



# Does homestead livestock production and ownership contribute to consumption of animal source foods? A pre-intervention assessment of rural farming communities in Tanzania

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## ABSTRACT

Livestock production at homestead level is widely reported as an important pathway to achieve optimal consumption of Animal Source Foods (ASF) in a household. However, the empirical evidence is limited. This paper examines the extent of homestead livestock production and consumption of ASF by rural farming communities in four villages of Dodoma and Morogoro regions, Tanzania. A cross-sectional survey of 663 households was carried out. Interviews and focus group discussions (FGDs) with mothers and caregivers sought to understand livestock production and consumption patterns of ASF. Analysis techniques included Chi-square test, ANOVA and binary regression. Animal source foods were grouped into four categories; (i) meat and meat products, (ii) eggs, (iii) fish, sardines and sea foods, and (iv) milk and dairy products. The average intake of ASF was low for the entire sample, with only 26% of the population consuming at least one of the four types, even though more than half (52.5%) of the surveyed households reported to keep livestock. Generally, proportion of livestock keepers consuming ASF was slightly higher compared to their counterparts. Results from chi-square test indicated that, Dodoma households were more likely to consume meat ( $\chi^2(1) = 11.1, p = 0.000$ ) and milk ( $\chi^2(1) = 10.8, p = 0.000$ ) than Morogoro households ( $\chi^2(1) = 0.2, p = 0.627$  and  $\chi^2(1) = 0.02, p = 0.887$ ). Notably consumption of fish and sardines prevailed more in Morogoro than Dodoma households. Keeping of livestock was further emerged as a significant predictor for consumption of ASF after controlling for demographic factors ( $p < 0.01$ ). Findings from FGDs further revealed that; low nutrition knowledge, limited number of livestock, monetary and cultural values attached to livestock were the barriers to consumption of ASF. These observations highlight a mismatch between level of production of livestock, availability and actual consumption of ASF in rural households. Optimizing the contribution of livestock keeping on the consumption of ASF requires a combination of efforts. These include; addressing socio-cultural norms and practices towards motives for keeping livestock, promoting good livestock rearing practices to maintain desired stock needed for consumption and households'

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income and addressing gaps on nutrition importance of ASF. Therefore, promoting livestock keeping at homestead level and nutrition behavior change strategies targeting specifically, the importance of consuming ASF are crucial for attaining adequate consumption.

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## Introduction

Sub-Saharan Africa is experiencing an increase of undernourished individuals from 181 million back 2010 to nearly 222 million as of 2017 [13]. This is also true in Tanzania where undernutrition remains the major nutrition challenge. Nationally, the prevalence of anemia is 58%, for women of reproductive age (15–49 years), and 45% for children under five years of age (TDHS-MIS 2015–16). Stunting is still prevalent among children under five years of age, with a national average of 34% (TDHS-MIS 2015–16). There is remarkable disparity in the prevalence of stunting and anemia between rural and urban areas. Currently, stunting affects children under five years of age more in rural areas, at 38%, than urban areas, at 25%; likewise, anemia affects 59% of rural children, but only 54% of urban children (TDHS-MIS 2015–2016; [39]).

The problem of undernutrition in low and middle income countries including Tanzania is multifaceted, but primarily results from inadequate intake of macro and micro-nutrients [10,21,42]. In particular, adequate consumption of animal source foods is of great importance due to its high protein quality and bioavailability of micronutrients. It plays an important role in preventing protein energy and micronutrient deficiencies [4,24,30]. Not only is ASF consumption known to increase dietary quality and adequacy [12,40], but its consumption is also linked to important micronutrients like iron, zinc, and vitamin A, as well as macro-nutrient like protein [10,28,33]. Despite the afore-mentioned benefits, ASF intake is reported to be low in rural Tanzania. Several studies [6,21,26] have reported that a typical diet in most rural areas is characterized by cereal based foods accompanied by vegetables with little or no ASF. According to FAO [12], dietary protein intake in developing countries is inadequate and significantly below the recommended level. Cochrane and D'Souza [6] noted that in developing countries, protein is mainly obtained from cereal based staple foods.

Livestock production at a household level is frequently cited as one of the nutrition sensitive approach to enhance not only optimal consumption of ASF but also good nutrition status [3,7,18]. Tanzania ranks the third in Africa, after Ethiopia and Sudan, with large number of livestock [36]. The country has 25 million cattle, 16.7 million goats, 8 million sheep, 2.4 million pigs, and 36 million chickens [29,36]. The 2012/13 national panel survey revealed that 50% of all households keep livestock, in which; 62% are from rural households and 23% from urban households. About 86% of households own chickens; 48% goats, 35%, cattle 9% pigs and other livestock 10% [29]. Nevertheless, per capita consumption of ASF is still low in Tanzania [14]. Given that rearing of livestock is mainly a rural activity, one would expect a large number of rural residents consuming ASF. However, this is not the case, as the average per capita consumption of ASF in urban households is nearly twice that of rural households. Specifically, the intake of meat, poultry, and dairy in urban households is twice as that of rural households, while for eggs, intake is approximately four times greater [8,14]. In addition, urban households rely mainly on purchasing of ASF from the market, but rural households depend on both production and purchase [8].

Despite the afore-mentioned benefits of ASF consumption the link between ASF production and consumption levels, especially in rural households, is not well explained. There is scant evidence demonstrating the linkage and the pathways through which they operate to improve ASF consumption. The few interventions involving homestead livestock production show mixed impacts on ASF consumption [3,17,20,31]. Some interventions indicate that livestock keeping may positively impact ASF consumption, only if some prerequisites are taken into consideration; these include; household income, gender, and market access to ASF [7,17,18,32,37]. Other studies have reported that livestock production generally has limited impact on ASF consumption and nutrition outcomes [1,11,19,27]. Given the mentioned inconsistent evidence, it is important to understand how livestock production may influence ASF consumption. The objective of this paper is to examine the extent to which livestock production can contribute to ASF consumption in rural settings. Considering that different ASF products might be consumed differently, this paper categorizes ASF into four groups: (1) meat (beef, pork, poultry, organs); (2) eggs; (3) fish (sardines and sea foods); and (4) milk (all dairy products). In examining the role of livestock ownership and its effect on ASF consumption, the paper attempts to describe mechanisms through which livestock ownership (and production) may alter dietary consumption in four villages of the Dodoma and Morogoro regions in Tanzania.

## Methods

### *Description of the study area*

This study is part of the baseline survey of Scaling up Nutrition Project (scale-N) operated in four villages of Morogoro and Dodoma regions of Tanzania. The study was carried out in July–August 2016 prior to the intervention of nutrition

education in the study regions. The two regions were chosen because of high prevalence of iron deficiency anemia (TDHS-MIS 2015-16). A total of two districts, namely Kilosa district from Morogoro region and Chamwino district from Dodoma region were chosen. These two districts represent diverse environmental and socio-economic conditions for exploring some of contributing factors to livestock production and ASF consumption, thus allowing for the transfer of results to other regions in Tanzania with similar characteristics [16,26,41]. The villages were randomly selected from each district, these include; Tindiga and Mhenda in Kilosa district and Mzula and Chinoje in Chamwino district.

### *Study population*

A cross-sectional study design was used in this investigation. A total of 663 households with mothers/caregivers of school going children aged between 6 and 9 years were randomly selected from the village registry to participate in the study. The sample was calculated proportionate to the number of households in each village. The number of households selected was 167, 166, 164, and 166 from Mzula, Chinoje, Mhenda, and Tindiga villages, respectively. From 663 households selected, a sub-sample of 60 women was randomly chosen to participate in the FGDs. Each of the woman selected was required to come with her husband/partner or any adult man living in the same household. This made a pair of 60 men and 60 women and mounted to a total of 120 FGDs participants. The focus discussions were then held separately for men and women in each village. The distribution and number of participants for each village is shown in (Appendix A).

### *Research instruments*

The main data collection tools were a semi-structured questionnaire and a focus group discussion guide. These tools were selected based on type of data to be collected and the study objectives. Consent was sought from mothers/caregivers as well as focus group participants to participate in the study activities (interviews and focus group discussions). The study was approved by National Institute of Medical Research of Tanzania with reference number (NIMR/HQ/R.8a/Vol.IX/2226). A pretested questionnaire was administered by trained field enumerators through face-to-face interviews with mothers/ caregivers responsible for household food preparation, cooking, and distribution. The first part of the questionnaire comprised socio-demographic details while later parts consisted of sections on food production and household food consumption. Demographic details collected including, number of people living in a household, sex of household head, age of household head, age of mother/ caregiver, marital status and education level of mother/caregiver. Food production section entailed information of the status of keeping livestock (whether or not a household keep livestock), type of livestock kept, number of livestock kept and total size of land owned. The food consumption section included information related to frequency of food consumption and a 24-h dietary recall. Food frequency section comprised a list of selected ASF, where a mother/caregiver was required to report the habitual consumption of itemized ASF in a week. A 24-h dietary recall was applied to assess recent intake of ASF consumed in the period of 24-h preceding the survey date. A series of Focus group discussions (FGDs) was also applied to verify/validate the information provided by mothers/caregivers and to provide an in-depth understanding of the reported food production and consumption patterns.

### **Analysis**

Intake of ASF was assessed by two ways; the first way was done by counting consumption of animal source food products, including meat (Beef, pork, poultry, organs), eggs, fish (sardines and sea foods), and milk (all dairy products). The counting was based on a recall period of 24-h preceding the survey date. The second way was by describing the frequency of consumption, the reference period was one week prior to the survey date. Each Animal source food item consumed was given a number depending on the frequency of consumption. A score of zero was given if food item was not consumed at all in a week, 1 was given for food item consumed once per week, 2= twice a week, 3=three times a week, 4=four times a week, 5=five times a week, 6= six times a week and 7=seven times a week or daily. The individual foods were then categorized into one of four ASF groups as described above (Meat, egg, milk, and Fish). Livestock production data were analyzed based on the status of keeping livestock (whether a household keep livestock or not) and type of livestock kept. The information on consumption of each ASF and livestock keeping was then described in terms of regions and villages. Frequencies and percentages were used to organize, summarize, and describe the data. Bivariate analysis (Chi-square and ANOVA) was carried out to identify association between production livestock and consumption of ASF. Binary logistic regression applied to predict the association between dichotomous variables where; consumption of ASF were tested against the following outcome variables: keeping of livestock, types of livestock kept, total size of land owned, number of people living in a household, sex of household head, age of household head, age of mother/ caregiver, marital status and education level of mother/caregiver.

### **Results and discussion**

#### *Characteristics of the study population*

A total of 663 households were reached, majority being mothers (85%) with mean age of 38 years. About 77% of households are headed by male (Table1). Results indicated that livestock keeping is practiced by more than half of the surveyed

**Table 1**  
Selected characteristics of the study population in Dodoma and Morogoro regions.

	Pooled (n = 663)	Dodoma		Morogoro	
		Mzula (n = 167)	Chinoje (n = 166)	Tindiga (n = 166)	Mhenda (n = 164)
<i>Continuous variables (Mean)</i>					
Age of mother/caregiver	37.6	39.2	38.3	36.3	36.4
Age of household head	42.7	43.4	41.9	43.2	42.1
Household size	5.7	5.5	5.9	5.6	5.6
Size of land owned	7.9	6.5	7.1	9.6	8.2
<i>Categorical variables (Percentage)</i>					
<i>Status of the respondents</i>					
Mother	84.9	80.8	84.3	85.5	89
Caregiver	15.1	19.2	15.7	14.5	11
<i>Marital Status</i>					
Married	77.4	81.4	69.9	74.1	84.2
Single	22.6	18.6	30.1	25.9	15.8
<i>Head of household sex</i>					
Male	76.5	79	69.3	75.3	82.3
Female	23.5	21	30.7	24.7	17.7
<i>Educational level of mother/caregiver</i>					
No formal education	44.8	44	44.6	51	39
Primary school	54.4	56	54.8	48	59.8
Secondary school	0.8	0	0.6	1.2	1.2
<i>Number of the children over 15 years</i>					
Yes	31.7	35.9	30.1	33.7	26.8
No	68.3	64.1	69.9	66.3	73.2
<i>Keeping of livestock</i>					
Yes	52.5	56.3	33.1	48.2	72.6
No	47.5	43.7	66.9	51.8	27.4
<i>Consuming ASF</i>					
Yes	26.4	15.0	10.2	35.5	45.1
No	73.6	85.0	89.8	64.5	54.9

Descriptive statistics: continuous variables are presented as Mean, while categorical variables are presented as percentages.

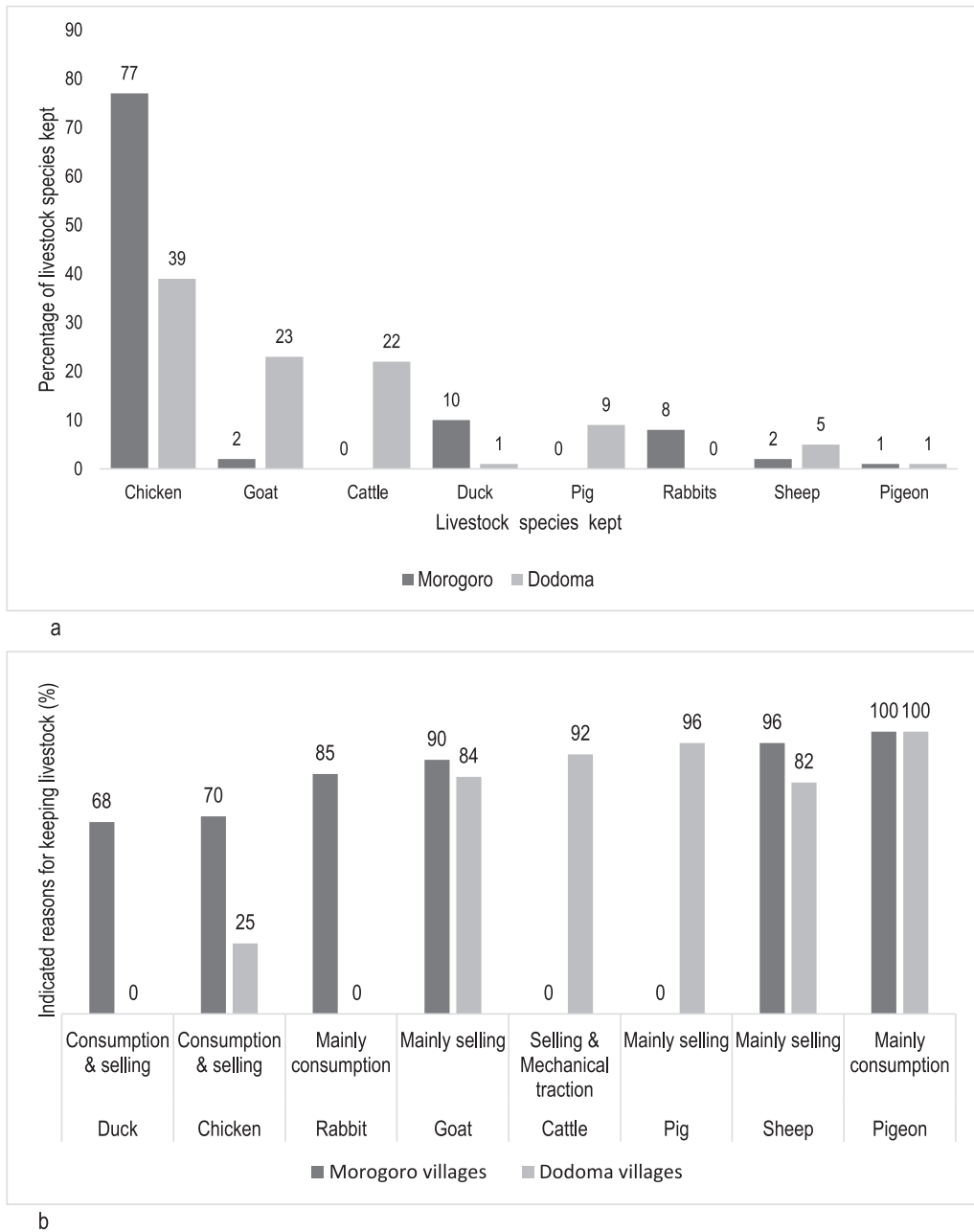
households (52.5%). However, the average ASF intake was low for the entire sample, with only 26% of the population consuming at least one ASF in 24-h prior to the survey date (Table 1). These findings are in line with other previous studies which demonstrated that; livestock keeping is an important aspect of rural Livelihood and typically ranges from subsistence to important source of household income [9,14,25]. A study by [43] reported that slaughtering of animals and consumption of poultry, meat, and milk is less frequent for livestock keepers; it only occurs when the animal is sick, has become less productive, or during important occasions, such as festivals. The fact that more than half of the surveyed population kept livestock but only quarter of them consumed ASF is clearly a gap that needs to be addressed (Table 1).

#### *Types of livestock kept and reasons for keeping livestock in study regions*

Fig. 1(a) represents types of livestock kept in study regions. Chickens are the most commonly owned livestock both in Morogoro (77%) and Dodoma (39%) regions. Large animals, such as cattle, goat, sheep and pigs, were mainly kept by households in Dodoma region, while small livestock such as poultry were mainly kept by households in Morogoro region. These findings concur with the results from National panel survey of Tanzania which revealed that 86% of Tanzanian households own chickens [29]. Fig. 1(b) represents reasons behind keeping livestock in study regions. The stated reasons behind keeping livestock were more or less the same across the study regions but differed across the type of livestock kept. Generally, most of the surveyed households reported that large animals, such as cattle, goat, pigs and sheep, were mainly kept for selling, while small animals including poultry, were for both consumption and selling. Similar observations were made by Smith et al. [35], Randolph et al. [43], and [23]; who reported that households may opt to produce varieties of livestock species to serve different household needs. Large animals such as cattle, goats and sheep may be considered as monetary assets while small animals such as poultry are viewed as immediate coping strategy. Wint and Robinson [45], further explained that small animals are more preferred than large animals. The main reason is that they are quick to reproduce and more affordable than large animals, but they can also provide a steady source of cash to the households.

#### *Association between keeping of livestock, consumption of ASF and household demographics*

Table 2 shows association between keeping of livestock, consumption of ASF and household demographics. Factors such as age of caregivers, marital status and sex of household head appeared to have significant effect on consumption of ASF. Significantly, higher proportion (82%) of those who keep livestock are married/co-habited than those who are single (18%)



**Fig. 1.** (a) Types of livestock kept in Dodoma and Morogoro regions. (b) Reported reasons for keeping livestock in Dodoma and Morogoro regions.

( $P = 0.02$ ). Similarly, significantly higher proportion of male headed households (81%) keeps livestock than female headed households (19%) ( $p = 0.001$ ). These findings concur with previous studies which reported that, in the context of African settings men have a control on decision making and matters pertaining family income, hence this may affect decision when it comes to slaughtering of homestead livestock or purchasing of alternative ASF and consumption [15,38]. However other studies acknowledged that female headed households prioritize consumption of quality animal protein rich foods to their family compared to their counterparts [37]. This signifies the ability of women to prioritize nutrition security of their family when they have been empowered to make decision and have a say over family income. Other socio-demographic factors such household size and education level of caregivers did not have effect on keeping and or consumption of animal source foods. This is contrary from what is commonly known from the literature that the quantity of ASF consumed is negatively affected by household size, even by increment of one person from the mean household size [44]. It is therefore important to further explore effects of these parameters on the production of livestock and consumption of ASF. In addition, this study

**Table 2**

Association between Keeping of livestock, consumption of ASF with household demographics (n = 663).

	Keeping of livestock	Consumption of ASF
<i>Marital status</i>		
Married	286 (82.2)***	144 (82.3)***
Single	62(17.8)	31(17.7)
<i>Education level</i>		
With formal education	202 (58)	100 (57.1)
Without formal education	146 (42)	75 (42.9)
<i>Head of household sex</i>		
Male headed household	281(80.7)***	144 (82.3)***
Female headed household	67 (19.3)	31 (17.7)
<i>Age of caregivers/mothers</i>		
40 years and below	234 (67.2)	144 (82.3)***
41 years and above	114(32.8)	31 (17.7)
<i>Age of household's head</i>		
40 years and below	171(49.1)	131(74.9)***
41 years and above	177 (50.9)	44(25.1)
<i>Total number of people living in a household</i>		
Four people or less	96 (27.6)	45 (25.7)
Five people or above	252 (72.4)	130 (74.3)

\*\*\* P values: Pearson Chi-Square test; values are significantly different at  $p < 0.05$ .**Table 3a**

Consumption of ASF in 24-h prior to the survey in the study villages.

ASF	All: n(%)	Dodoma region		Morogoro region		P-value
		Mzula: n(%)	Chinoje; n(%)	Tindiga; n(%)	Mhenda: n(%)	
Meat (Beef, pork, poultry, organs)	64(9.7)	15(9) <sup>a</sup>	5(3) <sup>b</sup>	13(7.8) <sup>a,b</sup>	31(18.9) <sup>c</sup>	<0.001
Eggs	11(1.7)	3(1.8)	0(0)	2(1.2)	6(3.7)	0.070
Fish and sardines (fresh or dried)	93(14.0)	5(3.0) <sup>a</sup>	2(1.2) <sup>a</sup>	44(26.5) <sup>b</sup>	42(25.6) <sup>b</sup>	<0.001
Milk and milk products	29(4.4)	7(4.2)	10(6.0)	4(2.4)	8(4.9)	0.436

ANOVA-post-hoc test: Values are expressed in number and mean percentage in brackets. Values within a row not sharing a common superscript letter (<sup>a,b,c</sup>) are significantly different at  $p < 0.05$ .

found no association between level of formal education of caregivers with either production livestock or consumption of ASF. A comparable observation was made by Leroy et al. [24] and [34], who documented that formal education was not appeared as a strong predictor for consumption of ASF however in their study they found that nutrition knowledge appeared to be a predictor for consumption of ASF.

#### Consumption of ASF based on 24-h dietary recall and frequency of food consumption

Table 3a and b both indicate results of ASF consumption. Table 3a describes ASF consumption based on 24-h period preceding the survey date while Table 3b indicates frequencies of consumption of ASF per week. Generally, there are significant differences in consumption of ASF between study villages. Morogoro villages had higher proportion of population consumed fish and sardines bought from markets compared to households in Dodoma villages ( $p < 0.001$ ). Eggs were the least consumed ASF in all villages (Table 3a). Based on frequencies of consumption of ASF in Table 3b, less than 2% of the total surveyed population reported to include at least one ASF in their daily meal. The percentage frequencies of consumption for all categories of ASF were higher in Morogoro region than Dodoma region, with exception of Milk consumption which was higher in Dodoma than Morogoro region (Table 3b). These findings further confirm what have been reported in Fig. 1(b) above, regarding the reasons behind keeping livestock. The mentioned reasons were inclining towards non dietary consumption. Similar observation was made by Covarrubias et al. [8], who found that high prices of livestock and livestock products create strong desire for producers to sell rather than consume livestock products. Additionally, studies done by World Bank et al. [14] and [22], observe similar patterns of consumption in both Sub-Saharan Africa and, specifically, Tanzania, where one-third of households do not include ASF in their meals. This is more prominent in rural households than urban households, even though livestock rearing is mostly taking place in rural areas. Covarrubias et al. [8] and [22] further narrated that it is hard for households to prioritize ASF consumption in their daily meals as it requires more household resources to acquire and to use than cereals and other foods. They also indicated that livestock kept by the rural households are habitually perceived as a valuable coping strategy. In case of unexpected events, they would sell to obtain immediate cash. Due to these constraints, households may opt to consume alternative sources of relishes, such as vegetables and or legumes. Given these constraints, nutrition behavior change communication strategy should be a central priority to influence consumption of ASF in rural households.

**Table 3b**  
Frequencies of consumption of ASF in the study regions.

Frequency of consumption of ASF	All: (%)	Dodoma region		Morogoro region	
		Mzula: (%)	Chinoje: (%)	Tindiga: (%)	Mhenda: (%)
<i>Meat (Beef, pork, poultry, organs)</i>					
Daily	0.5	0	1	0	1
Weekly	25	21	7	35	36
Occasionally	64.5	73	77	54	54
Never	10	6	15	11	9
<i>Eggs</i>					
Daily	0.5	1	0	1	0
Weekly	17.3	16	6	13	34
Occasionally	57	59	55	62	52
Never	25.2	24	39	24	14
<i>Fish and sardines</i>					
Daily	0.8	0	0	1	2
Weekly	40	41	19	51	49
Occasionally	43	47	57	37	31
Never	16.2	12	24	11	18
<i>Milk and dairy products</i>					
Daily	2	2	1	2	2
Weekly	12	16	9	6	16
Occasionally	49	59	53	41	44
Never	37	23	37	51	38

**Table 4**  
Consumption of ASF among livestock keepers in study regions.

	Dodoma		Morogoro	
	P-value	LR for consumption of ASF among livestock keepers	P-value	LR for consumption of ASF among livestock keepers
Meat (Beef, pork, poultry, organs)	0.001**	11.1	0.627	0.2
Eggs	0.053**	4.9	0.390	0.8
Fish and sardines (fresh or dried)	0.028**	5.2	0.002**	10.1
Milk and milk products	0.001**	10.8	0.887	0.02

LR, likelihood ratio; Pearson Chi-Square test; values marked with stars are significant at  $p < 0.05$ .

#### Consumption of ASF among livestock and non-livestock keepers in study regions

Results in Table 4, indicate consumption of different ASF among livestock keepers. Households in Dodoma are ten times more likely to consume meat and milk than Morogoro households. Morogoro households are nearly two times more likely to consume fish and sardines than Dodoma households. The high likelihood of milk consumption among livestock keepers in Dodoma signifies the importance of cattle ownership. Likewise, high consumption of fish and sardines in Morogoro indicates their availability in the markets. Hence suggests that part of the income attained from selling of livestock might have been used to purchase fish and sardines. A study done by Workicho et al. [38], demonstrated that keeping livestock is significantly associated with consumption of ASF. The authors further explained that, the increased ASF consumption observed in their study, could be resulted directly from what they produce or through purchasing from income generated after selling livestock. Additionally, evidences from other studies indicated that homestead livestock-based interventions are key to promote consumption of ASF [2,24]. Surprisingly, Morogoro households were less likely to use eggs (0.8) than Dodoma households (4.9), despite the higher production of chicken in the region. This further explains that priority for egg production is based on non-dietary consumption.

#### Predictors of consumption of ASF

Table 5 indicates results of binary regression where keeping of livestock is still emerged as a significant predictor for consumption of ASF after controlling for households' characteristics in both regions. These findings clearly verify the positive contribution of livestock production to ASF intake. Other studies have documented similar pattern where, livestock keeping predicted consumption of ASF [3,17,20]. Results from pooled statistics in Table 5, indicates that keeping of livestock together with additional variable of land size as the main predictors of consumption of ASF. In our study, we also found that the size land available for cultivation predicts livestock keeping as shown in Appendix C. These results are broadly consistent with the findings from [35] and [39] who related size of land ownership with production of livestock and consumption of

**Table 5**  
Predictors of consumption of ASF.

Model	Sig.		
	Morogoro	Dodoma	Pooled
Keeping livestock	0.00	0.00	0.00
Total number of livestock kept	0.52	0.77	0.09
Total size of land owned	0.14	0.52	0.00
Number of people in a Household	0.47	0.84	0.26
Education level	0.91	0.82	0.68
Marital Status of the mother/caregiver	0.88	0.74	0.99
Age of mother/caregiver	0.24	0.67	0.11
Household Head Age (years)	0.85	0.97	0.36
Household Head sex (1=male)	0.88	0.90	0.89

Binary regression, Significant at  $p < 0.05$ .

ASF. The authors further narrated that the size of land owned by households ensures adequate supply of animal feeds as majority of farming communities rely on crop residues for feeding their livestock.

#### *Results from focus group discussions on motives, uses, importance, and conditions necessary for ASF consumption*

Focus group discussions revealed that ASF consumption from homestead production is not part of the habitual household practice; this is because of the monetary and socio-cultural value attached to the livestock. Out of 120 FGDs participants 111 reported to acknowledge their motives for producing livestock is to sell and obtain household income (Appendix B). Nearly all participants indicated that livestock is important means for providing immediate cash in case of unexpected events. Additionally, participants indicated that having large number of livestock especially cattle, goat, sheep and pig, is a prestige for a family and a symbol of wealth. Furthermore, they indicated clearly that they had limited knowledge regarding the importance of ASF consumption. Participants from focus group discussion insisted that, slaughtering of homestead produced livestock for food consumption within the household is difficulty for several reasons. These including monetary value attached to livestock, few or limited numbers of livestock kept and livestock being a symbol for entertaining important visitors to the households. They elaborated that animal source foods are mainly consumed during important occasions, such as celebrations, religious festivals (Christmas, Eid, etc.), on weekends, or when an important visitor comes to the household.

The statement below are some of the quotations made by participants from focus group discussions on explaining different reasons for production of livestock and status of ASF consumption;

*"Our livestock are very important to us... Having them is like saving, in case of anything you can sell them and get an immediate cash to solve your problem."* [A man, 36 years old, from Mzula village, Dodoma]

*"How can I slaughter one chicken out of the seven I have.... it is impossible and if I have to eat daily from what I produce in a week I will no longer own any of them."* [A woman, 27 years old, from Tindiga village, Morogoro]

*"... and what if an important visitor come? How can you show your kindness if you are not able to slaughter even a single chicken?"* [A women 45 years old, from Mzula village, Dodoma]

Other reasons why households keep livestock include its value as an indicator of wealth (status symbol) and as savings to pay dowries to marry additional wives or when sons get married. However, other participants were unaware of the nutritional benefits of ASF consumption;

*"Here in Dodoma, having a large herd of cattle is prestigious, it becomes easy for a man to be accepted in a marriage proposal because the bride's parents are sure that you are capable of taking care of their child."* [A man, 48 years old from Chinoje village, Dodoma]

*"And yes, even me, I would accept being in a polygamous marriage, if a man is having enough cows! Why should I reject his proposal? For us it is a tradition to have polygamous marriage, but the man must be financially capable of taking care for his wives and having many cows is a symbol of wealth, after all he is supposed to be a bread winner."* [A woman, 25 years old from Mzula village, Dodoma]

*"But we have been eating for years these ASF they are desired foods, we like them, they are tasty! For example, when you cook meat in the household, everyone becomes happy and of course the meal becomes more palatable if you have ASF as a relish. Speaking about the importance of animal source foods to the body, that one, I do not know, but I do enjoy eating."* [A woman, 39 years old from Mhenda village, Morogoro]

These results suggest that there might be room to improve the extent to which livestock keepers benefit nutritionally from what they produce. Focus group findings suggest that for a household to consume ASF from its own production, there



are at least three necessary conditions; these include (i) having types of livestock that can breed and reproduce quickly enough to maintain desired stock needed to raise immediate cash for unexpected households' events; (ii) access at the market to alternative inexpensive ASF such as sardines and organ meat; and (iii) communication strategies that emphasize nutritional awareness underlying the importance of ASF consumption and behavioral change for household members. The information from FGDs was further triangulated by the information gathered through household interviews, whereby over three-quarters of the surveyed households in Morogoro region keep poultry, but they mainly consume fish and sardines bought from market instead of poultry meat or eggs. This suggests that part of the income attained from selling of livestock might have been used to purchase fish and sardines. Chingala et al. [5] also observed that producing animals for household consumption is often not prioritized because of other competing interests, with income generation being top priority. This might also be contributed by the poverty eradication programs implemented widely across rural Tanzania, which focus primarily on income generation and not consumption. To succeed, it is important that the social and economic drivers of livestock production be considered carefully when promoting livestock production as a means to increase ASF consumption. Leroy and Frongillo [24] mentioned that nutrition education is an important predictor associated with improvements of dietary intake and nutritional status for households producing livestock. Additionally, this study emphasizes the importance of exploring contextual aspects that dictate when, how, and why livestock production is considered ideal for household consumption (Appendix B).

## Conclusion

The findings of this study clearly highlight a mismatch between levels of livestock production and consumption of ASF in rural households. Despite the fact that livestock production contributed positively on the consumption of ASF in the study population, consumption levels was low and the stated reasons for keeping livestock inclined towards non dietary consumption hence constrained optimal consumption of ASF to the rural households. Findings from this study further revealed that, livestock keeping is integral to rural livelihoods; as it is embedded in socio, cultural and economic ties, ultimately it is difficult for livestock production to translate into optimal consumption of animal source foods. Optimizing the contribution of livestock keeping on the consumption of ASF requires a combination of efforts. These include; addressing socio-cultural norms and practices towards motives for keeping livestock, promoting good livestock rearing practices to maintain desired stock needed for consumption and for income generation and addressing gaps on nutrition importance of ASF. Conclusively, a nutrition sensitive approach accompanied by social behavior change strategies specifically targeting both the production and consumption of livestock and their products should be emphasized to facilitate a healthy balance between livestock production and consumption.

## Declaration of Competing Interest

The authors of this article declare no conflicts of interest.

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## Ethical approval and consent to participate in the study

This study was approved by National Institute of Medical Research of Tanzania with reference number (NIMR/HQ/R.8a/Vol.IX/2226). Consent was sought from households, including mothers/caregivers as well as focus group participants to participate in the study activities.

## Appendices

### Appendix A

Participants from focus group discussion.

Villages	Focus group discussion		Total
	Number of men	Number of women	
Mzula	15	15	30
Chinoje	15	15	30
Tindiga	15	15	30
Mhenda	15	15	30
Total	60	60	120

### Appendix B

Repeated themes on motives, uses, importance, and conditions necessary for ASF consumption.

Themes	Response from FGD participants	Number		
		Men <i>n</i> = 60	Women <i>n</i> = 60	Total <i>n</i> = 120
Motives for production and ownership of livestock	Obtaining household income	58	43	111
	Family prestige/status perceived as being rich, (especially for households owning large animals, like cow, sheep, and goats)	49	41	86
Uses of livestock	Coping strategy or source of emergency household funds (e.g. paying for medical care)	60	60	120
	Household food consumption	22	31	53
	Obtaining important basic services (e.g. water and milling services) in exchange of livestock products such as eggs (specifically for Dodoma villages)	30	30	60
	Mechanical traction, assisting in agricultural activities for cultivation of crops (specifically for Dodoma villages)	20	16	36
Importance of consuming ASF	A good source of protein and vitamins	12	27	39
	Do not know	48	33	81
Conditions necessary for household to consume ASF from what they produce	Obtain improved varieties of livestock species that reproduce quickly, enabling the household to consume and sell	53	48	111
	Market accessibility of inexpensive ASF sources; e.g. sardines	48	55	103
	Awareness of the importance of consuming ASF	47	41	88

### Appendix C

Multiple logistic regression; predicting the likelihood of keeping livestock.

	Sig.		
	Morogoro	Dodoma	Pooled
Household head sex	.237	.030	.003
Household head age	.734	.634	.856
Total size of land available for cultivation	.954	.376	.034
Number of people who live in this Household?	.543	.703	.880
Education level	.404	.716	.343
Marital Status of the mother/caregiver	.946	.016	.098
Total number of children in this household	.740	.362	.254
The number of children of 15 and above years age category	.221	.107	.048

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