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Women's empowerment, food security and nutrition of pastoral communities in Tanzania

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A B S T R A C T

This paper presents a mixed-methods study that examines the relationship between women's empowerment, household food security, and maternal and child diet diversity (as one indicator of nutrition security) in two regions of Tanzania. Indicators across three domains of women's empowerment were scored and matched to a household food insecurity access scale. Qualitative research helped appreciate the gender dynamics affecting the women's empowerment-food security and women's empowerment-nutrition security nexus. In cluster adjusted regression analyses, scores from each domain were significantly associated with women's dietary diversity, but not with household food security. All three empowerment domains were positively associated with food security and nutrition in the qualitative analysis. This article discusses these findings and shows the pathways by which respondents saw their empowerment to affect their household food security.

1. Introduction

Globally, there are about 300–600 million pastoralists.[1] In response to environmental, social, and political pressures, many pastoralists are shifting to more sedentary livelihood strategies,[2] a process known as 'sedentarization' (Desta and Coppock, 2004; Fratkin et al., 2006; Rota and Sperandini, 2009; IUCN and UNEP, 2014). In East Africa, sedentarization may have negative consequences for food security and maternal and child dietary intake, such as reduced consumption of animal-source foods (Sellen, 1996, 2000, 2016; Iannotti and Lesorogol, 2014). Galvin et al. (2015) found, for example, that sedentarization has fragmented common land making it difficult for herders to follow their traditional feeding strategy of freely moving livestock around. They need to rely on social networks to gain access to new land. This reduces their ability to feed livestock, and to rely on livestock and the products of livestock for household food security and nutrition.

Food security refers to the physical, social and economic access to sufficient, safe and nutritious food, at all times, to meet dietary needs and food preferences for an active and healthy life (World Food Summit 1996). Food security is necessary (but not sufficient) to achieve individual nutrition security (FAO and FHI 360, 2016). Nutrition security, defined as 'a situation that exists when secure access to an appropriately nutritious diet is coupled with a sanitary environment, adequate health services and care, in order to ensure a healthy and active life for all household members' requires not only food security but also adequate health status, hygiene and appropriate care practices (FAO, 2012). Individual diet diversity, defined as 'the number of different foods or food groups consumed over a given reference period', is strongly associated with the adequacy of nutrient intakes, and it is often used as an indicator of diet quality and nutrition security, as in this study (Jones et al., 2013; Ruel, 2003). Household diet diversity, on the other hand, measures the consumption of different food groups by any member of a given household over a reference period; it often is used as an indicator of food security and household diet quality but does not extend to approximate individual household members' nutrition security (Hoddinott and Yohannes, 2002).

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[1] Figures on the number of pastoralists worldwide vary depending on whether nomadic communities, transhumant herders, extensive pastoralists and agro-pastoralists are included. All these groups, despite their different types of mobility are facing similar challenges in both developed and developing countries (https://www.iucn.org/theme/ecosystem-management/our-work/global-drylands-initiative/iucns-work-drylands/world-initiative-sustainable-pastoralism-wisp/pastoralist-portal/pastoralism).(IUCN & UNEP, 2014).

[2] These include, for example cultivation, agro-pastoralism, or urban wage labor (Chatty et al., 2014).

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Box 1
Ololili pasture conservation system

Ololili are traditional grazing reserve areas used to feed animals during the dry months. When constructing an ololili, male livestock keepers identify an area (0.8–4 ha) close to the houses but away from main paths and which tends to retain moisture, and build a fence around it. The area is protected from livestock grazing during the rainy season in order for wild grasses to grow and to be used for feeding livestock in the dry season. Male household members take most livestock on long distance migrations in search of better pastures during the dry season. However, they will select and leave behind young, old and sick animals that may not withstand the long transhumance, as well as a few cows to provide milk for the remaining household members. The women feed these 'needy cows' on these ololili, and through them they feed their families during these harsh months when milk often becomes the only food available for weeks.

The empowerment of women increasingly is seen as a strategy to enhance household food security and nutrition (Sraboni et al., 2014; Verhart et al., 2015). Empowerment is the 'process by which an individual acquires the capacity for self-determination, that is, of living the life that she or he has reason to value' (Galiè et al., 2017; Kabeer, 1999; Sen, 1999). Scholars and development practitioners continue to strive to understand what determines such capacity for self-determination and to identify the key domains of empowerment to allow for its assessment. The choice of which domains to focus on (e.g. psychological, economic, political) may depend, for example, on the local context or on the topic of analysis (Bayissa et al., 2018).

In the context of empowerment and nutrition studies have found that when women earn an income in the household, child and household nutrition are more likely to improve than when men earn an income (Smith et al., 2003; United Nations Children's Fund, 2011). However, the mechanisms through which women's empowerment affects household nutrition and food security are complex and not fully understood. For example, a study in Ghana found that women's empowerment was positively associated with the quality of child feeding practices, but only weakly positively associated with child nutrition status (Malapit and Quisumbing, 2015a). A study in South Africa found that only certain domains of women's empowerment (influenced by socio-cultural factors that directly hindered agricultural production) had any effect on food security (Sharaunga et al., 2015).

Development programs have adopted dairy intensification as a strategy to enhance food security and nutrition among livestock keepers (Leroy and Frongillo, 2007), as it would translate in increased production levels. Dairy intensification is a promising approach to women's empowerment in poor livestock communities, where dairy products and revenue often are more accessible to women than the revenues of other resources, such as land, buildings, and technology (Galiè et al., 2015, J. Njuki and Sanginga, 2013). Improving forage supply is an important component of strategies for dairy intensification in East Africa, where forage shortages are a key reason for limited milk productivity in dry areas (Kakengi et al., 2001; Kanuya et al., 2006), a situation exacerbated by the process of sedentarization (Sadler et al., 2010).

A gender-sensitive approach and the active involvement of women in dairy development have been found to be consistent elements in effective nutrition interventions (Berti et al., 2004). Yet, the results of a Tanzanian dairy intensification project illustrate the complex interplay between dairy intensification, empowerment, and nutrition. The project successfully increased milk production; as soon as higher yields made milk a marketable product its control transferred from women to men; women's control over milk and revenue decreased, and no improvements were seen in child nutrition (Mwaseba and Kaarhus, 2015).

The relationship between empowerment, food and nutrition security, and dairy intensification in sedentarizing pastoral households requires further study to elucidate effective pathways for enhancing maternal and child nutrition (M. J. Njuki et al., 2016). To this aim, we conducted a mixed-methods study to explore two research questions: 'Are the three specific domains of women's empowerment— 'access to and control over assets'; 'control and use of income'; 'workload and control over own time'—related to household food security and individual nutrition in selected pastoral communities of Tanzania? How do respondent women perceive these domains of empowerment to be related to food security in the context of forage conservation and livestock management?'. The mixed methods approach was purposely adopted to address the complexity of the relationships between empowerment, food security and nutrition security because it provides both a quantified measurement of these relationships, and, depth of understanding on how these relationships unfolded according to the respondents.

In this paper, we first provide an overview of the study methodology by explaining the rationale for a mixed-method design, and the methodological details for qualitative and quantitative components of the study. We then present findings on the connection between women's empowerment, their nutritional status and that of their children, and on household food security according to both the quantitative and qualitative study components. In the findings section we describe in detail how the respondent women saw their empowerment to relate to household food security in a Maasai traditional forage conservation system, the ololili (Box 1). The implications of the findings are elaborated in the discussion session, where some methodological considerations also are addressed. In the conclusion section we summarise the main points raised in the paper and suggest opportunities for future research.

2. Methodology

Study sites and respondents. This study was undertaken in the context of the 'More milk in Tanzania' (MoreMilkiT) project (www.maziwazaidi.org). Led by the International Livestock Research Institute (ILRI) of the CGIAR, between 2012 and 2017 the project aimed to enhance the livelihoods and food security of pastoralists in Tanzania by establishing 'dairy market hubs'—groups of small-scale producers with interests in gaining access to inputs, services and markets for dairy intensification. Pastoralists are defined largely by their identity as livestock-keepers, and a life-style from nomadic to semi-sedentary in dry regions with low crop potential (Rota and Sperandini, 2009). This group includes some of the most politically disempowered and economically marginalized societies. In reaction to climate, economic and social pressures many pastoralists have shifted to more sedentary livelihoods and lifestyle: some pastoralists move completely out of livestock and into sedentary agriculture and/or wage-based livelihoods; others move to a mix of farming/herding practices, such as agro-pastoralism.

The households surveyed for MoreMilkiT, are smallholder pastoralists - either settled, intensive cattle keepers or, semi-settled extensive herders - located in Handeni and Lushoto districts (Tanga region) and Mvomero and Kilosa districts (Morogoro region). In all these districts, livestock farming is the main economic activity. Kilosa and Handeni districts represent mostly extensive, agro-pastoral livestock keeping (with local breeds) with pre-commercial milk production for rural consumption. Households here generally sell small volumes of milk to a variety of informal markets (often neighbours) and on an irregular basis. They are generally subject to considerable risks, particularly with respect to prices, feed sources, animal health and lack access to credit facilities. As a result, they are not able to invest in improving their

productivity. Mvomero and Lushoto districts have significant semi-intensive and intensive livestock production characterised by improved cattle, conducive agro-climatic conditions, and relatively more commercial milk production for urban consumption.

Study components. The overall study comprises three components: the first is a quantitative survey undertaken in July–August 2015 with 373 women from MoreMilkiT households — including small-holder pastoralists, either semi-sedentary, extensive cattle keepers or settled, semi-intensive and intensive livestock keepers from the four districts — to assess the links between women's empowerment, household food security, and maternal and child nutrition (details are provided below). Because the results showed no significant association between the three selected domains of women's empowerment and household food security — while such an association is often reported in the literature (BRIDGE, 2014) and supported by anecdotal evidence — between December 2015 and January 2016 we undertook a qualitative, in-depth study to explore this relation with a subset of the respondents from the quantitative survey — 176 respondents from semi-sedentary, extensive pastoralists Maasai only from Morogoro. We focused this second component on a forage conservation system, ololili (Box 1), because forage is a key determinant of livestock production and an exploration of women's empowerment and food security in livestock overall was too broad a focus to provide useful details. Finally, in April–May 2016 we undertook a third study to complement the quantitative survey with a qualitative and in-depth exploration of how women's empowerment, their nutrition and that of their children are connected through livestock. This third component was undertaken with 62 women, who constituted a subset of the survey respondents different from those of the second study but also belonging to semi-sedentary, extensive pastoralist Maasai communities from Morogoro and Tanga. Details of each study component are provided in the following paragraphs.

The quantitative survey. We undertook a survey to assess quantitatively the associations between household food security, maternal and child diet diversity (an indicator of individual nutrition security), and women's empowerment. All MoreMilkiT households with a woman > 15 years of age were engaged in the survey according to the following criteria. The questions on maternal diet diversity were administered to women of reproductive age (15–45 y). In households where there was a child < 2 years of age, enumerators collected information from the mother or primary caretaker of that child on infant and young child feeding practices, including dietary diversity. The empowerment module (discussed, below) was administered to the mother/caregiver of the child. In the event there was no child and more than one woman > 15 years of age, enumerators randomly selected one woman from the household. In the event there was more than one child < 2 years, enumerators randomly selected one index child. We interviewed 373 women in total. Sixteen enumerators collected household data using Open Data Kit (ODK) (www.opendatakit.org).

Household food insecurity was assessed with the FANTA household food insecurity access scale (HFIAS, n = 373) (Coates et al., 2007) and categorized into four categories of food insecurity severity ranging from food secure to severely food insecure. The HFIAS is an experiential scale that assesses whether households experience a lack of resources to obtain food and the manner in which they cope. We assessed maternal (n = 346) and child dietary diversity (n = 114) using a 24-h open recall approach (FAO and FHI 360, 2016) and developed women's and children's diet diversity scores using the approaches described by the Food and Agriculture Organization (FAO and FHI 360, 2016) and the World Health Organization, respectively (WHO and UNICEF, 2010). We categorized women's diet diversity scores as adequate if they consumed 5 or more of 10 food groups (FAO and FHI 360, 2016) and children's dietary diversity as adequate if they consumed four or more of nine food groups (WHO & UNICEF, 2010). Dietary diversity is a qualitative measure of food consumption that reflects access to a variety of foods and adequacy is a useful proxy for assessing whether individuals achieve an adequate intake of micronutrients (Martin-Prével et al., 2015). We additionally created a variable for any consumption of meat, eggs, or fish in the previous 24 h, given that these animal source foods (ASF) are rich sources of protein and micronutrients. We excluded milk from this ASF variable, given the high milk consumption among these communities.

For this study, women's empowerment was measured across three domains using the Women's Empowerment in Livestock Index (WELI) (A. Galiè et al., 2018), a standardized measure to capture the empowerment of women involved in the livestock sector, which ILRI and Emory developed in 2015 based on the Feed the Future Women's Empowerment in Agriculture Index (WEAI) (Alkire et al., 2013). The domains were: 'access to and control over land and livestock; 'control and use of income'; 'workload and control over own time'. These domains were selected based on evidence from the literature that women's bargaining power, control over income, control over time and workload affect the health and nutritional status of children under five years old (BRIDGE, 2015; Gillespie et al., 2012; Verhart et al., 2015). Each domain is comprised of three binomial achievement indicators. For each of these, "achieved" status is defined by a minimum number of positive responses to a specific set of empowerment-related questions. An

Table 1
WELI dimensions and indicators.

Domains	Indicator	Topics covered by questions contributing to indicator (components)	Indicator adequacy threshold (minimum number of questions achieved)
1. Access to and control over resources	a. Ownership and control of livestock assets	Decisions regarding the purchase, sale or transfer of livestock assets	2 out of 7 questions[a]
	b. Ownership and control of land and crop assets	Decisions regarding the purchase, sale, or transfer of crop and land assets	2 out of 5 questions
	c. Credit access	Loan recipient within household	1 out of 1 questions
4. Control and use of income	a. Control over farm income	Decisions about the use of income generated from farm-based activities	3 out of 8 questions
	b. Control over non-farm income	Decisions about the use of income generated from non-farm activities	3 out of 9 questions
	c. Control over expenses	Decisions about the use of income for household expenditures	2 out of 5 questions
6. Extent and control of work time[4]	a. Total workload	Amount of time allocated to productive and domestic tasks	< =10.5 h/d
	b. Proportion of revenue generating workload	Share of revenue-generating activities of total work-load	> 20%
	c. Control over own time	Responsibility for allocating jobs within farm and household	5 out of 14 questions

Source: Women's empowerment in livestock index (WELI) (A. Galiè et al., 2018),
[a] "2 out of 17" or "2 out of 5" refer to the number of questions considered required for this indicator to assume the value of 1.

indicator is assumed to have been adequately achieved if a certain number of questions have met minimum achievement levels (Table 1, indicator "adequacy"). In this case, the value assigned is 1; 0 otherwise. The definition of this certain number of questions within each indicator is an arbitrary decision within the WEAI methodology (Alkire et al., 2013). To introduce some consistency, achieving roughly one third of the included questions is assumed to be appropriate threshold value for indicator adequacy (A. Galiè et al., 2018) (Table 1).

To better understand the associations between empowerment, food security and diet quality, separate cluster-adjusted regression models were run with the various nutrition and food security indicators as dependent variables and the three empowerment domains as the key explanatory variables, while adjusting for household size, maternal age, household income from other sources and village (the clustering unit) (for a similar approach see Malapit and Quisumbing, 2015b). Women's and children's diet diversity scores were evaluated both as categorical (adequate/inadequate) as well as continuous score variables. Consumption of ASF was examined as a categorical variable (yes/no). For the household food security indicator, an ordered logit regression was used. All these relationships were analysed in separate regression models using STATA 14.2. The level of significance was set to ≤ 0.05.

The qualitative component. The qualitative component included two sets of focus group discussions (FGDs): one explored in depth the gender dynamics affecting the three surveyed domains of empowerment vis-à-vis household food security in the context of the ololili traditional forage conservation system (referred here as 'food security FGDs'). The second set of FGDs explored women's local perceptions of empowerment and the relationship between empowerment and nutrition vis-á-vis livestock (referred in this article as 'nutrition FGDs').

Sixteen single-sex 'food security FGDs' were conducted in five villages in Morogoro region between December 2015 and January 2016. Eighty men and 88 women who participated in the quantitative survey, were involved in an ololili, and were interested in participating in the study, were invited to the FGDs. One facilitator and one note taker from a local university and with expertise in gender analysis were present for each FGD together with a gender scientist from ILRI. Each FGD involved between 8 and 11 participants. The families of the respondents were Maasai. They used mostly a hybrid system for cattle management known as the 'base residence–satellite camp' model: they resided in a stable home base for most of the year but during the dry season the men and in some cases the whole family migrated in search of pastures and would return to the home base during the rainy season (McPeak et al., 2012; O'Leary, 1994; Xiaogang, 2007).

Eight 'nutrition FGDs' were conducted between April and May 2016 in eight villages in Morogoro and Tanga regions by the facilitator and the note taker involved in the 'food security' FGDs and by a gender expert completing her MA studies at ILRI. The villages had been involved in the survey but not in the 'food security FGDs'. Each FGD included between five and eight participants. Sixty-two women who were involved in the MoreMilkiT project were purposively selected based on high and low levels of female participation in the project. The degree of participation was considered to indicate different levels of empowerment and therefore to be informative for the study. More than half of the women who participated in this study were Maasai pastoralists, and about 40 percent were from other ethnic groups.

Each FGD was recorded and then translated into English and transcribed by five professional transcribers. The English transcripts then were coded by the gender scientist, the gender expert and a research assistant using Nvivo, a software package for qualitative data analysis (International PTY, 1999–2013). Coding was based on both pre-set codes (e.g. 'control over time', 'access to resources', 'control over resources', 'food security', 'nutrition') and on codes emerging from the discussions (e.g. 'social status', 'governance of ololili', 'collapse of ololili') (Campbell et al., 2013). The notes taken during the FGDs were used to add nuances and observations that transcripts did not provide, and also to check for consistency of understanding between note-taker and those involved in analysis. Consensus analysis (Borgatti and Halgin, 2011) was performed manually to identify statements all FGD respondents agreed on—considered to represent the view of the majority in the group—as well as statements of disagreement or viewpoints different from those of the rest of the group. Results from the 'food security FGDs' and 'nutrition FGDs' are reported together. Instances where the views of individuals or smaller groups diverged from the views of the majority are reported as relevant.

Research protocols and tools were reviewed and approved by ILRI's Research Ethics Committee, and the Institutional Review Board at Emory University and at the University of South Florida. Participants provided written informed consent (thumbprint or signature) prior to participating in interviews/discussions. The anonymity of all interviews was ensured by assigning a numerical code to each survey and discussion participant. Codes were used during the discussions, when transcribing these discussions, and during data analysis. The digital copies of all interviews were stored in the password protected computer of the principal investigator. De-identified survey data are stored on ILRI's open access data portal.

3. Findings

3.1. Women's empowerment, household food security and nutrition

From the quantitative household survey data, 26% and 20% of households were moderately or severely food insecure, respectively; 36% of women and 25% of children achieved diets of adequate diversity in the 24 h preceding the survey -which is one indicator of nutrition security. According to the WELI, women's empowerment varied across the three domains. However, even in the time domain, which shows the highest levels of empowerment, 31% of women did not achieve empowerment in any of the three respective indicators (Fig. 1).

The regression results show that a difference of one percentage point between respondents in the 'assets' and 'income' domain scores within the empowerment index are each associated with a 13.2 ± 2.1% and a 7.4 ± 1.9% difference in the Women's Dietary Diversity Score (WDDS), respectively. Furthermore, higher 'assets' domain scores and 'income' domain scores were each associated with greater odds of women achieving adequate diet diversity overall and, more specifically, consuming meat, eggs or fish in the previous 24 h (Table 2 that presents the seven regression results, one per row). Similar trends were observed for children's diets, though associations were stronger and more consistent for scores on the assets domain than with the income domain. The time use domain was not significant for dietary diversity of women and children in this population of cattle keepers (see Table 3).

In the qualitative 'nutrition FGDs' women viewed empowerment through livestock as an important avenue to increase their assurance of nutrition for household members (Price et al., 2018). Women emphasized the importance of milk in their ability to provide adequate food for the family. They felt that larger quantities of milk—either through improved breeds or increased herd number—would allow them to offer more nutrient-rich milk to children and have better nourished children. They explained that because in their communities the women typically controlled the income from milk sales, increased milk production would provide women with more money, which could be used for purchasing food and other necessary items for the household. Having control over more money decreased their dependence on others, they argued. Similarly, women asserted that having more control over assets would allow them to make better decisions about household nutrition. For example, if they could decide when to sell or purchase a cow they could have more control over the milk and purchase other nutrient-dense foods for children. Women did not feel that increased control over their time would affect empowerment and many expressed that they knew how to manage their time well. The consequences of a substantial increase in milk production on women's control over milk are discussed

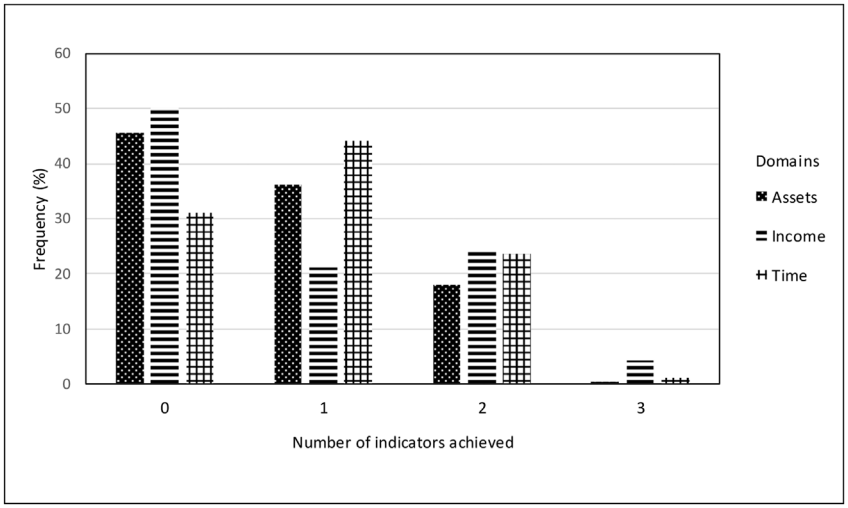

Fig. 1. Proportion of individuals achieving indicators (up to 3) within each empowerment domain.
Source: Women's empowerment in livestock index (WELI), (A. Galiè et al., 2018)

below.

The quantitative analysis showed no significant associations between women's empowerment domains and household food security (HFIAS) (Table 2). This contrasts with the findings from the 'food security FGDs', according to which all three empowerment domains were positively associated with household food security. Most women participants shared feelings of disempowerment and challenge providing sufficient and nutritious food (which they equalled to food security) for their children because their husbands controlled cattle, deciding when to move them, when to sell them, and how much of the profit could be used for household food and other goods. Participants felt that if they could have greater control over livestock and land resources and decide how much and which kinds of food to purchase, they would ensure that every family member would have sufficient and nutritious food to eat.

3.2. Women's empowerment and food security through forage conservation

The 'food security FGDs' showed that according to both women and men, ololili were effective in enhancing household food security in the dry months by stabilizing the supply of forage and through it, the production of milk, which was used mostly to feed the children and also sold to pay their school fees and cover other household expenses including food. Respondents further argued that ololili had been created a couple of generations before to address scarcity of forage in the dry seasons, a condition that had worsened recently, making ololili even more relevant for food security.

Collapse of an ololili (because of a ruined fence or grazed pastures, see below) resulted in food insecurity and poverty because households had to find cash to buy fodder for the animals during dry seasons, milk for the children, and food for the household; they also had to cover other expenses the sale of extra milk would otherwise be used for. Moreover, some female and male respondents reported that the inability to maintain ololili and their proper functioning affected their livelihood strategy along the sedentarization spectrum. When ololili were not able to provide enough forage, the whole family would need to follow the herd to ensure an adequate supply of milk. This meant that the weakest animals died of fatigue in the transhumance (the practice of moving livestock from one grazing ground to another in a seasonal cycle in search of pasture), and that children stopped going to school. Both the death of some animals and children dropping from school were considered to impoverish the family.

The rest of this section describes how the women respondents from the 'food security FGDs' described how each selected domain of empowerment is associated with the food security of their households in the ololili forage conservation system.

Gaining access to and control over land and livestock. Regarding the first of the three empowerment domains considered explicitly, the study found that livestock keepers, women and men, with low social status (apparently linked to poverty, a connection not analyzed in this study) were discriminated against by the community when establishing an ololili pasture system: they could not effectively claim a plot of community land to establish their own ololili and could therefore not own one. The majority of respondents did not face this issue. Women, however, faced a further level of discrimination at intra-household level. Although land in the studied communities is mostly public (i.e. owned by the state), the land claimed by a given household

Table 2
Associations between nutrition and food security indicators, and domains of women's empowerment.

Nutrition and food security indicators (dependent variables)	Assets domain	Income domain	Time use domain
Model 1: Woman's diet diversity score	13.2% ± 2.1 (< 0.001)	7.4% ± 1.9 (< 0.001)	−0.04% ± 2.3 (0.99)
Regression 2: Woman achieved adequate diet diversity	3.9 (1.8, 5.0; < 0.001)	1.9 (1.2, 3.3; < 0.001)	0.03 (0.01, 1.6; 0.97)
Model 3: Woman's consumption of meat, fish, eggs in previous 24h	3.4 (1.9, 4.9; < 0.001)	1.7 (1.4, 3.0; 0.01)	0.7 (0.4, 2.2); 0.7)
Model 4: Child's diet diversity score	15.4% ± 4.1 (< 0.001)	23.6% + 7.9 (0.07)	16.4% ± 5.5 (0.2)
Model 5: Child achieved adequate diet diversity	5.8 (3.2, 8.3; < 0.001)	3.4 (2.1, 6.1; 0.01)	2.3 (0.6, 5.2; 0.12)
Model 6: Child's consumption of meat, fish, or eggs in previous 24h	4.6 (1.8, 7.5; < 0.001)	2.8 (1.2, 5.4; 0.04)	2.5 (0.13, 5.1; 0.06)
Model 7: Household Food Security Category (HFIAS (Food secure is referent)			
Mildly food insecure	0.9 (0.2, 8.2; 0.7)	0.2 (0.05, 8.0; 0.9)	0.5 (0.2, 4.0; 0.2)
Moderately food insecure	0.6 (0.4, 6.1; 0.6)	6.1 (0.7, 7.6; 0.1)	0.7 (0.4, 6.6; 0.7)
Severely food insecure	0.2 (0.02, 6.1; 0.9)	1.1 (0.5, 9.0; 0.8)	0.3 (0.08, 3.6; 0.2)

Data are presented as the odds ratio (95% confidence limit; p-value) or as mean % increase ± standard error (p-value).
n households = 373; n women = 346; n children = 114. Control variables are not presented.

Table 3
Overview of the findings from each study component.
Source: authors' elaboration

Study component	Domain of empowerment	Type of association	Nutrition and food security
Women's empowerment and nutrition			
Quantitative study (WELI + FANTA)	Women's access to and control over assets	+ +	Diet diversity of women and children
	Women's control to and use of income	+	
	Women's workload and control over time	/	
Nutrition FGDs	Women's access to and control over assets	+	Improved household nutrition
	Women's control to and use of income (through larger milk quantities produced)	+	
	Women's workload and control over time	/	
Women's empowerment and food security			
Quantitative study (WELI + FANTA)	Women's access to and control over assets	/	Household food security
	Women's control to and use of income	/	
	Women's workload and control over time	/	
Food security FGDs	Women's access to and control over assets (i.e. land and livestock)	+	
	Women's control to and use of income (from small quantities of milk only)s	+	
	Women's workload and control over time (time to engage in revenue-generating activities)	+	

+ + strong positive association.
+ positive association.
/no association.

to establish an ololili was considered men's property within the community and the household. One woman explained: “because the man is the head of the family, the children are his, the wife is his, all the wealth is his …” A second one added: “house, authority and everything in the family belongs to him”. Women therefore, were considered to lack ownership of land. Lacking land to feed the livestock was used to justify why women could look after livestock and gain access to the ololili, but not make decisions about either of them (see below).

Poorer livestock keepers also reported that, if they did manage to establish an ololili, this was likely to be invaded by neighbours' livestock who would ruin the fence and completely graze the conserved pastures, causing the ololili to collapse. Low status prevented men from confronting the invading neighbour, and poverty affected their ability to rebuild the fence. Women generally were not able to face the invading neighbour because custom discouraged them from confronting men; they relied on their husbands. Single women and widows had no men folk to rely on to defend their ololili, had little revenue available to commission the rebuilding of the fence, and had little social status to claim public land for their ololili in the first place.

When asked about how control over land and livestock affected their ability to provide food for the family, all of the women said that the dry season, when the men were away with their herd, was the most difficult time. These are the dry months, when all pastures are dry and food is scarce. Maasai men take the herds to the steppe for grazing and leave a few cows behind to provide milk to the family—to be fed by the women. Men and women declared it was the men's responsibility to decide which animals to leave behind. One younger man from Twatwatwa specified: “It is the man [who decides what cattle to leave in the house] but he must cooperate with the woman because she is the one who knows which cattle can remain or go depending on their condition and which cattle can produce more milk. However, regardless of her advice, I am still the one who will make the final decision”. Most women voiced their concern that not being able to choose which cattle to keep reduced their ability to secure food for the family because men often left behind only those livestock that would not make it through the migration because of sickness, injuries, young or old age, and only few lactating animals. Together, these animals required much work and provided little milk, they argued.

Control and use of income. Women stated that because they lacked the ability to claim land and because they were not allowed to make decisions over animals—but only looked after their husbands' animals—they had no control over the revenue generated from animals, the second empowerment domain considered here. The women asserted that lack of control over animals and revenue reduced their ability to prioritize household food expenditures. In two villages where milk was considered a women's domain (control over milk within the households differs by village), the women argued they managed food expenditures because they controlled the revenue generated through the sale of milk. They added though that if the cows produced a lot of milk, the men would ask the women to manage the money together with them and to spend it on household food expenses—thereby reducing men's contribution to the latter.

Ololili were said to increase household income also through the sale of better-fed animals. The men controlled this income, and only in some cases, spent on food for the household. In all villages, men exclusively controlled the sale of livestock (excluding chicken which women controlled). In this respect, and according to women and men respondents, ololili mostly benefited men, as they could sell more animals (fewer died of lack of feed when ololili were functioning); sell the fattened animals for higher prices; address all household food expenditures, which was their responsibility; and use the money left over on beer and restaurants. A few men mentioned leaving the money to their wives (as a recognition of their work on ololili) who, however, needed to ask for their permission to use it. Five respondent women complained that despite their work in the ololili, their husbands controlled all revenue and that they had to be content with being ‘informed’ about the price for which the animals were sold.

Workload and control over own time. Because they were considered to own the land, men were in charge of managing ololili. They achieved this by assigning tasks to women and children, thereby, the women argued, reducing the time women had available to engage in revenue-generating activities of their choice, the final empowerment domain included in this study. This was considered by most respondent women to negatively affect the food security of the household. Women and men from all villages agreed that the men make decisions about ololili management because they are the heads of the households and have always made decisions on ololili. Widows or their older sons make decisions if the husband dies. A young man from Twatwatwa said, “A man is the one who assigns the roles. When the man comes back in the evening, the first person to be asked is the woman, who is responsible for the execution of his instructions.” Women and men respondents added that physical punishment awaited the wife in case of problems, such as losing an animal, not performing some activities, or invasion of the ololili. Women, therefore, felt they had limited capacity to gain more control over their own time.

Despite the fact that men controlled the time family members spent

on ololili-related work, the women believed that ololili freed up some of the time they spent on looking after animals grazing in the neighbourhood (being enclosed in the ololili), collecting and transporting grass (provided by the ololili), and attending to sick animals and household members (due to an overall improvement of animals' health). The women, however, complained that ololili-related tasks also added to household chores that also were their responsibility, thereby, reducing to a minimum time for other revenue-generating activities.

The 'food security FGDs' also explored changes that the respondents had seen over time in gender norms in their community vis-à-vis the domains of empowerment analysed in this study. Respondent women mentioned that, as compared to women in previous generations, they had become more powerful, controlled some livestock, contributed to husband's decision-making, and were subjected to less beating. One woman mentioned: "previously, in all the tasks which were done, a woman was only contributing under the authority of the man … now when you do it under order, then you are not having any authority … you only supervise as a slave, but for now the situation has changed … the woman is also doing activities with freedom". The women attributed these changes to education and religion only. Men generally agreed that gender roles had not changed in their community in the last decades regarding gendered control over land, livestock, income, workload and time. A few only argued that women nowadays had greater freedom to take decisions than they used to in the previous generation.

4. Discussion

The quantitative and qualitative components of this study found that women's control over assets and income was positively associated with dietary diversity (a proxy of micronutrient adequacy and thereby of good nutrition) by increasing women's ability to produce or purchase more diverse, more nutritious foods. This finding corroborates prior research in Ghana (Amugsi et al., 2016; Malapit and Quisumbing, 2015a), Ethiopia (Yimer and Tadesse, 2015) and Nepal (Malapit et al., 2015). With greater control over assets and income, more empowered women may be able to procure, either through their own production or purchase, more food and of higher quality and retain the food for their own and their children's consumption. The findings also show, however, that interventions to enhance milk production need gender-responsive measures to support women's continued control over milk and revenues, because when milk production and sales increase, milk becomes a lucrative commodity that men start to control. This pattern also is shown in Mvomero and Njombe districts in Tanzania (Mwaseba and Kaarhus, 2015).

The quantitative component, however, showed no correlation between women's overall empowerment and household food security. This finding appears inconsistent with research from Ghana (Malapit and Quisumbing, 2015a), Bangladesh (Sraboni et al., 2014) and Nigeria (Olumakaiye and Ajayi, 2006) that consistently suggest positive associations. The definition of food security might play a role in the observed difference, as those studies did not use experience-based questionnaires of food security as this study did, but rather proxy indicators such as household calorie availability, food expenditures, household diet diversity, food production diversity and BMI. Also, the research cited above illustrates that the influence of various domains of women's empowerment on nutrition and food security outcomes may be context specific, affected by characteristics of the local socio-cultural or agricultural systems (Amugsi et al., 2016; Johnston et al., 2015; Malapit and Quisumbing, 2015a; Olumakaiye and Ajayi, 2006; Sraboni et al., 2014; Yimer and Tadesse, 2015). It is plausible, for example, that gendered assets, labour and time divisions in livestock-dominant livelihoods differ from those observed in crop-based livelihoods - that are the focus of the cited papers-thus, explaining the differences in findings between this study and others.

However, the lack of association was also inconsistent with the qualitative component of this study (the 'food security FGDs'). We hypothesized that, as in the case of the difference between crops and livestock, a difference existed between gendered labour and time allocations between extensive and intensive systems. The quantitative survey was conducted in a more heterogeneous population across four districts, which included extensive, semi-intensive and intensive livestock smallholders. The qualitative research was restricted to extensive pastoral households in one district. To assess whether the different livestock systems affected gender–food security dynamics, we repeated the quantitative analyses excluding intensive, sedentary cattle-keepers; however, results did not change.

The different findings may be interpreted also in terms of 'aspirational' versus 'actual' empowerment–nutrition correlations. By showing a positive association between women's empowerment and dietary diversity but no association with food security, the quantitative results may reflect the norms, that emerged in the 'food security FGDs' as customary in the respondent communities, according to which men are mostly in charge of household food security (i.e. providing money to purchase food) and women of ensuring nutrition security (i.e. purchasing, producing, preparing and distributing food in the household with the money made available by the men). Because of this association between men and food security, and women and nutrition security, women are excluded from control over food security regardless of their empowerment level. The qualitative study, on the contrary, may have revealed women's aspirational view of how, only by having a say on the overall household food security strategy (e.g. what budget to assign to food expenditures, what food items to purchase, etc.) women would be able to fulfil their role as providers of good nutrition. Similarly, the association between women's control over own time and household food security may reveal an 'aspirational' situation that they, in fact, are not able to experience in actual daily reality, as shown by the quantitative analysis. Further research is needed on the association between empowerment and the roles determined by gender norms in the provision of food and nutrition security.

The different definitions, domains and related indicators used in the qualitative and quantitative studies may again be the reason for the different findings on the association between household food security and women's empowerment. For example, the qualitative study showed that 'social status'—a domain not included in the quantitative study—is an important indicator for empowerment and a determinant of food security via forage access in these communities. The importance of 'social status' for food security in sedentarizing pastoralists is in line with a study by Galvin et al. (2015), who report that in sedentarizing pastoral communities in Kenya, low social status reduces household access — gained mostly through social networks — to privatized pasture land for feeding its livestock, with negative consequences on the nutritional status of the family. Undertaking a qualitative assessment of the empowerment-nutrition-food security links before a quantitative study (and not after, as in the case of this study) may therefore be needed to identify the most relevant conceptualizations, domains and indicators of empowerment for food security and nutrition, also vis-à-vis gender roles in both nutrition and food security (as discussed above), in the selected context (in this case characterized by semi-sedentarization). Not having developed the quantitative survey on the basis of a qualitative exploration of the empowerment-nutrition-food security links may have resulted in a less targeted formulation of the quantitative indicators as compared to the qualitative investigation. This different formulation, may also help explain the contrasting results that emerged from the quantitative and qualitative studies. These contrasting results may also arise from the need in the quantitative survey of distilling complex phenomena, such as food security and women's empowerment, into simplified, independent indicators (for wider applicability) when collecting data — rather than exploring them jointly, as interdependent, mutually constitutive phenomena, as was done in the qualitative study.

The qualitative findings also showed that decision-making with

respect to household management may be shared between husband and wife in some households. Yet, men customarily are considered to be the main decision-makers and they may feel the pressure to assert this role in a public space, such as the FGDs unless further probed with specific questions. Consequently, women's decision-making may have been underreported by all respondents particularly in relation to household food security, a man's domain. Such underreporting is likely to occur also in the survey where yes/no answers leave little space to explain the complexity of decision-making arrangements in the households. Exploring such arrangements in depth may provide quantitative studies with better targeted questions. Tavenner et al. (2018), however, discuss the overall limited suitability of quantitative tools to capture gender dynamics.

While the study showed the relevance of engaging qualitatively with the local concepts of empowerment and food security, it also showed that adopting a conceptualization of empowerment entangled in the local context can be problematic vis-à-vis more universal definitions widely adopted in research. For example, while our empowerment framework highlighted the unequal management of ololili, neither most women nor most men respondents considered the ololili system unfair. They did not question the present arrangement—that women have to implement men's directives for ololili management while the men are away for months; and that although they have no say regarding this management they are held responsible for any problems of invasion by neighbours or loss of cows. The women were generally content that they received less beatings than in the past, if such problems occurred.

Also, they did not consider unfair having to feed their family in the most difficult part of the year and with the most 'needy' animals, or not having a say in which and how many animals would be left behind for them to look after. Some women and men, however, did bring up issues of intra-household management of the money earned through ololili, showing an awareness that sharing benefits could be made more equal. Also, some women mentioned that their increased involvement in decision-making did not translate into more control over the earnings. Kabeer (2011) discusses the importance of opportunities that provide a reflexive vantage point to evaluate 'usual' relationships (such as those of the family or community) and reshape individuals' perceptions of themselves that contribute to empowerment. This approach emphasizes the potential value of discussing different conceptualizations of empowerment: one brought by the researcher and one by the respondents. We therefore recommend adopting both local and universal definitions to question empowerment-relevant assumptions held by both researchers and respondents. Galiè et al. (2018) discuss some of the pros and cons of universal versus local conceptualizations and measures of empowerment.

The findings also indicate that the three economic domains of empowerment measured in this study may not capture all of the relevant dimensions of women's empowerment that are related to food security and nutrition. While all respondents did relate food security and nutrition strongly to the economic domains of empowerment selected by this study, more socially determined domains, such as social status or social capital, and their intersecting (e.g. 'being poor' and 'widow' seemed to increase experiences of disempowerment as compared to 'being poor' and 'man', 'being poor' and 'woman', or generally 'being poor'), seemed to be actually more relevant. Women argued that their ownership of land would allow them to have more decision-making over livestock, which in turn would increase their ability to provide secure and nutritious food. Yet, this study also showed, *ability to claim* control over land and livestock—rather than ownership per *se*—affected decision-making power, given that land in these communities is only informally claimed. In fact, men were able to claim control over milk revenue, when it became higher, although milk was considered to be owned by the women. Social-dimensions of empowerment, such as for example social status, affected women's ability to claim control over resources and decision-making. This study therefore recommends the adoption of a conceptual framework of empowerment that includes economic domains but also social ones to better capture the link to nutrition and food security.

Most constraints to empowerment that women respondents faced related to gender norms about appropriate roles and spaces for women that, for example, excluded them from claiming their rights (if the ololili was invaded) or from more decision-making. When discussing changes that had happened in gender norms over time in their community, it was interesting to note that women seemed to notice change more than men, who mostly referred to unchanging arrangements fixed by 'tradition'. Women attributed changes in gender roles to education and religion only, and therefore placed them somehow outside women's control. Moreover, the women respondents mentioned these changes not to discuss the persisting inequities in the system but rather as reasons to accept and be content with the status quo. Yet, these changes are evidence of how gender norms vary over time—particularly in communities such as these, which are going through important changes in livelihood strategies—and could be leveraged towards gender equity.

Notably, the qualitative findings also revealed how a given intervention that aims to strengthen women's empowerment and enhance food security and nutrition through forage, may need to focus first on governance issues around ololili management rather than on the more commonly prioritized development and introduction of forage technologies (such as new crops or varieties). Such governance interventions need to take into account the social status of livestock keepers, which, affected by various social markers including gender, age or marital status, determined the ability of individuals to benefit from the ololili system and not fall into a spiral of poverty, and affected their livelihood strategies along the sedentarization spectrum.

5. Conclusions

The study presents complementary quantitative and qualitative findings on the association between selected domains of women's empowerment, household food security, and women's and children's nutrition in pastoral communities of Tanzania. Both methodologies showed a positive correlation between women's empowerment, their dietary diversity and that of their children, and therefore their nutrition security. Only the qualitative component indicated a positive relationship between women's empowerment and household food security. This component also provided an understanding of the processes by which the empowerment of women in a forage conservation and livestock system might affect food security and nutrition of semi-sedentary households. The qualitative component also showed a customary distinction of gender roles between men as guarantors of household food security and women as in charge of nutrition security, and women's perception that such distinction is detrimental to achieve nutrition security. Such distinction is discussed as a possible reason behind the discrepancy — on the correlation between women's empowerment and household food security — between the quantitative and qualitative findings. The article also discusses that other reasons behind this discrepancy could be: different definitions, domains and indicators adopted by the two studies; 'aspirational' versus 'actual' gender roles in guaranteeing food and nutrition security. We suggest undertaking qualitative research into sedentarizing communities to elucidate the complex links between women's empowerment and food security and nutrition as affected by the interplay of new livelihood arrangements, social and gender norms at societal level, gender roles and relations within the household, and individual characteristics also including age, gender and social status. The qualitative findings inform and complement the quantitative findings. We recommend that locally relevant domains of empowerment be used together with universal paradigms to engage researchers and respondents in constructive dialogue that challenges assumptions on both ends. In particular, we recommend the adoption of an empowerment–nutrition framework that includes non-economic domains of empowerment (e.g. human and social capital that were not measured by this study but emerged as important for the

respondents), and, for nutrition, also control over purchasing, sales and preparation of animal source food (ASF) products. We suggest that future dairy projects assess the need to combine technology and institutional interventions at different stages to enhance women's empowerment, household food security, and nutrition. Finally, opportunities to enhance gender equity can be particularly important in communities undergoing dramatic livelihood changes (e.g. sedentarization) and facing new environmental challenges, such as increasing droughts. From a methodological perspective, this paper shows our approach to analysing findings from quantitative and qualitative methods that were, at times, contradictory. We engaged with the discrepancy (rather then, for example, resolving it by favouring the reliability of one method over the other) and used it to add more depth to the analysis, to improve our tools, and to identify future areas of research. Mixed-method approaches are often recommended but very rarely studies discuss how to address non-alignment of findings that may arise.

Conflict of interest form

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome. The financial support obtained has been mentioned in the acknowledgements.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

We understand that the Corresponding Author is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). She is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs.

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Appendix A. Supplementary data

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