limited diversity in sources of income. As noted above, evidence of the prevalence of the food crisis is on records way back from the 1830s. In those past days, significant causes of food insecurity were three: recurring incidences of prolonged drought, pest infestation, and social unrest. Overall, the current food insecurity status is perpetrated by three main factors: weaknesses in food management, faults in the food production system, and rainfall irregularities.

4.1 Past Food Security Situation

The study was able to unveil records of historical events about food-related situations from 1837 to 2020 in the history of Tanzania, and particularly in the study area, which was characterized by of scant, unreliable, and unpredictable rainfall (DCT, 2017). Table 2 summarizes the records.

Table 2: Selected Famine Records in the Study Area (1837-1929)

Sn	Name	Hunger cause	Year
1	Chonya Magulu (swollen legs)	Drought induced	1837
2	Mundemu	Drought induced	1870
3	Sotoka ya Wajerumani	Rinderpest cattle disease	1884
4	Mazije –I & II	Locusts	1894 &1955
5	Mutunya (1918-1919)	Social unrest	1918-1919
6	Mabilazi	Stock borers infestation	1928/1929

Source: Field data collection, 2019/2020.

Table 2 shows that people have never led stable lives as they have been disturbed by hunger throughout their history (MUMM, 1978). According to the preceding literature, among the leading causes of food insecurity in the study area—and Dodoma region in general—were recurring incidences of drought, pest infestations, and social unrest. Additionally, the change of staple food from millet to maize can be cited as another factor contributing to chronic food insecurity.

4.2 Current Food Security Situation

The study explored the main determinants of food security at village levels, and presented at ward levels to give a more localized perception of the food security situation (Table 3).

Table 3: Main Causes of Food Insecurity

Three Main Causes of Food Insecurity	Frequency	Percent
Drought	162	42.1
Food production system	117	30.4
Faults in households' food management	106	27.5

Source: Field data collection, 2019/2020.

The respondents attributed three factors contributing to food insecurity. The first was drought, as mentioned by 42.1% of the respondents. The findings show that prolonged periods of drought and rain irregularities significantly contribute to crop failure and food shortage. About 30.4% of the households reported faults in the food production system, while faults in food management were reported by 27.5% of the households. A comparative analysis of the status of food security was made among the four study wards (eleven villages). In all the villages, drought was found as the leading cause. Of the three factors that were attributed to contribute to deteriorating status of food security, drought was seen as a dominant and life-threatening problem in three others wards. An exception was made at Ngambaku ward, where faults in the food production system was the fundamental cause of food insecurity. Here, they cultivate and produce sufficient amounts of millet and sorghum (drought-resistant crops that does well even on scant rains). But, even when harvests are low, some will still be sold to get money to meet other household expenditures.

At Mlowa Bwawani, Majeleko and Zajilwa, people did not prefer to grow millet or sorghum: they grew maize instead. A unique case was observed at Zajilwa, where food mismanagement was identified as the critical cause of food insecurity. Harvested grains, such as maize and wheat, were used to brew local alcohol more than being used/stored for food. There was no much effort geared towards food self-sufficiency because people were very sure of food supply bought from income earned from alternative sources. Field observation noted many different forms of day (casual) works at Zajilwa because many in-migrants have invested in livestock and agriculture. Consider the following quote from a respondent at Magungu village:

> *Whatever we harvest is allocated for three basics: sale to get money, domestic consumption, and brewing local beer. This is how we have been raised and survived all the seasons. However, the government's responsibility is to ensure that we do not starve of hunger. If the government denies our right to free food, we don't have other alternatives than doing casual works* (Interviewee response from Magungu village, 2019)

The quote above indicates the importance of money in discharging family obligations. Because agriculture is the reliable primary source of income, people must sell agro-products or do casual works to finance other household expenditures.

4.3 The Rural Food Production and Processing Technology

Cattle skins are among the livestock products sold at the market for further re-selling to regional and external markets. However, their value-addition has not improved. For example, there is no modern skin tannery: skins are processed traditionally by being salted and stretched in the sun to dry. Moreover, there are no skin processing industries nearby. In this respect, products and their derived by-products are sold without value-addition. The overall technology in food production, processing, storage and distribution is local and mainly hand-driven. The agricultural system is rain-dependent, and there are no irrigation infrastructures. Farming is still practised while the probability of crop maturity is uncertain.

Agro-pastoralists do not depend on government agricultural and livestock extension officers because they not free of charge: they are expensive; hence they use their local experience even in the use of modern treatments. To some extent, modern technology is used in pre-processing of groundnuts, maize, and sunflower. Once crops are harvested, they are processed and stored for domestic consumption and sale. There are two processing options: either by hand, or by using machines. In all studied villages, there were many private fuel-operated machines. These machines include maize and millet milling, groundnuts winnowing, sunflower and groundnuts oil pressing, filtering and crushing machines. The use of fuel-operated machines is a technological advancement that has transformed rural agriculture by directly influencing the processing sub-sector.

The most dominant mode of land cultivation was by hand hoe (47.3%), but also there were tractors and ox ploughs. The 'hand hoe technology' was still dominant for farming, seeding, weeding and harvesting. Pests control was another technological challenge that influenced farmers' decisions on land sizes to be cultivated. The findings show the indigenous agro-pastoralists would have preferred to use advanced agricultural implements if they could afford. Because they cannot, they resorted to the old traditional ways of hand hoes, and in in few instances, oxen-ploughs. Also, due limited financial power, the agro-pastoralists used domestically stored grains as seeds. Eventually, the use of unimproved seeds and limited use of modern farming technologies lowered agricultural productivity. Low-income levels and limited life exposure to learning from others' experiences were also identified to influence the types of technologies used, which in turn determined the quantity and quality of agricultural produce. For example, most of the local agricultural practices relied on sensory evaluation instead of using advanced mechanisms to qualify and qualify produced goods (Mukantwali, 2014).

4.4 Agro-pastoralists Assets Ownership

Livestock keeping is under traditional management systems with multiple challenges. Although the impacts of production challenges are felt by both indigenous and in-migrants agro-pastoralists, the indigenous are the most disadvantaged over the latter group. This is because of the fact that in-migrants seem to be more informed and updated. They seem to know market trends, and have wider business connections. This is revealed by the quoted explanations below:

> *My fellow Gogo are relaxed with minor achievements. They don't bother about seeking for greener pastures to improve their livelihoods. For example, they think tractors are to be owned by government employees, the retired, the Chaga and Rangi people* (Interviewee response from Ndogoe village, 2019)

From the above response, it is indicative that even the indigenous agro-pastoralists acknowledges the fact that in-migrants do well in agro-pastoralism. They also wish to be so, but they do not have sufficient farming capital for intensive mechanization and extensive farming:

> *These in-migrants always have market information. They are rich, they have capital, access to good markets, as well as experience in doing business than us. In fact, they are the ones who own most of the tractors, milling machines, shops and local hotels* (Interviewee response from Gwandi village, 2019)

Most of these in-migrants have large investments in agriculture and livestock in the villages. They have big herds of livestock and maize estates as was seen through the Zajilwa transact walk. Soon after harvests, they export their grains. Reportedly, they export to Kenya, Uganda, and Sudan. They have not established processing industries in the study area, but these investors are said

to be among the big investors in places of their origins where they own schools, milling machines, and food supply companies. Since they have intact connections with external food buyers, they take advantage in agribusiness over indigenous agro-pastoralists; and remit funds to their places of origin such as Kilimanjaro and Arusha regions. Consider the quotation below from a respondent in Gwandi village:

> *These in-migrants investors (mostly Chagga from Kilimanjaro and Rangi from Kondoa) are rich. They own big and prosperous companies in their lands of origin. For example, they are connected to various food export companies. They have vast of maize, sunflower estates and livestock herds in our villages. But they haven't established processing industries and create reliable employments here. From this situation, we feel that we are being exploited* (Key informant response at Gwandi village, 2019).

The presentation in the above quote explains the transfer of money and resources, by the non-indigenous, out of the study area. This situation is typical to what is explained by the concept of 'capital flight theory'. The locals think that they are being exploited; that they are losing control over their natural resource (land). This jeopardizes their food sovereignty (Duthie-Kannikkatt, 2016; Gysel, 2016). Based on current globalised businesses, they should have taken it as a lesson; and the government should have enabled the agro-pastoralists to become part of the ongoing agribusiness with their fellow countrymen. Capital flight in many cases has negative effects on the economic development of any place. It is indeed a loss of opportunity if the money and resources of an area fail to make significant economic contributions to the area where production originates (Wujung & Mbella, 2016). For example, Zajilwa's economy is influenced by in-migrants investments in agriculture and the associated initiatives in the area. Therefore, even the severity of food insecurity is highly reduced than in other wards because they create casual employment to the majority of the rural agro-pastoralists. Such investments offer a wide range of income generating activities that play a crucial role as food insecurity adaptive mechanism.

4.5 Food Access and Food Choices

Among other factors, the findings show that food choices are affected by household's income levels. The food crisis is more disastrous in dry seasons, from July to November, when both planted and wild vegetation wilt due to excessive dryness, and therefore food choices are limited by quantity and quality. Rains begin typically in November; the start of the farming season. At this time, families do not have sufficient food stored; so, they must engage in labour work to get food. Here, poor rural households will use any means to ensure they survive. For example, they will even eat any types of undesirable foods just because of the lack of resources to obtain the desired foods. Eating wild undesired food is among the mostly unusual alternatives opted for. It might sound strange elsewhere, but eating wild, unhealthy and low-quality foodstuffs in the study region is quite normal. This habit has a long history with most of the indigenous people.

The recurring frequency of food shortage have forced the people to consume such food types as baobab tree leaves (*ikui*) and seeds (*sichili*); tubers of the wild cassava (*likayewa*); wild water melons (*mahikwi*); and famous wild plants such as *ndugulu, ngazi, saka;* and *sagulasagula* and *mlendapoli* vegetables from the genus *corchorus in malvaceae* family, and aloe vela flowers (*chidingulilu*). These foodstuffs are neither delicious nor nutritious, but they must be eaten for survival because of their free access. Dead livestock and animal skins are among the recoded alternative meals preferred most because of their availability and relatively cheap prices during extreme dry periods. Domesticated dead animals are eaten regardless of their cause of death: sometimes it does not matter even if the animals were under antibiotic medications or poisoned. It was strange to note that animal carcasses provide opportunities for most households to access beef. Slaughtering livestock for family consumption is considered a loss because these are strictly households' income-generating assets. It is clear from the above findings that food insecurity dictates the types and quantity of food to be eaten.

4.6 Agro-pastoralists Food Insecurity Cycle

Rainfall irregularity, characterized by unpredictable patterns, is common in the study area. Usually, farming begins between November and January each year. Field observations noted that, in 2020, rains were received early in December. However, in 2019/2020, 48.8% of the agro-pastoralists had food insecurity while in 2018/2019 only 6% of interviewed households had food insecurity (Table 4).

Table 4: Food Shortage Status 2017-2020.

Variable		Frequency	Percent
Year of experience of food shortage	2017-2018	46	11.9
	2018-2019	23	6
	2019-2020	188	48.8

Source: Field data collection, 2019/2020.

During the 2018/2019 season, there was no rain, which caused a crop failure: the food produced was lower than the capital invested; and there were no food reserves in households. According to Giller (2020), this is a yield gap that requires deliberate appropriate solutions to close. Unfortunately, these are not usually handy. Typically, every household strives to ensure that farms are cultivated in each new farming season. However, as typical to agricultural dependent economies, most households cannot afford farming costs because almost all their farming produce is consumed in the last season. These rural agro-pastoralists have little or nothing to re-invest in farming if there is a crop failure in the previous season (Ritzema et al., 2017). For example, after the 2018/2019 drought, livestock in many households were sold to facilitate farming for the 2019/2020 season. Because of the drought, a cattle worth TZS300,000 was sold at TZS120,000; and a goat worth TZS90,000 was sold for

TZS25,000. Characteristically, during farming seasons the selling prices of livestock are low because of the influence of brokers (*galagaja*). So, even if agro-pastoralists would wish to sell their livestock, they would not get promising returns. Also, those without livestock must use any available means to get funds for farming labour and buying seeds. During this period of the year, casual work is the most dependable means of obtaining subsistence earnings.

Wealthy farmers employ those with weak financial bases as casual laborers. This form of work is commonly known as *miraba.*[1] Wage payments are supposed to be in cash, but they are mostly in physical goods at the rate of 20kgs of grains for cultivating a quarter of an acre. Money earned from livestock sales and wages received from casual labour are used for subsistence, to finance cultivation, and/or meet other household expenditures. Furthermore, poor agro-pastoralists returning back from *miraba* may miss the rains because of time delays. Thus, they may cultivate their farms when the rains have gone. Also, they may find it difficult to cultivate because grasses have grown tall and the soils have become heavier: all these conditions rendering it difficult to till the land by hand. Ultimately, poor households become food insecure in the next round; a trend that recurs every year. This paper has termed this food insecurity phenomenon as the '*Miraba Food Insecurity Vicious Cycle*' because it significantly contributes to the food security problem in the study area.

4.7 Food Security Determinants

4.7.1 Gender and Land Ownership

The findings show that the land problem is mainly confined to female-headed households all over the study area: customarily, land is owned by males. It was further noted that out of the 385 studied households, 76.1% of the households land is male-owned but only 19.5% is female-owned; while in 4.2% of households land is owned by the family (Table 5).

Table 5: Land Ownership Status

Variable	Frequency	Percent
Owned by head of household (Male)	293	76.1
Owned by the family	16	4.2
Owned by head of household (Female)	76	19.5

Source: Field data collection, 2019/2020.

In rare observations where land was noted to be under female-ownership, it was due to the deaths of male heads of households, inheritance, or the land being bought privately by a female. Once separated from their husbands by deaths or divorces, females lose even their right to own or access previously co-

[1] Name given to casual labour in the study area.

owned resources such as land. In most of such families, males leave all the children to the separated wife; but confiscate all land and other important household resources such as livestock. This cultural norm within the study area make female-headed households to be more vulnerable to food insecurity than male-headed household as assets are vital to agro-pastoralists survival.

4.7.2 Livestock Ownership

Although agro-pastoralists are the livestock keepers, out of the 385 studied households, only 193 (50.1%) own livestock (Table 6).

Table 6: Livestock Ownership Status

Ward	Respondents	Owners	Owners Percentage	Non-owners
Majeleko	78	40	20.7	38
Zajilwa	120	70	36.2	50
Ngambaku	84	42	21.7	42
Mlowa Bwawani	103	41	21.2	62
Total	**385**	**193**	**100**	**192**

Source: Field data collection, 2019/2020.

The statistics in Table 6 show that the Zajilwa ward owns livestock by (16%), ahead of others. A detailed enquiry revealed that this is because of the influence of in-migrants investments in villages within the Zajilwa ward. Across the study area, ownership of key domestic animals such as cattle, goats, sheep, donkey, and pigs are crucial in determining not only the status of food security, but also the general economic stability of households. As important domestic assets, livestock can be sold and the income be spent in buying food. In the subject area, there is an observable difference on resilience to food insecurity between livestock owners and those without livestock. Livestock owners were found to be more resilient than the other groups. Secondly, the difference lies on livestock as an alternative survival strategy. Households without livestock resort to tedious labour works than those owning livestock. This means, those with livestock are likely to be stable against food insecurity by selling livestock.

4.7.3 Education Levels

Traditionally, agro-pastoralists do not prefer formal education. Education does not have a robust social support starting from the family level. Out of the 385 respondents, there was no single resident with a university education. About (66%), (7.3%) and (1.6%) respondents had primary, post-primary and adult education, respectively. To a large extent, the socio-economic characteristics of household members do not differentiate them education-wise. This is because they appear to be equal as there is no any apparent evidence suggesting that education has influenced a change of livelihood styles for the majority. Their

education levels do not show any significant impact on their income, livestock production and stability in crops cultivation. In other words, education levels do not correspond to the food security status of households. The overall lack of formal education is seen to have denied them access to basic school-learned cognitive skills, which, in the long-run denied them access to formal employment with more secure incomes, which in turn ensures less vulnerability to food insecurity.

4.7.4 Soil Fertility

Generally, soils of the study area are naturally fertile, and there are rains crops grow naturally without the application of industrial fertilizers. Chamwino still has an arable land of about 276,900ha potential for crop and livestock production. However, out of these, only 107,249ha are used, while the remaining land is idle (URT, 2012b). Varieties of crops are cultivated, with the common crops including maize, sorghum, millet, pulses, groundnuts, pumpkins, sesame and sunflowers. Among the livestock kept are goats, pigs, sheep, cattle, and donkeys. Agriculture is rain-dependent, with the rain pattern being irregular, and dependency on it also being unreliable. On good agricultural years (sufficient rains), efforts invested in cultivation and cultivated land sizes are the main determinants of quantity of crops to be harvested.

4.7.5 Brokers and Marketing of Rural Agro-Pastoralists Products

In the study area, the rural agro-pastoralists market is expected to operate on forces of demand and supply under a free market economy but unfortunately, brokers determine prices of goods because of their market powers. Marketing begins at the household level, directly involving negotiations and transactions between agro-pastoralists and brokers, popularly known as *galagaja*.[2] These brokers are very prominent in the study area. Usually, they buy goods from households or primary markets at lower prices, and resale them lucratively right within market borders (within the same market). The dry season is the excellent period for the *galagaja* as they take full advantage of agro-pastoralists' 'need for money as farming capital'. The quotation below from a Ngambaku transect walk attests to the presence and implications of the *galagaja*:

> *The* galagaja *are connected and have good links to diverse markets. As buyers and ordinary agro-pastoralists, we all depend on the* galagaja *for market connections. For example, to sell our livestock, we must accept their prices. They are indeed powerful in influencing the prices of our products. We wish the government could re-establish our lost powers in the market* (Interviewee response from Mlazo village, 2019).

This is exploitation exists because market governing mechanisms have failed to safeguard the rights of producers (Gysel, 2016): brokers have been left to take control of the market while they are not producers.

[2] Brokers of agro-pastoral produced goods

4.7.6 Access to Diversified Income Sources

The study area is in a rural setting, where reliable sources of income are limited. Apart from agriculture and livestock keeping, the most dependable income sources include employments in *migahawa* (local food vending hotels), *bodaboda*,[3] petty trading, and in food processing firms (Table 7). Also inclusive is casual labour in farming, weeding and harvesting; which is seasonal. Brewing of local alcohol is the only activity done throughout the year.

Table 7: Off-farm Living Strategies and Sources of Income

Off- farm Living Strategies	Total	Percent
Brewing of local liquor	54	14
Local hotel (Mgahawa)	7	1.8
Casual labour (Miraba)	93	24.2
Petty trade/Kiosk/shop	95	24.6
Local butchery and livestock trading	36	9.7
Begging	15	3.9
Driving (bodaboda and vehicles)	8	2.1
Seasonal migration	3	0.8
Others/ unspecified	38	9.9
Reliable employments	17	4.5
Handicraftsmen	18	4.7
Total	**385**	**100**

Source: Field data collection, 2019/2020.

4.7.7 Transportation and Distribution Infrastructure

There are no reliable roads to be accessed by public motorized transport. The principal means of transportation between and among the villages are tractors, ox-driven carts and motorcycles servicing between homes, markets and farms. For example, the main road to Majeleko village, which is off-the-Morogoro highway, is usually not passable during heavy rains because the river is repeatedly flooded, and the bridge overflows. Almost all rural villages become incommunicado during and after the rainy season, mostly from November to February, except through motorcycles. For instance, at Ngambaku, usually the roads turn into gullies during and after the rainy season because of erosion caused by surface run-off.

As mentioned earlier, agriculture remains the only reliable source of income for these rural communities; and especially for the agro-pastoralists. Their meagre incomes generated mainly from agriculture ends up being used to finance other household expenditures, in addition to unspecified emergencies because their villages—such as Ndogoe, Mlazo, Magungu and Mbelezungu—are remote and inaccessible from urban centers.

[3] Motorcycle transportation service

4.7.8 Contribution of Other Factors

Generally, household's efforts to achieve food security is also limited by external factors stemming out of administrative inefficiencies in the provision of vital social services. For example, detailed field investigations unveiled the absence of: entrepreneurial education to the study community; irrigation infrastructures to support domestic and business agriculture; and the absence of water, electricity, agricultural field extension services; and police and health services to the people and their livestock in most parts of the study villages. Consequently, households bear the burden of using their meagre funds to finance expenditures that could have been met by the government. This reduces the resilience of households to food insecurity.

5. Conclusion and Recommendations

In the study area, agriculture is the key source of livelihoods, followed by casual labour as a major off-farm income-generating source. This area is not food secure: it has a chronic food insecurity history dating back to the 1830s. Prolonged droughts, together with crop and animal diseases, characterize its history. Generally, the main determinants of food security were noted to be administrative, environmental and socio-cultural factors. If these conditions remain unchanged, the food situation is expected to be worse because land is increasingly becoming scarce for both crop production and livestock grazing. The ever expanding urbanization and commercialized farming have converted the locals into casual labourers, and cropland into residential or urbanized commercial land. Those who are landless have become more prone to food insecurity.

Despite the good intentions of the government to end food insecurity by providing food and financial aids to hunger victims, this strategy is critically challenged as it is short-lived; and causes food dependency in the long-term. To achieve food security, it is recommended that the government deliberately break the food insecurity cycle through the following strategies: modernizing the traditional food production system by simple technologies in food processing, and by introducing irrigation farming infrastructures. Also, existing rural development plans should be implemented in sectors such as transportation and food semi-processing to create alternative sources of income for agro-pastoralists to get rid of agricultural dependency.

Competing interests

All authors declare that they have no conflicts of interest.

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