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The Relationship of Male and Female Pastoralist Income with Household Food Security and Nutrition Status in Tanzania: Maasai, Sukuma, and Barabaig Ethnic Groups.

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THE RELATIONSHIP OF MALE AND FEMALE PASTORALIST INCOME WITH HOUSEHOLD FOOD SECURITY AND NUTRITION STATUS IN TANZANIA: MAASAI, SUKUMA, AND BARABAIG ETHNIC GROUPS.

by

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THE RELATIONSHIP OF MALE AND FEMALE PASTORALIST INCOME WITH HOUSEHOLD FOOD SECURITY AND NUTRITION STATUS IN TANZANIA: MAASAI, SUKUMA, AND BARABAIG ETHNIC GROUPS.

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Although previous work provides a significant baseline for understanding the impact of gender on household decision making and resource (i.e. income and food) allocation, there are gaps in evidence for important groups, including East African pastoralists. Previous authors have noted that pastoralists' gender roles and relations appear to be resistant to change, potentially impeding household development. This paper attempts to assess the relationship between male and female pastoralists' income control and household food security and nutritional status in Tanzania. We use three surveys: a household-level livestock health and economics survey, a household food security survey, and an individual woman-level survey on diet, nutritional status, and health. The surveys were administered to 196 pastoralist households from three tribes (Maasai, Sukuma, and Barabaig) in Tanzania in 2012-13. The results support what the majority of the previous studies find, that women's income has a positive association with dietary diversity but also differ from the previous studies since women's income has a negative association with household food security. While previous studies show that women's income will have a larger positive correlation with household food security and dietary diversity than men's income, our findings show that not only does men's income have a

negative association with household food security and dietary diversity, but also that women's income does not have a statistically significant, larger positive correlation with household food security and dietary diversity than men's income. We also find that chicken ownership and education for the head household in the pastoralist communities have a significant positive association with household food security and nutrition status.

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DEFINITION OF ABBREVIATIONS

AIC:	Akaike Information Criterion
ASF:	Animal Source Food
Cm:	Centimeter
FAO:	Food and Agriculture Organization
FHI 360:	The science of Improving Lives
GDP:	Gross Domestic Products
HFIAS:	Household Food Insecurity Access Scale
HFIAP:	Household Food Insecurity Access Prevalence
Kg:	Kilogram
N:	Number of Observations
MDD-W:	Minimum Dietary Diversity – Women
M.E:	Marginal Effect
Mm:	Millimeter
MLDF:	Ministry of Livestock Development and Fisheries
MUAC:	Mid-Upper Arm Circumference
SD:	Standard Deviation
TLU:	Tropical Livestock Units.
Tsh:	Tanzanian Shillings
USD:	United State Dollars
USAID:	United State Agency for International Development
WDD:	Women's Dietary Diversity
WDDS:	Women's Dietary Diversity Score

CHAPTER 1: INTRODUCTION

1.1. Motivation

Food insecurity and low consumption of important dietary nutrients are consequences of and, likely, contributors to poverty, especially in developing countries such as Tanzania (Villa et al., 2010). To combat poverty and its many undesirable effects such as hunger and malnutrition, policy-makers and practitioners have applied programs to help low-income households generate additional income and to control food prices (Villa et al., 2010). Despite such efforts, many households in low-income countries still do not have access to adequate food and nutrition. Some researchers argue that these programs and policies have failed due to a lack understanding of the relationship between nutrition and income (see, for example, Hoddinott et al., 2002; Thomas, 1990; Villa et al., 2010). Current studies have found mixed results concerning this relationship (Villa et al., 2010). When income increases, nutrient consumption is expected to rise as well. However, that proportional increase only continues until a certain level. After that level, the nutrient-income elasticity diminishes possibly to zero (Villa et al., 2010).

Moreover, researchers like Blumberg (1988) and Deaton (1997) argue that to create successful policies to combat food insecurity, it is necessary to understand the dynamics within the household that govern the allocation of income, food, and other resources. Blumberg (1988) explains that neoclassical economists, in earlier decades, failed to consider the internal economic dynamics of the family. According to this earlier view, it did not matter who provides food and income in the household since a household was viewed as a unitary entity with a single production function that followed a new home economic model of Gary Becker (Blumberg, 1988). However, a lack of knowledge about

internal economic differences in a family based on gender, may limit the progress of household projects and weaken women's economic position (Blumberg, 1988). Therefore, the dynamics of wealth and resource control within the household merits more research.

In the last two decades, a large literature has developed that examines the impact of gender on household decision making and resource allocation (see, for example, Blumberg, 1988, Thomas, 1993; Hoddinott and Haddatt, 1995; Deaton, 1997). These researchers agree that it matters, especially in developing countries, who earns, controls, and spends money since income control by women tends to increase household spending on food, health, and education, bringing benefits to all household members compared to income controlled by men (Thomas, 1993; Hoddinott and Haddatt, 1995; Deaton, 1997). These findings are consistent with the cultural norms of many developing countries where women are expected to possess maternal altruism, referring to the devotion of a woman's energies and earnings to their families' well-being, especially that of their children (Whitehead, 1981). To illustrate, in Whitehead's (1981) study on the Kusasi of the northeast Ghana, women dedicate 92 percent of their income to household well-being versus 76 percent for men, even in the case where men and women have equal income.

Additionally, studies primarily conducted in developing countries, suggest that an increase in male income does not improve household educational and nutritional status as much as an increase in female income would (Kennedy and Peters, 1992; Engle, 1993; Thomas, 1990). These findings explain why empowering women has become a consistent goal in international development projects. This goal was emphasized worldwide during the Beijing Women's Conference in 1995 (Spivak, 1996), which was the fourth world

conference organized by the United Nations to ensure equality and development for women against multiple barriers. Therefore, empowering women through cash transfer programs, for example, has become a predominant objective (Anderson and Eswaran, 2009).

However, some researchers argue that increasing female income control or empowerment does not guarantee household well-being (see, for example, Ringdal and Sjursen, 2017; Akresh et al., 2016; Haushofer and Shapiro, 2016; Benhassine et al., 2015; Yoong et al., 2012; Carloni, 1984). To examine this matter, researchers often look at cultural norms and social restrictions, rather than gender itself, since female and male household responsibilities may differ from one society to another (Carloni, 1984). In societies with cultural norms that do not obligate women to sustain the family, they may not have a more altruistic spending pattern than men (Carloni, 1984). Women from the Gambia and Atlas Mountain villages of Morocco do not have responsibility for family maintenance; rather, their husbands do (Carloni, 1984). Under these cultural norms, husbands provide food, while women spend their income on jewelry and clothes. However, it is not clear whether women spend money on jewelry and clothes because they themselves want to, reflecting a state of female empowerment, or because their husbands expect them to do so. If the latter is true, increasing women's income (without changing their power) will not necessarily increase household welfare. Furthermore, due to women's lower exposure to outside influences like business ventures, fraud, and embezzlement, a cash transfer to women, for example, will be less helpful to the family than a cash transfer to men (Yoong et al., 2012). In other words, women's lack of market experience may lead to a loss of household resources to dishonest agents.

According to Hodgson (1999), indigenous pastoralists' gender roles, social restrictions, and cultural norms give the impression that they are resistant to change. Pastoralists raise domestic animals like cattle, goats, sheep, chickens, camels, and donkeys, which provide them with food products, such as milk, meat, and blood, as well as wealth and cultural value (Fratkin, 2001; Tenga et al., 2008). Since their livelihoods and household wealth still heavily rely on domestic animal herding, Hodgson (1999) argues that traditional male and female responsibilities still govern their internal household economy. Consider the Maasai of East Africa, which is a well-known pastoralist group. While Maasai women's responsibilities include caring for calves and sick animals, milking cattle, distributing milk to the household members, and processing animal skins for either clothing or sleeping skins, Maasai men oversee decisions about grazing locations, herding and watering the herds, and securing the household and livestock from attacks by wild animals (Hodgson, 1999). Hodgson (1999) further explains that pastoralist men often view their spouse as property they own, control, and limit on a domestic level. To illustrate, due to cultural norms and beliefs, pastoralists women are allowed to rear poultry, but are kept from working in the labor market outside of their household (Hodgson, 1999). This may explain why development programs targeting pastoralist communities in Tanzania, for example, have often proved disappointing since the impact that gender roles and cultural norms imposes on the household economy, food security, and nutrition is still unclear (Villa et al., 2010). Since previous studies show that the implications of increasing male or female income differ based on cultural norms and gender roles from one society to another, this paper will

attempt to assess the relationship between male and female pastoralists' income control and household food security and nutritional status in Tanzania.

1.2. Study Objectives

The primary goal of this research is to assess how male and female pastoralists' income relates to household food security and nutritional status in Tanzania. Although prior studies with non-pastoralist populations have shown that empowering women increases food, health, and education within a household, others see men as the main drivers of household improvement. To understand the baseline economic situation in pastoralist households in the study area, the first objective of this study is to determine the resources controlled by males and females from three pastoralist tribes in Tanzania. The second objective is to characterize the indicators of their household food security and nutritional status, while the third objective is to assess associations among indicators of nutritional status (dietary diversity and anthropometric data), ethnicity, household characteristics (size, education, age, number of wives), and household food insecurity status with respect to male and female income control.

1.3. Research hypotheses

The majority of the previous studies on the effect of men's and women's income on household well-being and nutrition status finds that women's income has a larger positive effect than men's income. Therefore, this study will test the following hypotheses:

- The first hypothesis: Women's income is positively correlated with household food security.
- The second hypothesis: Men's income is positively correlated with household food security.

- The third hypothesis: Women's income will have a larger positive correlation with household food security than men's income.
- The fourth hypothesis: Women's income is positively correlated with women's dietary diversity (an indicator of nutrition status).
- The fifth hypothesis: Men's income is positively correlated with women's dietary diversity (an indicator of nutrition status).
- The sixth hypothesis: Women's income will have a larger positive correlation with women's dietary diversity than men's income.

I will also control for other variables that may have a relationship with household food security and dietary diversity.

1.4. Organization of the study

The remainder of the paper is organized as follows. Chapter 2 provides a brief review of the existing literature on male and female income control, indigenous pastoralists' lifestyles (economics; feeding and nutrition; and polygamy and gender roles and relations), and household food security and nutrition status. Chapter 3 describes data and discusses methodology. Chapter 4 presents the main results and discussion. The last chapter includes a summary, conclusion, and policy implications.

CHAPTER 2: BACKGROUND AND LITERATURE REVIEW

2.1. Male and female income control

There is a large and growing literature on household economic development that evaluates the extent to which gender plays a role in determining household food security and nutritional status. Using survey budget data from 55,000 Brazilian households, Thomas (1993) examines whether non-labor income and total (labor and non-labor) income assigned to men versus to women impact household commodity demand patterns equivalently. His hypothesis was that under a model of perfect altruism (or common preferences of all household members), expenditure patterns should not be affected by income allocation within the household. He splits the households into two groups, the 29,373 households with both a male and female present and the 11,119 households which are male only- or female only-headed households. Thomas (1993) finds that where both a male and female are present in the household, women devote their income to human capital (household services, health and education) and leisure (recreation and ceremonies) about four times more than if the additional income is in the hands of men. He adds that women know how to manage the food budget, spending less money at the same time that the household's nutrient intake rises. However, from male only or female only-headed households, the differences in the income effects on household commodity demand are smaller (Thomas, 1993). He concludes that more knowledge of household composition patterns and labor supply decisions will lead to better insights on household resource allocation.

Shelley and Burton (1998) use microdata from the 1992 Statistics Canada Family Expenditure Survey to analyze how husbands' income and wives' income are used in the

household. Both partners had to be full time and full year paid workers. Multiple categories of household consumption were examined, including restaurant food, household food, housing, wife's clothing, husband's clothing, household operations, recreation flows, transportation flows, children's clothing, child care, recreation stock, transportation stock, donations, and tobacco and alcohol. This study's uniqueness is that while husband's income and wife's income may be pooled for some categories of consumption (e.g. housing), the income pooling hypothesis that an additional dollar of male income is spent in the same way as an additional dollar of female income, must be rejected for others. Shelley and Burton (1998) find that at the 10 percent level of significance, the income pooling hypothesis must be rejected for eight of the 14 expenditure categories and stress the importance of traditional gender roles. An extra dollar of the wife's income is more likely to be spent on child care or food while an extra dollar of the husband's income is more likely to be spent on private consumption like clothing and transportation **(**Shelley and Burton, 1998). For the categories in which pooling is significant, Shelley and Burton (1998) explain that the couples pool resources for major expense items, housing and recreation, for instance, especially if these involve a loan, for which both partners will have to establish a fixed schedule of payments.

Ringdal and Sjursen (2017) conducted a lab experiment to see whether an increase in each gender's bargaining power impacts spending on children. To examine gender and bargaining power, researchers recruited married couples in Dar es Salaam, Tanzania. During the experiment, each partner distributed a fixed endowment among the husband, wife, and their children. The experiment had four treatments: husband dictator, husband bargaining, wife dictator, and wife bargaining. Under each dictator treatment,

the distribution of the endowment is made by the dictator while knowing that his or her partner will be informed about that decision. Under the bargaining treatment, the proposal on how the endowment is distributed by one partner is shown to his or her spouse. If the spouse agrees, the proposal is implemented. If not, no one receives anything. The results did not find a change in the share allocated to children resulting from an increase in bargaining power of either wife or husband. However, they found that an increase in the wife's bargaining power leads to more equal allocations between boys and girls rather than increasing the total allocation to the children. On the other hand, the husband in the dictator condition allocates significantly more to boys. However, there are some potential flaws with this research. For instance, each participant was aware of how much money was available to divide within the family, and how the proposer chose to allocate it. While the researchers describe the experiment as examining the effect of changes in bargaining power on distributional outcomes, the participants were real-life couples who likely made decisions in the context of their long-term relationship, rather than treating the experiment as a one-shot game. These distributional choices may not reflect real-world outcomes, since, in the real world, each spouse may not have complete information on the earnings of the other.

An experiment by Ashraf (2009) supports the previous statement that unawareness of how much endowment a partner has may impact the distribution. Ashraf studied married couples in the Philippines to test whether the spouses' income decisions significantly affect savings and consumption outcomes in the household. During the experiment, the same couples were assigned into three different treatments. Treatment 1 was a negotiation treatment in which the husband and wife discuss each experimental

choice and make individual choices by allocating their endowment. In a non-privacy treatment, the husband and wife review each other's choices but cannot negotiate before allocating their endowment. In a privacy treatment, there is neither negotiation nor the ability to review the other's choice. The results reveal that when information is kept private (treatment 3), the same proportions of men and women spend less on their households' consumption but commit more money to consumption in the non-privacy condition (treatment 2). This shows that each partner will save more and share less if his or her spouse is unaware of his or her endowment. However, under the negotiation treatment (treatment 1), men save significantly less while women choose to put money away rather than committing it to consumption.

2.2. Indigenous Pastoralists of Tanzania

2.2.1. Economic Contribution of Indigenous Pastoralists of Tanzania

Indigenous Tanzanian pastoralists' household wealth mainly depends on raising domestic animals (Jahnke, 1982; Fratkin, 2001; Tenga et al., 2008). Lupindu (2007) explains that access to Tanzania's abundant natural resources for livestock enables pastoralists to continue their traditional livestock-keeping activities in many areas of the country. However, access to land is changing for many pastoralists and some are diversifying their livelihoods by increasing agricultural production. Out of a total of 88.6 million hectares in Tanzania, 60 million hectares are rangelands suitable for grazing with a potential to carry up to 20 million Tropical Livestock Units[1], or TLU (Lupindu, 2007; Chengula et al., 2013). However, due to tsetse infestation, low rainfall, strong

[1] Tropical Livestock Units (TLU): is a standard measure for aggregating livestock herds across various species based on equivalent average bodyweight; 1 TLU=1 cow = 2 donkeys = 10 sheep =10 goats (Lybbert et al. 2007).

seasonality, and other constraints, only 40 percent of the rangelands are utilized for grazing. During 2007-2008, livestock keepers in Tanzania raised about 21.2 million cattle, 15.1 million goats, and 5.7 million sheep, which are equivalent to 25.9 million TLU (MLDF, 2012). This large number of domestic animals is mainly divided into three traditional livestock production systems: pastoralism, agro-pastoralism, and small-scale intensive specialized system (Kauzeni, 1999). Pastoralism is a livestock system which traditionally involves migratory movements with livestock and temporary settlement. Under this system, pastoralists build up their numbers of livestock during favorable seasons to ensure the survival of their herds during drought or disease outbreaks. Agro-pastoralism, which is the most common mixed farming system in Tanzania, is a system where crop and animal production are combined. Agro-pastoralists grow food crops (maize, sorghum and millet) and maintain livestock for plowing, transportation, food, and as a reserve of wealth to provide insurance against crop failure or as a source of cash when needed. The small-scale intensive specialized system is mainly a crop-based production system in which limited numbers of livestock play a complementary role. Under this system, small-holders raise cattle and goats mainly for milk and as a supply of manure for the crops (Kauzeni, 1999).

Although the traditional livestock sector accounts for about 95 percent of the livestock population, which is mainly owned by the major pastoralist and agro-pastoralist societies (Maasai, Datooga, Makonde, Gogo, Sukuma, and Barabaig) who occupy more than 30 percent of arid and semi-arid lands of Tanzania, its economic potential contribution has not been fully exploited **(**Galvin, 1992; Sellen, 1996; Tenga et al., 2008; Chengula et al., 2013). The sector contributes 13 percent of the agricultural GDP and 6.1

percent of the national GDP of Tanzania (Tenga et al., 2008). Authors have argued that the output of pastoralist systems is not accurately captured in the GDP of Tanzania, including the value of draft animals, animal manure provided by livestock production for crop production, animal transport, cultural tourism in pastoralist communities, and livestock products such as meat, milk, hides, and wool **(**Kauzeni, 1999; Tenga et al., 2008).

Although pastoralists did not traditionally engage in cropping and their economic system was marked by relatively little exchange for agricultural products, certain pastoralist groups have become increasingly involved in the market economy (Galvin et al., 1994). Maasai pastoralists, for example, have increasingly participated in the market economy because the number of livestock per person has decreased due to diseases, drought, inadequate water and dipping tanks, limited access to grassland, insufficient livestock experts and drugs, and livestock raiding as the human population increased (Galvin et al., 1994; Chengula, 2013). Cash from livestock sales is spent on food (primarily maize) and household items, especially clothing and cultural goods, but the largest amount of income is allocated to livestock reinvestment through purchasing veterinary drugs, equipment, or additional animals (Bekure et al., 1991; Galvin et al., 1994; Tenga et al., 2008).

Loss of grazing land, globalization, and sedentarization (the settling of nomadic pastoralists due to reduced seasonal movements) are other factors causing pastoralists to become agro-pastoralists or wage laborers in urban areas or to distribute portions of their herds to friends and relatives who might have better access to good grazing as coping mechanisms to increase their livestock numbers later (Tenga et al., 2008; Galvin, 2009;

Yana and William, 2010; Chengula, 2013). On the other hand, pastoralists who become wage laborers in town financially support their other family members who still herd the family's livestock (Galvin, 2009). Many studies agree that regardless of the degree of acculturation and wide differences in the degree of involvement in the market economy, pastoralists are still determined to conserve their traditional practices of raising livestock and drinking milk where reinvesting in cattle, for example, is seen as traditional store of wealth to insure against future income shocks (Galvin et al., 1994; Sellen, 1996; Thornton et al., 2007; Tenga et al., 2008). In other words, pastoralists aim to build up herds/flock size and only sell livestock or livestock products when income is needed.

2.2.2. Feeding and Nutrition of Indigenous Pastoralists.

According to Kauzeni (1999), the quality and quantity of food eaten by pastoralists mainly depends on the season. The major components of all pastoralist diets consist of milk and milk products, meat, blood obtained from their animals, and cereals either grown or obtained from market transactions (Galvin, 1992; Fratkin, 2001; Tenga et al., 2008). Milk and milk products are consumed mainly in the wet season, while meat (usually from goats and sheep or slaughtered sick animals), blood (tapped from living animals), and cereals and cassavas are mainly consumed during the dry season (Galvin, 1992; Sellen, 1996). While all children eat any moment of a day, adults eat twice a day (Kauzeni, 1999). Due to a taboo of not feeding their children either chicken or fish unless a doctor prescribes those foods, despite access to poultry and fishing, many pastoralist children are malnourished (Kauzeni, 1999). Another harmful pastoralist cultural practice is that pregnant women fast so that they may have an easy delivery (Kauzeni, 1999).

Pastoralists' herds are managed to primarily comprise milk-providing females, while castrated males are raised for meat consumption and traditional and market exchange (Fratkin, 2001). A field survey by Tenga et al. (2008) on the Tanzanian pastoralist diet in the Usangu Plains of Mbarali District, reported that on average eight cattle, seven goats, seven sheep and thirty-nine chickens are killed annually for household consumption and traditional ceremonies while their average household milk consumption stood at 2,422 liters per annum. Due to high consumption of livestock products, the pastoralist diet is generally rich in protein, but pastoralists tend to have low body mass from chronic energy, iron, and vitamin A and C deficiencies (Galvin et al., 1994; Sellen, 1996). A diet intake study conducted among two Kenyan pastoralist tribes for example, finds low caloric intake, ranging from 1000 kcal per day among Maasai women and children to 1400 kcal per day among Turkana (Galvin et al., 1994). Pastoralist dietary intake becomes much lower during dry seasons and drought periods due not only to milk reduction but also to a failure to substitute sufficient cereals to replace lost household milk production (Sellen, 1996). This failure is caused by unfavorable trade conditions (for instance: higher grain prices, lower market demand for livestock, poorer condition of animals, and difficulties in transporting livestock and grain between pastoralist villages and market centers) in dry seasons (Sellen, 1996).

Although pastoralists have low body mass on average, their protein consumption is higher than that of most agriculturalists, which allows them to survive in arid lands (Sellen, 1996; Fraktin, 2001). Fratkin et al. (1991) compared the Ariaal children from nomadic pastoralist communities in Lewogoso in Kenya with local agricultural communities on how they have adapted to and survived both natural (drought and

famine) and human (commoditization or agriculture) induced disasters. Their hypothesis was that commoditization or agriculture under sedentary conditions would alleviate drought stress by providing a more consistent diet through purchases or production of grain. To test their hypothesis, they recorded anthropometric and nutritional data for children from both communities over three years in which total rainfall was 500 mm in the rainy period and less than 250 mm in the drought period. The results did not support their hypothesis because all sedentary communities showed far higher levels of malnutrition than the pastoralist community. There were fewer children with malnutrition in the nomadic pastoralist Ariaal community than from sedentary communities. Secondly, nomadic children consumed on average over ten times the amount of milk consumed by children in agricultural communities. In the drought period, access to their camel herds provides nomadic children with sufficient amounts of protein-rich milk in order to continue satisfactory rates of growth while children's diets in sedentary communities reflect the separation of households from their livestock, which are herded at some distance from these centers. Although containing adequate carbohydrates and fats, children's diets in the agricultural communities are uniformly poor in protein, and consequently the children fail to maintain adequate growth (Fratkin et al., 1991). Fratkin et al. (1991) conclude that rather than showing the expected improvement with sedentarization, child nutrition and growth patterns are worse in comparison with the pastoralist communities subsisting on livestock.

2.2.3. Polygamy and gender analysis of indigenous pastoralists

Apart from relying mainly on traditional livestock, pastoralist cultures widely include polygamous marriage, which is the custom of having more than one wife at the

same time (Ogunsumi and Ogbosuka, 2009; Villa et al., 2011). Ethiopian pastoralist men for instance, who have two or more wives are well-off because their wives, who live in separate locations, allow pastoralists to diversify access to water and pasture sources especially in periods of rainfall shortages (Yohannes, 2009). The benefit could be in both directions because men have to be wealthy enough to provide a dowry for each wife. Villa et al. (2011) additionally explain that since household heads in pastoralist communities are generally males, while female heads are usually widows, a man who practices polygamy gains respect among his male peers. Although some groups (e.g., the educated and certain religious) believe that polygamy leads to gender inequality, it is in fact rational in the pastoralist culture (Villa et al. 2011). Girls marry young and live either in their husband's household or in that of his parents. A girl's health, nutritional status, and education before marriage determine the bride price that her parents receive (Villa et al. 2011).

Kauzeni (1999) gives an overview of gender roles in household responsibilities in pastoralist communities of Morogoro in Tanzania. The male heads of the pastoralist households own all family resources (e.g. cattle, sheep, and goats), assets (e.g. motor vehicles, motorbikes, and bicycles), and control the religious and traditional rituals of the family. Men's hardest and most time-consuming work is building houses and keeping them in good repair, but some wealthy men may pay casual laborers to build their houses. Kauzeni (1999) further explains that boys who have left school (mostly due to the long distance to schools where they may have to stay all day long without food (Yanda and William, 2010)) or children on vacation, have the task of moving the herd to grazing areas and water sources especially in dry seasons, but in some cases, the male head of the

household will graze his animals or use hired labor. Boys or occasionally male heads are responsible for buying medical treatment for the sick animals and doing service which the elders might demand, such as sending messages to other households (Kauzeni, 1999).

Households also have preferences about the gender of their children. A Maasai family with male children, for example, is believed to be wealthier because they influence the increase of livestock numbers and preserve the household when a father dies. If the male head of the household dies without a male child, his household vanishes as no one will maintain the name of the late head of household (Yanda and William, 2010). Older men's responsibilities include managing all matters concerning their communities (for instance, settling legal disagreements, marriages, bride-price, and arranging ritual ceremonies); managing their sons' herds and wives; supervising the work of all members of the household, and disciplining wrongdoers in the community (Kauzeni, 1999).

On the other hand, pastoralist women and girls have limited rights, which are given to them by their husbands or fathers. Women's tasks include preparing the daily food by pounding maize, collecting wild food (berries, fruits, nuts, and honeycombs), keeping food stores, and making butterfat from milk (Kauzeni, 1999). They are also responsible for looking after young animals, controlling the distribution and consumption of milk and food, collecting water and firewood, doing daily cleaning and repair of the house, cleaning milk containers either with water or cattle urine and fire, working the skin of slaughtered animals to make traditional hide skirts, robes, and water jugs, working traditional bead jewelry for decoration, and milking the cows twice a day (Kauzeni, 1999). However, there is an exception in the Sukuma tradition, where milking is done by

men, but the milk is passed on to the wife for distribution (Kauzeni, 1999). Despite pastoralist women's considerable work, they are excluded from major decision making in the household due to cultural laws and traditions. However, conflicts between men and women are inevitable because women give first priority to satisfying the milk needs of their children while men put the needs of the herd first (Kauzeni, 1999).

Although pastoralist and agro-pastoralist households follow mainly the same traditional gender responsibilities, agro-pastoralist women possess more rights in household decision making. While an agro-pastoralist man mainly controls cattle production and cash crops, a wife has the right to own livestock that she has purchased with money obtained from the sale of surplus food crops or other income-generating activities (Kauzeni, 1999). In polygamous agro-pastoralist households, a husband has the responsibility to allocate small plots of land to each wife to grow food crops for the family, but a woman cannot sell the excess of the food crops for that plot without her husband's permission (Kauzeni, 1999). Other farming activities such as land cultivation, sowing, transport of inputs and products, and crop harvesting, processing and marketing are distributed among the family members. In agro-pastoralist households, the domestic duties for livestock and crop production are mainly done jointly (Kauzeni, 1999).

2.3. Household food security

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Vermeulen et al., 2012). Being able to access sufficient diets and food preferences over time leads to people having healthy working lives and participating in the growth and development of their society (USAID, 1992). A

nation may have the ability to meet the nutritional needs of its population, but access to the available food is often unequal (Habicht et al., 2004; Coates et al., 2006). Access to food at the household level means that individuals have the means (income or other resources) to produce or buy the amount of food needed to maintain a healthy diet (USAID, 1992). According to Kauzeni (1999), the key factors that affect pastoralist household food security in Tanzania are declining land availability for grazing, lower productivity of the animals, increasing family consumption requirements, lack of household food storage capacity, low rainfall, low education levels, and an inability to gain the required income for needs such as school fees, medical fees, and clothing.

Knueppel et al. (2010) conducted a study to measure household food insecurity and to determine the socioeconomic characteristics associated with it. They interviewed a random sample of 237 households of agricultural and agro-pastoralist ethnic tribes (Hehe, Bena, Masaai, Gogo, and Hereina) in Tanzania. For a household to be in the sample, Knueppel et al. (2010) considered whether chickens, female caregivers, and children between 1 and 5 years of age were present in the household. The interview consisted of questions on household socio-economic characteristics (e.g. household wealth status) and frequency of animal-source food (ASF) consumption for the mother and child. Knueppel et al. (2010) find that 20.7 percent of the households were categorized as food secure and 79.2 percent as food insecure. Since the study took place during the hungry season before the annual harvest of maize, a time marked by low household food stores, it may explain this high percentage of households experiencing food insecurity. The results also show that food security is positively associated with maternal and paternal education, household wealth status, being from an agricultural rather than pastoralist tribe, and ASF

consumption, but negatively associated with maternal age and household size. While mothers' ASF consumption was marginally associated with household wealth with (P-value = 0.07), children's ASF consumption was significantly associated with household wealth with P-value = 0.01. Knueppel et al. (2010) conclude that the Household Food Insecurity Access Scale (HFIAS), calculated as a continuous measure of household food insecurity ranging from 0 (lowest level of food insecurity) to 27 (highest level of food insecurity), gives accurate findings on household food insecurity of agricultural and pastoralist households in Tanzania.

Due to population growth and conversion of pasture to agricultural use, pastoralists' traditional livelihood is under pressure to change. Yanda and William (2010) examine livelihood strategies and whether these strategies help to alleviate Tanzanian Maasai households' poverty while ensuring their household food security in Simanjiro district. An equal number of Maasai males and females were picked from the three villages (Kitwai, which is dominated by pastoralism; Landanai, which is predominantly agro-pastoralism; and Orkutu, in which agriculture is the dominant economic activity), with a total random sample comprising 166 Maasai households. Yanda and William (2010) use indicators such as wealth categories (the rich or high-class people, moderately rich or middle-class people, and the poor or low-class people) and family size to classify the Maasai households. The results reveal that rich Maasai households, based on cattle numbers, ownership of farmland, and number of wives and children, have the opportunity to increase their livestock numbers by adopting emerging livelihood strategies, including agriculture, mining, trading, and charcoal making, which will allow them to easily recover from weather shocks and maintain their wealth status. However, the moderately

rich and the poor Maasai households, which constitute 98 percent of the Maasai households, do not recover easily when they lose cattle numbers during years of severe weather and do not have the capital required to invest in new business activities. Yanda and William (2010) conclude that although the Maasai have been trying to adopt new economic activities over time in response to changing socio-economic and environmental conditions while at the same time keeping their animal wealth, the majority are still poor and becoming poorer as their food sources deteriorate over time. They add that household poverty and food insecurity is also due to the fact that Maasai women do not have access to and the ability to make decisions about family resources other than taking care of calves and small ruminants.

Ogunsumi and Ogbosuka (2009) test the association between selected personal characteristics of pastoralist women from Oyo state of Nigeria and their efforts in maintaining household food security. Of 100 pastoralist women who participated in the research, 55 percent were from polygamous households, 43 percent were monogamous, and only two percent were single. Ogunsumi and Ogbosuka (2009) find that cattle, ducks, chickens, and goats are reared by pastoralist women who are, at the same time, processing livestock products (78 percent produced cheese, 72 percent nono (millet and milk), 61 percent butter, 45 percent yoghurt, 65 percent ghee, and 78 percent made other products), which makes animal protein available for their households and the local market at cheaper prices. Although pastoralist women reported receiving between 1.52 and 2.77 US dollars as a monthly food allowance from their husbands, women trade 51 percent of cattle milk and 29 percent of weaving mats to supplement their husbands' income. Just over 59 percent of women contributed food for their household whenever

food was needed, 28 percent contributed to their household needs only when the money given by their husband was not enough, and 13 percent contributed only when they had the means. Additionally, polygamous households were able to maintain household food security because women engage cooperatively in food security activities needed to sustain the family unit (Ogunsumi and Ogbosuka, 2009). The authors conclude that women play vital roles in ensuring household food security (Ogunsumi and Ogbosuka, 2009).

2.4. Nutritional status

Nutritional status can be defined as a physiological state of an individual, which results from the relationship between nutrient intake (macro-nutrients (calories, protein, and fat) and micro-nutrients (vitamins and minerals)) and from the body's ability to digest, absorb, and use these nutrients (FAO, 2017). According to Sellen (1996), dietary assessment and anthropometric assessment are the standard methods to assess nutritional status of individuals or populations. While dietary assessment uses some combination of survey and observational techniques, anthropometric assessment uses physical measurements on a sample of the population (stratified by age and gender), which is compared to well-nourished populations (Sellen, 1996). There are few reliable studies on food consumption and nutritional status for pastoralists.

Villa et al. (2011) study whether pastoralists from 285 households randomly selected in northern Kenya and southern Ethiopia exhibit differential nutritional responses to various sources of income. To assess the relationship between nutrition status and income, they use dietary diversity to measure nutritional status and six different income sources such as income earned from non-farm and non-livestock trade

and business such as from crafts, firewood and water; income earned from wages and salary; income earned from livestock trade; income earned from the production of livestock products; the value of crops harvested; and net remittances, which includes the value of cash and in-kind gifts as well as of food aid, to measure all sources of income. More specifically, this study tests whether households exhibit symmetric dietary diversity responses to income above and below the household's specific mean income. Villa et al. (2011) find evidence of differential dietary diversity responses to changes in various income sources particularly among male and females within a household. Male household heads' dietary diversity exhibits responses to below-mean income but not to above-mean income, while wives' and adult sons' dietary diversity is unresponsive to below-mean income but responds to above-mean income. While sons' primary occupation is herding away from towns which may limit their access to diverse diets, the adult daughters' dietary diversity is relatively stable in the face of fluctuations in household income. The family receives a higher bride price based on a daughter's nutrition status regardless of the household income instability**.** Villa et al. (2011) conclude that no discrimination, in terms of dietary diversity, against women exists in these households. However, adult sons are systematically worse off than their fathers, mothers, and adult sisters. Therefore, they imply that there could be a danger in assuming that females are universally worse off and thus excluding males from being targeted in food and nutrition programs.

CHAPTER 3: DATA AND METHODOLOGY

3.1. Study area

To assess the relationship of male and female pastoralists' income with household food security and nutrition status in Tanzania, I use a survey of pastoralist households conducted in 2012-2013 in 21 rural villages located in Pawaga and Idodi divisions in Iringa Rural District, Iringa Region, Tanzania. The survey has three parts: a household-level livestock health and economics survey, a household-level food security survey, and an individual woman-level diet and health survey. The household head (or another member of the household involved in livestock production decisions if the head of household was not available) responded to the household-level livestock health and economics survey while the senior woman with decision-making authority (or another woman involved in household food preparation if the senior woman was not available) responded to the food security survey. Pawaga and Idodi divisions have semi-arid to arid climates, with short rainfall patterns providing approximately 500 mm annually (Walsh, 2000; Arnold, 2001).

Pawaga and Idodi villages are mainly occupied by Bena and Hehe agriculturalists (who typically have the land closest to water sources, which gives them better access to irrigation) and Barabaig and Maasai pastoralists as well as Sukuma agro-pastoralists (all of whom are nomadic or semi-nomadic and occupy marginal lands farther away from the village) (Dickman, 2008; Gustafson et al., 2015). However, due to population growth, loss of herding lands to farmers, economic opportunities (e.g. commoditization of the livestock economy), access to social services, dislocations brought about by drought, and land use changes, the traditional nomadic/semi-nomadic life of the pastoralists and agro-

pastoralists is less widespread in many areas of East Africa (Fratkin, 2001; Galvin, 2009). The majority of the pastoralists (Maasai and Barabaig) and Sukuma agro-pastoralists in Pawaga and Idodi divisions have become more stationary with permanent households where they raise domestic animals, grow crops annually and, among some households, send children to school (Gustafson et al., 2015). Since their economies and traditional ways of life rely heavily on raising domestic animals, Hodgson (1999) argued that traditional male and female responsibilities still govern their internal household economy. Therefore, Pawaga and Idodi areas permit investigation of the relationship between pastoralist male and female income with household characteristics, ethnicity, household food security, and nutritional status. From this point forward, I use the term 'pastoralists' to describe both pastoralist and agro-pastoralist livestock keepers (Gustafson et al., 2015).

3.2. Sampling

3.2.1. Selection of study households

A household consists of all people who live in the same house and share meals or living accommodations and are controlled by the head of household (Gustafson et al., 2015). To generate a census of pastoralist households in Pawada and Idodi villages, the researchers were guided by village leaders, pastoralist leaders, and other pastoralist community members as key informants. After a list of pastoralist households was assembled for each village, an ordered list of fifteen households was selected via a random sampling approach. The first ten households were approached about participating in the study. If one of the first ten households could not be located or did not agree to participate, the next household on the list (starting with the household numbered 11) was approached. In some cases, it was not possible to include ten households in a village

because there were a limited number of pastoralist households in the area. Four to ten households were included from each of the twenty-one pastoralist communities. A total of 196 households were enrolled in the study.

3.2.2. Selection of Women Participants

A total of 262 women from the 196 households were recruited for the study for data collection on women's diet, health, and anthropometric data. Data collection on women's nutritional outcomes was completed with women themselves for an accurate view of their nutritional status. According to Villa (2011), nutritional status is an individual, not household, characteristic. This explains why researchers interview women individually as members of the household. Adult female participants from households in the study area had to meet the following criteria to be included in the study: to be in the age range of 18-48 years old; to be a member of the Maasai, Barabaig, or Sukuma pastoralist tribes; to be from households that owning at least ten cattle, sheep or goats; to be available during the study period (not planning to move out of the study area for at least 2 years); and to be willing to accept visitors in the home.

An exclusion criterion was also included. If a woman had a chronic medical condition that required frequent medical attention (≥2 health clinic visits per month), she was excluded from the study. Due to the practice of polygamy, some households have more than one wife. In that case, up to three women between 18-48 years of age in a household were recruited using the following conditions: women with babies 6-9 months of age received first priority; the second priority was women who had had a baby since March 2013 or who were pregnant. After that, the first wife of the head of the household was recruited, then the second wife, etc., up to three women per household.

3.3. Data collection

Trained Tanzanian field staff, some of whom grew up in the study area, conducted interviews with participants in Swahili. Additionally, local enumerators who were familiar with the tribal languages were able to assist if any misunderstanding with Swahili arose (Gustafson et al., 2015). Responses were recorded in Swahili and translated to English prior to data analysis.

3.3.1. Household-level livestock health and economics survey

The head of the household or another household member who was involved in livestock production decisions responded to questions about the number of livestock owned, number of wives, family size, annual income from livestock or livestock products, annual income from crop sales, land ownership, annual income from other sources, head of the household characteristics (age, sex, and education), wives' education, number of wage earners in the household, whether the household received remittances, and tribal affiliation, among other questions.

3.3.2. Food security survey

The food security questionnaire was modified from the Household Food Insecurity Access Scale [HFIAS] survey (Coates et al., 2007). The questionnaire was completed with the senior woman in the household or a woman in charge of food preparation if the senior woman was not present. The HFIAS assesses household food insecurity prevalence over a four-week time frame, asking nine questions about the occurrence and frequency of food insecurity conditions (Coates et al., 2007). Based on responses to these questions, the HFIAS score is calculated as a continuous measure of household food insecurity ranging from 0 (lowest level of food insecurity) to 27 (highest

level of food insecurity). Then, an HFIA prevalence (HFIAP) is generated to categorize households into one of four levels of household food insecurity: food secure (household experiences none of the food insecurity (access) conditions, or just experiences worry, but rarely), mildly food insecure (household worries about not having enough food sometimes or often, and/or is unable to eat preferred foods, but only rarely), moderately food insecure (household sacrifices quality more frequently, by eating undesirable foods sometimes or often, and/or has started to cut back on quantity by reducing the size of meals or number of meals, rarely or sometimes), and severely food insecure (household has increasingly cut back on meal size or number of meals often, and/or running out of food, going to bed hungry, or going a whole day and night without eating). Due to a lower number of households with mild food insecurity (10.5%), moderate food insecurity (4.2%), and severe food insecurity (21%), I collapsed these three categories into one category (food insecure). Therefore, HFIAP will be represented by two categories: food secure and food insecure (Frayne and McCordic, 2015).

3.3.3. The individual woman-level survey

The individual woman-level survey is characterized by a dietary intake survey completed with the woman and anthropometric measurements taken directly from the woman, which included height, weight, and mid-upper arm circumference (MUAC).

3.3.3.1. Dietary intake survey

Dietary intake questionnaires were adapted from the Food and Agriculture Organization (FAO) of the United Nations' guidelines for measuring household and individual dietary diversity (WDD) (Kennedy et al., 2011). The questionnaire assessed consumption of different food groups over 24-hour and 7-day periods. Responses were

used to assess consumption of nine different food groups (starchy staples; dark green leafy vegetables; other vitamin A rich fruits and vegetables; other fruits and vegetables; organ meats; meat and fish; eggs; legumes, nuts and seeds; and milk and milk products) for women and to calculate women's dietary diversity score (Kennedy et al., 2011).

Women's dietary diversity categories are generated from one of three dietary levels: lowest dietary diversity (consumption of 3 or fewer food groups), medium dietary diversity (consumption of 4 to 5 food groups), and high dietary diversity (consumption of 6 or more food groups). Since the data for this study were collected, a new indicator has been recommended (Minimum Dietary Diversity – Women), but the way the data were collected for this study precludes calculating the MDD-W (FAO and FHI 360, 2016).

3.3.3.2. Anthropometric data

Anthropometric data for women included measurements of standing height using a SECA® 217 adult stadiometer (measuring accuracy ±0.1 cm; SECA® Hamburg, Germany), weight using a SECA® 876 adult scale (weighing accuracy ±0.1 kg) and mid-upper arm circumference (MUAC) using a Teflon, non- stretch SECA® 212 measuring tape. MUAC was used to assess acute adult undernutrition using the following cutoffs: ≥220 mm (well-nourished); 190-219.99 mm (mildly undernourished), 160.00-189.99 mm (moderately undernourished), and <160.00 mm (severely undernourished) (Collins et al., 2000; Ferro-Luzzi and James, 1996). All measurements were done in duplicate by a trained and standardized team, with a third measurement performed if weights differed by >0.1 kg and if height and MUAC measurements differed by >0.5 cm. The two closest measurements were averaged for use in all anthropometric calculations. Of the 262

women, there is one (0.4 percent) for whom anthropometric data is missing, and two (1 percent) who refused all anthropometric measurements.

3.4. Statistical Methodology

To analyze the survey data collected, we use descriptive statistics, t-tests, and regression analysis conducted with R statistical software (R Core Team, 2018). A significance level of $\alpha = 0.05$ is used for all statistical tests.

3.4.1. Descriptive statistics

Participant households' characteristics are reported in Table 3.1. Most participant households are Maasai (61.7%), followed by Sukuma (23%) and Barabaig (15.3%). Based on the mean income from both genders, male income is higher than annual female income. While females get their annual income from selling milk, chickens, ghee, hides, eggs, fertilizer, and cultural items, male annual income is from selling animals (cattle, goats, and sheep), crop production (maize, beans, rice, squash, peanuts, greens, potatoes, and sorghum), and other sources of income. There were 68.3 Tropical Livestock Units (TLU[1]) per household on average. Tropical livestock units are estimated from the number of livestock owned at the household level. Only 23.6% of heads of household had received any formal education, and 19.9% of households had at least one wife who had received any formal education. About 23% of the households received remittances. Just under two-thirds of households were estimated to be food secure, while 35.4% were food insecure.

Female participants' characteristics are reported in Table 3.2. Among the surveyed women, 91.6% are well-nourished and 8.4% are mildly under-nourished. None of the women is either moderately or severely undernourished. Approximately 75

percent of women obtained the majority of their food from their own production while 25 percent obtained the majority of their food from the market. The majority of women (55.3%) consumed three or fewer food groups (lowest dietary diversity), 41.2% consumed 4 to 5 food groups (medium dietary diversity) while 3.4% consumed 6 or more food groups (high dietary diversity) in the 24 hours before responding to the survey. Due to a small number of women with high dietary diversity (3.4%), I combine women with medium dietary diversity and high dietary diversity. For further analysis, women's dietary diversity will be presented by two categories: low dietary diversity and medium-high (MH) dietary diversity. Food groups consumed during the previous 24 hours included starchy staples, such as maize-based foods (99.6% of women); milk and milk products (88.9%); dark green leafy vegetables (71.8%); legumes, nuts and seeds (36.2%); and meat and fish (26.6%). Fewer reported consuming other vitamin-A rich fruits and vegetables (15.3%); other fruits and vegetables (11.8%); organ meats (3.05%); and eggs (1.1%).

3.4.2. Models

To test the first three hypotheses (1- women's income is positively correlated with household food security; 2- men's income is positively correlated with household food security; and 3- women's income will have a larger positive correlation with household food security than men's income), I analyze the association between household food insecurity access prevalence (HFIAP) as a binary response variable taking the values of food secure or food insecure with male income, female income, and TLU as independent variables. The fourth hypothesis is that women's income is positively correlated with women's dietary diversity, the fifth hypothesis is that men's

income is positively correlated with women's dietary diversity, and the sixth hypothesis is that women's income will have a larger positive correlation with women's dietary diversity than men's income. These last three hypotheses are tested by analyzing women's dietary diversity as a binary response variable taking the value of low dietary diversity or medium-high dietary diversity with the independent variables male income, female income, and TLU. For each analysis, I use logistic regression model:

Binary logistic regression analysis for household food security

$$HFIAP_j = \beta_0 + \beta_1 \text{ male income}_j + \beta_2 \text{ female income}_j + \beta_3 TLU_j + u_j \quad (1)$$

Binary logistic regression analysis for women's dietary diversity

$$WDD_{ij} = \beta_0 + \beta_1 \text{ male income}_j + \beta 2 \text{ female income}_j + \beta_3 TLU_j + u_j \quad (2)$$

where, $HFIAP_j$ is the measure of Household Food Insecurity Access prevalence in household j; WDD_{ij} is the dietary diversity of woman i in household j; male income_j is income earned by males in household j; female income_j is income earned by females in household j; TLU_j is the tropical livestock units owned by household j; and u_j is an error term capturing the parts of HFIAP or WDD that cannot be explained by available independent variables.

In addition to the aforementioned independent variables, I control for other variables that may contribute to household food security such as head of household education, wives' education, number of wives, family size, land ownership, number of chickens kept by a household, whether a household received remittances, number of wage earners, and tribes (Maasai, Sukuma, and Barabaig). For women's dietary diversity, I also control for variables such as primary source of obtaining food for women, pregnant women, number of chickens reared by the woman being interviewed,

whether a household received remittances, number of wage earners, tribes (Maasai, Sukuma, and Barabaig), head of household education, wives' education, number of wives, family size, and land ownership.

Table 3. 1. Characteristics of the surveyed pastoralist households (N=196): Rural Iringa Rural District, Iringa Region, Tanzania.

Household characteristics (N=196)	**Mean (SD)**	**N**	**%**
Male income (million Tanzania shillings/year)	2.604 (3.500)	196	
Female income (million TZ shillings/year)	0.201 (0.559)	196	
Tropical Livestock Units (TLUs)	68.350 (59.71)	195	
Head of household characteristics			
Age(years) [a]	41.756 (12.221)	158	
Sex (Male=1)	0.958 (0.201)	191	95.8
Education (Any formal education Yes=1)	0.236 (0.425)	191	23.6
Wives education (Any wife receiving any formal education=1)	0.199 (0.400)	196	19.9
Number of wives	1.611 (0.935)	190	
Family size	13.815 (9.391)	189	
Land ownership(hectares)	5.726 (5.382)	196	
Chickens	15.011 (14.661)	190	
Number of wage earners in the household	0.138 (0.428)	189	13.8
Receive remittances (Yes=1)	0.230 (0.422)	196	23
Ethnicity			
Maasai		121	61.7
Sukuma		45	23
Barabaig		30	15.3
HFIA score	3.326 (6.080)		
Food secure		122	64.2
Food insecure		68	35.8

TLUs: Tropical Livestock Units. Three main species of livestock (cattle, goats, and sheep) were converted into Tropical Livestock Units (TLUs)[1]. HFIA Score: Household food insecurity access score with two categories: food secure (HFIAP=1) and food insecure (HFIAP=0) (Frayne and McCordic, 2015). However, 3.1% of HFIAP are missing observations in our study. [a] total n=158, 19.4% of the heads of household were unable to specifically estimate their age. N: number of observations

Table 3. 2. Characteristics of the surveyed pastoralist women (N=262): Iringa Rural District, Iringa Region, Tanzania.

Women's Characteristics (N=262)	**Mean (SD)**	**N**	**%**
Age (years) [a]	29.42 (8.5)		
Height (Cm) [b]	161.419 (44.825)	260	
Weight (Kg) [c]	55.203 (11.056)	260	
MUAC (mm)	256.06 (46.36)		
Mildly under-nourished (190-219.99mm)		22	8.4
Well-nourished (≥220 mm)		239	91.6
Pregnant women (Yes=1)	0.096 (0.295)	250	9.6
Women dietary diversity score (WDDS)	3.523 (0.977)		
Low dietary diversity (≤ 3 food groups)		145	55.3
Medium-High dietary diversity (≥ 4 food groups)		117	44.7
Primary source of obtaining food for household (1 = own production; 0 = purchased)	0.748 (0.435)	262	
Own production		196	74.8
Purchased		66	25.2

WDDS: Women's dietary diversity was split into 3 groups (lowest, medium, and high dietary diversity) (Kennedy et al., 2011), which I collapsed in two categories (low dietary diversity and medium-high (MH) dietary diversity. [a] Women were unable to specifically estimate their age except saying that their age range is 18-48 years. [b and c] total n=260; 0.8 % of women had missing height and weight measurements.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1. Results and discussion

Table 4.1. shows the correlation coefficient (tested from R software) between each factor and household food insecurity access prevalence (as a binary response variable taking the values of food secure or food insecure) and women's dietary diversity (as a binary response variable taking low dietary diversity or medium-high dietary diversity). Since none of the correlation coefficients is close to either 1 or -1, there is a weak relationship between the variables. Both male and female income shows weak negative relationship with household food security and women's dietary diversity. Increasing herd size is often an objective of pastoralists, which may explain why they build up their herds size and sell livestock or livestock products only when it is needed. Pastoralists who produce crops, they mainly produce from home consumption than selling for income.

Household food security has weak negative relationship with wives' education, number of wives, wage earners in the household, receiving remittances, and Maasai tribe variables, but weak positive relationship with TLU, head of household education, family size, land ownership, chickens, and Sukuma tribe. Woman with medium-high dietary diversity has weak negative relationship with wives' education, number of wives, number of wage earners in the household, receiving remittance, Maasai tribe, and food purchased on the market variables, but weak positive relationship with TLU, head of household education, family size, land ownership, chickens, Sukuma woman, Barabaig woman, being a pregnant woman, and women who produce their own food.

Table 4. 1 Bivariate Correlation Analysis for Household Food Insecurity Access Prevalence and for Women's Dietary Diversity (as Binary Response Variables)

	Food Secure (N=190)	**Medium-High WDD (N=262)**
Male annual income (million Tanzania shillings)	-0.066	-0.125
Female annual income (million Tanzania shillings)	-0.057	-0.148
Tropical Livestock Units (TLU) categories	0.087	0.094
Head of Household Education (Any=1, None=0)	0.040	0.068
Wives' Education (Any=1, None=0)	-0.060	-0.083
Family Size	0.043	0.015
Number of wives	-0.071	-0.117
Land Ownership(hectare)	0.040	0.020
Number of chickens kept by the household	0.132	0.124
Number of wage earners in the household	-0.078	-0.039
Receiving Remittance (Yes=1, No=0)	-0.027	-0.035
Tribes/ Ethnicity		
Maasai	-0.185	-0.225
Sukuma	0.204	0.251
Barabaig	0.010	0.003
Pregnant women (Yes=1, No=0)		0.013
Primary source of obtaining food		
Own production		0.220
Purchased		-0.220

Table 4.2. shows the results of the binary logistic regression analyzing HFIAP (as a binary response variable taking the values of food secure or food insecure) with the marginal effect and p-value of each independent variable. Based on the final regression outcome (with all controlled independent variables), there was no statistically significance relationship between all variables with household food insecurity access prevalence (P-value > 0.05). The number of chickens kept by the household (at the 5% level of significance) and male income (at the 10% level of significance) are the only statistically significant variables.

While keeping all other variables constant, an increase of one million Tanzanian shillings in male income (approximately 1,644 US Dollars in 2013) is associated with a lower probability that the household is food secure by 2.5 percentage points while an increase of one million Tanzania shillings in female income (approximately 126 US dollars) is associated with a lower probability of household food security of 3.3 percentage points. One more chicken is associated with an increase in the probability that a household is food secure by 0.68 percentage points. An increase of one Tropical Livestock Unit per household is associated with an increase in household food security by 0.11 percentage points. Households in which the head of household has any formal education are 11.02 percentage points more likely to be food secure than those with non-educated heads of household.

Wives with any formal education are 8.2 percentage points less likely to be food secure than non-educated wives. An addition of one wife in the household is associated with a lower probability of household food security of 6.6 percentage points, but an

addition of one member in the household (family size) is associated with an increase in the probability that the household is food secure of 0.37 percentage points. An addition of one hectare of land owned by a household is associated with a decrease in probability that a household is food secure by 0.5 percentage points. A household receiving remittances is 1.24 percentage points more likely to be food secure than a household without remittances, but an addition of one wage earner in the household is associated with a lower probability that a household is food secure by 7.4 percentage points.

Table 4.3. shows the binary logistic regression analyzing women's dietary of diversity as a response variable, which takes the values of low dietary diversity or medium-high (MH) dietary diversity. Based on the final regression model (with all available independent variables included), there was no statistically significant relationship between all variables with women's dietary diversity since (P-values > 0.05). At the 10 percent level of significance, reared chickens in household and head of household education variables are statistically significant.

While keeping all other variables constant, an increase of one million Tanzanian shillings of male income is associated with a decrease in the probability that women have medium-high dietary diversity by 0.61 percentage points while an increase of one million Tanzanian shillings of female income is associated with an increase in the probability that women are in the medium-high dietary diversity category by 3.72 percentage points. An increase of one TLU per household is associated with an increase in the likelihood women have medium-high dietary diversity by 0.03 percentage points. Households in which the head has any formal education is 14.4 percentage points to have women with

medium-high dietary diversity than non-educated head of household. However, households in which any wives have any formal education are 0.19 percentage points less likely to have medium-high dietary diversity than non-educated wives. An addition of one wife in the household is associated with an increase in the probability that a woman has medium-high dietary diversity by 6.71 percentage points, but an addition of one member in the household is associated with a decrease in women having medium-high dietary diversity by 0.5 percentage points.

A woman who is pregnant is 5.07 percentage points more likely to fall into the medium-high dietary diversity category than non-pregnant women. Women in households in which the majority of food is produced in the home are 10.5 percentage points more likely to have medium-high dietary diversity than households in which the majority of food is purchased from the market. An addition of one hectare of land owned by a household is associated with a decrease in the likelihood that women have medium-high dietary diversity by 0.66 percentage points. An addition of one chicken is associated with an increase in the probability that women have medium-high dietary diversity by 0.64 percentage points. Women in a household receiving remittances are 10.34 percentage points more likely to have medium-high dietary diversity than a household not receiving remittances. An addition of one wage earner in the household is associated with a decrease in the likelihood that women have medium-high dietary diversity by 0.02 percentage points. Maasai women are 9.25 percentage points less likely to have medium-high dietary diversity than Barabaig women while Sukuma women are 8.4 percentage points more likely to have medium-high dietary diversity than Barabaig women.

Table 4. 2. Binary Logistic Regression of Household food insecurity access prevalence (HFIAP) (N=190)

Independent Variables	Coef. (Std. E)	M.E	Coef. (Std. E)	M.E	Coef. (Std. E)	M.E	Coef. (Std. E)	M.E
Intercept	0.521** (0.212)	0.117	0.532** (0.233)	0.117	0.661* (0.374)	0.144	0.309 (0.441)	0.065
Male income	-0.077 (0.051)	-0.0174	-0.090* (0.052)	-0.020	-0.093* (0.056)	-0.020	-0.121* (0.066)	-0.025
Female income	-0.147 (0.261)	-0.0331	-0.203 (0.269)	-0.045	-0.219 (0.271)	-0.048	-0.160 (0.271)	-0.033
TLUs	0.005* (0.002)	0.001	0.005* (0.003)	0.0012	0.004 (0.003)	0.0009	0.005 (0.003)	0.0011
Head_HH_Edu			0.492 (0.395)	0.1089	0.450 (0.402)	0.098	0.521 (0.414)	0.1102
Wives_Edu			-0.469 (0.405)	-0.1038	-0.399 (0.4418)	-0.087	-0.390 (0.434)	-0.082
Family size					0.023) (0.028)	0.005	0.017 (0.029)	0.0037
Number of wives					-0.222 (0.206)	-0.048	-0.315 (0.226)	-0.066
Land ownership							0.023 (0.045)	0.005
Chickens kept by the household							0.032** (0.017)	0.0068
Wage earners							-0.351 (0.441)	-0.074
Receive remittances							0.0588 (0.412)	0.0124
AIC	249.59		244.6		238.83		234.66	

TLUs: Tropical Livestock Units, Head_HH_Edu: Head of household with any formal education (any formal education: yes=1 or No= 0), Wives_Edu: Wives with formal education (any formal education: Yes=1 or No=0), and Remit: a household received remittances (Yes=1 or No=0). M.E: Marginal effect, Std. E: standard error, Coef.: coefficient. AIC: Akaike Information criterion. * Significance level of 10%. ** Significance level of 5%. *** Significance level of 1%.

Table 4. 3. Binary Logistic Regression of Women Dietary Diversity ((N=262)

Independent Variables	Coef. (Std. E)	M.E	Coef. (Std. E)	M.E	Coef. (Std. E)	M.E	Coef. (Std. E)	M.E	Coef. (Std. E)	M.E
Intercept	-0.283* (0.165)	-0.069	-0.413** (0.191)	-0.1001	-0.634** (0.300)	-0.149	-1.192*** (0.401)	-0.278	-1.180* (0.621)	-0.2606
Male income	-0.012 (0.034)	-0.003	-0.010 (0.035)	-0.002	-0.0007 (0.040)	-0.001	-0.021 (0.042)	-0.005	-0.027 (0.047)	-0.0061
Female income	0.081 (0.185)	0.0199	0.063 (0.187)	0.015	0.078 (0.191)	0.0184	0.058 (0.202)	0.013	0.168 (0.207)	0.0372
TLUs	0.001 (0.0008)	0.0002	0.001 (0.0009)	0.0002	0.001 (0.001)	0.0003	0.001 (0.001)	0.0004	0.001 (0.001)	0.0003
Head_HH_Edu			0.554* (0.296)	0.1341	0.583* (0.302)	0.137	0.552* (0.312)	0.128	0.654* (0.340)	0.1445
Wives_Edu			-0.088 (0.315)	-0.021	-0.155 (0.327)	-0.036	-0.102 (0.338)	-0.023	-0.009 (0.369)	-0.0019
Family size					-0.026 (0.016)	-0.006	-0.020 (0.018)	-0.004	-0.022 (0.021)	-0.0050
Number of wives					0.308* (0.163)	0.072	0.305* (0.166)	0.071	0.304 (0.191)	0.0671
Pregnant women							0.293 (0.460)	0.068	0.229 (0.481)	0.0507
Food primary source							0.656** (0.326)	0.153	0.476 (0.348)	0.1051
Land ownership									-0.030 (0.032)	-0.0066
Chickens reared by a woman									0.029* (0.016)	0.0064
Wage earners									-0.001 (0.399)	-0.0002
Receive remittances									0.468 (0.365)	0.1034
Tribes Maasai									-0.419 (0.456)	-0.0925
Tribes Sukuma									0.380 (0.581)	0.0840
AIC	364.63		357.14		344.01		330.59		319.78	

TLUs: Tropical Livestock Units, Head_HH_Edu: Head of household with any formal education (any formal education:Yes=1 or No= 0), Wives_Edu: Wives with formal education (any formal education: Yes=1 or No=0). Remit: a household had remittances (Yes=1 or No=0), and Tribes as categorical variable where Barabaig tribe is dropped from the regression to avoid perfect multicollinearity, M.E: Marginal effect, Std. E: standard error, and Coef.: coefficient, AIC: Akaike Information criterion.
* Significance level of 10%. ** Significance level of 5%. *** Significance level of 1%.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS

5.1. Summary

5.1.1. Summary of pastoralist household food security

The first hypothesis, which is that women's income is positively correlated with household food security, is not supported by the data. An increase of one million Tanzania shillings for women's income is associated with a decrease in the probability that a household is food secure by 3.3 percentage points, but it is statistically insignificant. The second hypothesis, men's income is positively correlated with household food security, is not supported by the data because an increase of one million Tanzanian shillings in men's income is associated with a decrease in probability that a household is food secure by 2.5 percentage points and is statistically significant at 10% level of significance. Since female income is statistically insignificant at any level of significance, not much can be concluded based on its association with household food security.

As pastoralist households have a choice between building up herd/flock size or selling an animal/chicken for income, it isn't surprising that there is not a statistically significant relationship between income and food security. In other words, pastoralists reinvest the largest amount of their income in livestock and sell an animal or animal products only when needed. If a household did not sell any livestock or livestock products, none of its annual income could be captured during the survey. For pastoralist households that do farming activities, produce crops mainly for home consumption. The third hypothesis is not confirmed by the data. The Wald Test of the differences in the coefficients on male income and female income shows the p-value of 0.89, indicating that

female income does not have a significantly greater association with household food security.

While Ogunsumi and Ogbosuka (2009) showed that polygamous households were able to maintain household food security because wives engage cooperatively in food security activities needed to sustain the family unit, our results about number of wives in the household (although it is statistically insignificant) show that an addition of one wife in the household is associated with a decrease in probability that a household is food secure by 6.6 percentage points. Some other variables show unexpected associations with household food security although they are statistically insignificant. Households in which one or more wives have any formal education are 11.02 percentage points less likely to be food secure than those with no educated wives. This negative association may be explained by other factors. For instance, it is possible that the educated wife is not the one in charge of decision making and resource allocation in the household or it may also depend on what relationship she has with the head of household or with other wives if it is a polygamous marriage.

Galvin (2009) said that pastoralists who become wage laborers financially support their other family members who still herd the family's livestock. Our findings show that an addition of one wage earner in the household is associated with a decrease in the likelihood that the household is food secure by 7.4 percentage points. There are multiple possible explanations of what drives this negative association. For instance, wages in the very rural study area are low, so the time spent by wage earners working outside of the household may not be markedly more valuable to the household than if that time was spent in the household. It may also be that the effect of the wage earners' income to the

household food security can be captured in long-term while the data of this study only reflect a short-term period (2012-2013). There may also be important relationships between household characteristics and the decision to work for wages. It is possible that only households with inadequate herd sizes to maintain their traditional way of life would send a family member to work for wages, so the negative relationship may capture this fact.

An addition of one member in the household (family size) is associated with an increase in the probability that the household is food secure by 0.37 percentage points. There is a possibility that the new member in the household increases the labor force of the household contributing to productive activities such as livestock and farming production or if it is a newborn for instance, members of the household work more to provide for the young and the mother or the household receives more outside support such as gifts through their traditional ceremonies to welcome a newborn.

5.1.2. Summary of the pastoralist women's dietary diversity

The fourth hypothesis, which is that women's income is positively correlated with women's dietary diversity, is weakly supported because an increase of one million Tanzania shillings in women's income is associated with an increase in the likelihood that women have medium-high dietary diversity by 3.72 percentage points. The fifth hypothesis, that men's income is positively correlated with women's dietary diversity, is not supported because an increase of one million Tanzanian shillings in men's income is associated with a lower probability that women fall into the medium-high dietary diversity category by 0.61 percentage points. Neither male income nor female income is statistically significant in the full model and not much can be concluded based in their

association with women's dietary diversity. If women's income was statistically significant given the fact that it has a positive association with women's dietary diversity. The suggestions to the policy-makers and practitioners could be to apply nutrition and economic programs that generate additional income for pastoralist women. The sixth hypothesis, women's income will have a larger positive correlation with women's dietary diversity than men's income, is not supported because the Wald Test of the differences in coefficients on male income and female income shows the p-value of 0.36.

The result related to the number of chickens in the household, which is statistically significant at 10% level, shows that one more chicken is associated with an increase in the probability that women have medium-high dietary diversity by 0.64 percentage points. The result related to chicken ownership supports Hodgson's (1999) findings that pastoralist culture gives women the control over, and income from, rearing poultry. The income from rearing poultry or the meat/eggs from rearing poultry may drive the increase in women's medium-high dietary diversity. Therefore, one more chicken is associated with an increase in women's dietary diversity. The results also show that head of household education (statistically significant at the 10% level of significance) plays a significant role for women's dietary diversity since households in which the head has any formal education are 14.4 percentage points more likely to have women with medium-high dietary diversity than those with a non-educated head of household.

Some variables show unexpected associations with women's dietary diversity although they are not statistically significant. First, wives with any formal education are 0.19 percentage points less likely to achieve medium-high dietary diversity than non-

educated wives. As explained in the summary on household food security, this negative association may be explained by other factors. Second, an addition of one wife in the household is associated with an increase in the probability that women have medium-high dietary diversity by 6.71 percentage points. This finding supports results from Ogunsumi and Ogbosuka (2009) that in polygamous households, wives engage cooperatively in productive activities to support their households. Last, an addition of one wage earner in the household is associated with a decrease in the likelihood that women have medium-high dietary diversity by 0.02 percentage points. As explained in the summary on household food security, this negative association may be explained by other factors.

Kauzeni (1999) says that a harmful pastoralist cultural practice is that pregnant women fast so that they may have an easy delivery. However, our finding about pastoralist pregnant women shows that pregnant women are 5.07 percentage points more likely to have medium-high dietary diversity than non-pregnant women. Kauzeni (1999) did not specify what he meant by saying that pregnant women fast. He could have meant that pregnant women reduce their quantity of diets intake or fast some period of time of their pregnancies. However, he did not specify how long their fasting take or whether they fast in first semester of pregnancy or the last one. Therefore, not much can be concluded based on his findings. Since pastoralist pregnant women cannot fast all 9 months, they probably reduce their caloric intake and still eat a healthy diet at time. In this case, pregnant women may have a high dietary diversity while reducing the quantity of diets intake. On the other hand, an addition of one more member in the household is more likely to decrease women's medium-high dietary diversity by 0.5 percent. This finding may support what Whitehead (1981) explained that due to women's maternal

altruism, they devote their energies and earnings to each family member's well-being. In the other words, women may reduce their dietary intake to ensure that other family members have enough to eat.

Moreover, our findings also show that women in households in which the majority of food is produced within the home are 10.5 percentage points more likely to have medium-high dietary diversity than households in which the majority of food comes from the market. Many reasons can explain this result. First, women who produce their own food may rotate crop production to access different food types or they may sell the surplus of their produced food crops to access other food types. Second, it is possible that there is a long distance to the market or the food market may be expensive for women who purchase food from the market. Under these cases, women who produce their own food may have an advantage over women who primarily purchase food from the market. Again, more information is needed to understand these results.

Maasai women are 9.25% less likely to have medium-high dietary diversity than Barabaig women while Sukuma women is 8.4% more likely to have medium-high dietary diversity than Barabaig women. In the other words, Sukuma women had medium-high dietary diversity more often than Maasai women and Barabaig women. This finding is likely related to the fact that Sukuma women are agro-pastoralists, and previous work has found that these women possess more rights in household decision making than purely pastoralist women (Kauzeni, 1999). Not only do agro-pastoralist households combine crop and animal production, but women also have the right to own livestock that they have purchased with money obtained from the sale of surplus food crops or other income-generating activities (Kauzeni, 1999). This may explain why Sukuma women have an

advantage over Maasai women and Barabaig women. This may also explain why more Sukuma households were food secure than Maasai households and Barabaig households.

5.2. Conclusion

In this paper, we assess the relationship between male and female pastoralist income and household food security and dietary diversity. The main goal of this study is to understand how pastoralist gender roles impact their household food security and nutrition. Our findings will help to create successful development programs for pastoralists communities.

Using binary logistic regression model in R statistical software, this study test whether 6 hypotheses (1- women's income is positively correlated with household food security; 2- men's income is positively correlated with household food security; 3- women's income will have a larger positive correlation with household food security than men's income; 4- women's income is positively correlated with women's dietary diversity; 5- men's income is positively correlated with women's dietary diversity; 6- women's income will have a larger positive correlation with women's dietary diversity than men's income) created from the previous studies' findings on other societies.

We use secondary data collected from three pastoralists tribes located in 21 villages from Pawaga and Idodi divisions of Tanzania in 2012-2013. Data were collected using a sample of 196 pastoralist households to respond two surveys (household level-livestock health and economic survey and food security survey. Another sample of 262 pastoralist women from the 196 households responded to questions on dietary intake and participated in anthropometric measurements.

We find that income controlled by pastoralist men is negatively association with household food security and nutrition status while the income controlled by pastoralist women is negatively associated with household food security but positively associated with nutrition status. While previous studies show that women's income will have a larger positive correlation with household food security and dietary diversity than men's income, our findings show that pastoralist women's income does not have a larger impact on with household food security and dietary diversity than pastoralist men's income. The results also show that chicken ownership and education for the head household in the pastoralist communities have a significant positive association with household food security and nutrition status.

5.3. Policy Implications

Pastoralist communities need more educational programs for many reasons. First, it is possible that the majority of pastoralists may not be aware of what kind of diets they need to eat for a healthy lifestyle. Second, literacy and numeracy skills may improve pastoralist's business skills. For instance, illiterate pastoralists who are the majority struggle on how to use MPESA (Mobile phone-based money transfer, financing and microfinancing service) because they do not know how to read or to write. Literacy and numeracy skills can also improve their livestock management (keep accurate financial records, ensure proper care and feeding of animals). Third, to introduce more poultry production programs for pastoralists may benefit their households' economy, food security, and nutrition status. Last, findings also have shown that households that are food secure and that have women with adequate dietary diversity are associated with being from agro-pastoralist households rather than being from pastoralist household (Knueppel

et al., 2010). Therefore, authorities (government or policy makers) should emphasize what can help pastoralists to have more interest in combining crop and livestock production.

The results presented in this paper suggest an avenue for new research. The questions about food security were asked at the household level and were responded to by either the senior woman or another woman in charge of food preparation. The respondent answered on behalf of all household members (for instance, if one of the household members did not have enough food while others had enough food at that time the household was considered to be food insecure regardless of other members being food secure). This suggests that our study results could look different if the study was focused on individual rather than household food security. In this case, individual food security could capture how some members may be food secure while others are food insecure because male income and female income may not be allocated to all members of the same household equally. The study of Ringdal and Sjursen (2017) finds that women spend resources on boys and girls equally while husbands spend more on the boys. Therefore, the future research should look at how individual food security varies within pastoralist households.

There are a few limitations to this study that bear mentioning. First, the pastoralist households in the study area live in remote locations in an already rural area. Reaching the households was time-consuming and difficult and, consequently, the study may be unable to detect significant relationships between the dependent and variables. A second limitation of this study is based on the lack of some important variables that could explain some results. First, understanding each wife's relationship to the head of

household may give a clear understanding of some correlations. Second, more explanation is needed to explain why an addition of one wage earner in the household is associated with a decrease in household food security by 7.4 percentage points and a decrease in the likelihood that women have medium-high dietary diversity by 0.02 percentage points. Future research could evaluate similar outcomes but with more variables over time (panel data).

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APPENDIX

FORM SES01 – ANIMAL HEALTH & ECONOMICS

Version 13-11-2012

Sub-village_____ GPS Waypoint: E _ _ . _ _ _ _ _s_ _ . _ _ _ _ _ Init.: _____

Q									
1	Date of interview (day/month/yr)							___|___| / |___|___| / 20|___|___|	
2	Household number: |____| - |___|___|___|								
3	Tribe						Barabaig / Maasai / Sukuma		
4.1	How many animals do you have?								
	a. Cattle _____	b. Goats _____	c. Sheep _____	d. Chickens _____	e. Donkeys _____	f. Ducks _____	g. Cats _____	h. Dogs _____	i. Pigs _____
4.2	How many animals did you have 12 months ago?								
	a. Cattle: _____		b. Goats: _____		c. Sheep: _____		d. Chickens: _____		
4.3	How many animals died or were lost in the last year resulting from:								
		a. Cattle		b. Goats			c. Sheep	d. Chickens	
	i. Illness								
	ii. Predation								
	iii. Lack of food/water								
	iv. Other (Describe)								
4.4	How many cattle were ill and how many died from the following diseases or symptoms in the past 12 months:								
	a. Foot and Mouth	|_____| Ill		|_____| Died					
	b. CBPP	|_____| Ill		|_____| Died					
	c. Tetse	|_____| Ill		|_____| Died					
	d. Brucellosis	|_____| Ill		|_____| Died					
	e. Lameness	|_____| Ill		|_____| Died					
	f. Other (Describe)	|_____| Ill		|_____| Died _____					
		|_____| Ill		|_____| Died _____					
		|_____| Ill		|_____| Died _____					
4.5	How many goats/sheep were ill and how many died from the following diseases or symptoms in the past 12 months:								
		a. Goats					b. Sheep		
	i. Foot and Mouth	|_____| Ill	|_____| Died				|_____| Ill	|_____| Died	
	ii. CCPP	|_____| Ill	|_____| Died				|_____| Ill	|_____| Died	

	iii. Tsetse	|_____| Ill |_____| Died	|_____| Ill |_____| Died
	iv. Circling Disease	|_____| Ill |_____| Died	|_____| Ill |_____| Died
	v. Lameness	|_____| Ill |_____| Died	|_____| Ill |_____| Died
	vi. Brucellosis	|_____| Ill |_____| Died	|_____| Ill |_____| Died
	vii. Other (Describe) _____ _____ _____	 |_____| Ill |_____| Died |_____| Ill |_____| Died |_____| Ill |_____| Died	 |_____| Ill |_____| Died |_____| Ill |_____| Died |_____| Ill |_____| Died
4.6	How many chickens were ill and how many died from the following diseases or symptoms in the past 12 months:		
	a. Newcastle Disease	|_____| Ill |_____| Died	
	b. Fowl pox	|_____| Ill |_____| Died	
	c. Other (describe)	|_____| Ill |_____| Died _____ |_____| Ill |_____| Died _____ |_____| Ill |_____| Died _____	

4.7	In the past 12 months, how many livestock have you removed from your herd to:				
		a. Cattle	b. Goats	c. Sheep	d. Chickens
	i. Sell? (If > 0, how much money did you receive for each animal?)	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=
	ii. Eat at home?				
	iii. Prevent the spread of disease to other animals?				
	iv. Give as a gift/ help for another family?				
	v. Lend to another family?				
	vi. Use for a wedding/party?				
	vii. Other? (Describe)				

4.8	In the past 12 months, how many livestock have you added to your herd from:				
		a. Cattle	b. Goats	c. Sheep	d. Chickens
	i. Birth?				

	ii. Purchase? If > 0, how much money did you pay for each animal?	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=	_____ Total __ _____/= __ _____/= __ _____/= __ _____/=
	iii. Gift/ help from another famiily?				
	iv. Loan from another family?				
	v. Received for a wedding/party?				
	vi. Other? (Describe)				

4.9	In the next 12 months, in your experience, how many livestock do you expect to:						
		a. Cattle		b. Goats		c. Sheep	
		High rain	Low rain	High rain	Low rain	High rain	Low rain
	i. Be born?	|_____|	|_____|	|_____|	|_____|	|_____|	|_____|
	ii. Die of disease?	|_____|	|_____|	|_____|	|_____|	|_____|	|_____|
	iii. Die from lack of food/water?	|_____|	|_____|	|_____|	|_____|	|_____|	|_____|

4.10	What animal products do you normally sell?				
		a. Cattle	b. Goats	c. Sheep	d. Chickens
	i. Do you sell milk?	Yes / No Dry / Wet / Both	Yes / No Dry / Wet / Both	Yes / No Dry / Wet / Both	**Eggs** Yes / No
	ii. If yes, how much?	|_____| (L/ other) each (week/ month/ yr)	|_____| (L/ other) each (week/ month/ yr)	|_____| (L/ other) each (week/ month/ yr)	|_____| eggs/ (week/ month/ yr)
	iii. On average, how much money do you receive per measure?	|_____| Shillings/ measure	|_____| Shillings/ measure	|_____| Shillings/ measure	|_____| Shillings/ egg.

	iv. Do you sell hides? v. If yes, how many? vi. On average, how much do you receive per hide?	Yes / No |_____| hides/ (week/ month/ yr.) |_____| Shillings/ hide	Yes / No |_____| hides/ (week/ month/ yr.) |_____| Shillings/ hide	Yes / No |_____| hides/ (week/ month/ yr.) |_____| Shillings/ hide	
	vii. Do you sell ghee? viii. If yes, how much per measure? ix. On average, how much do you receive per measure?	Yes / No Dry / Wet / Both |_____| (Kg/ Other) each (week/month/yr.)) |_____| Shillings/measure	Yes / No Dry / Wet / Both |_____| (Kg/ Other) each (week/month/yr.)) |_____| Shillings/measure	Yes / No Dry / Wet / Both |_____| (Kg/ Other) each (week/month/yr.)) |_____| Shillings/measure	
	x. Do you sell manure to grow crops or other uses? xi. If yes, how much? xii. On average, how much money do you receive per measure?	Yes / No |_____| (Kg/ other) each (week/ month/ yr) |_____| shillings/ measure	Yes / No |_____| (Kg/ other) each (week/ month/ yr) |_____| shillings/ measure	Yes / No |_____| (Kg/ other) each (week/ month/ yr) |_____| shillings/ measure	Yes / No |_____| (Kg/ other) / (week/ month/ yr) |_____| shillings/ measure
5.1	How many donkeys, dogs, and cats did you have 12 months ago?				
	a. Donkeys: |_____|	b. Dogs: |_____|	c. Cats: |_____|		
5.2	How many donkeys, dogs, and cats died in the past 12 months?				
	a. Donkeys: |_____|	b. Dogs: |_____|	c. Cats: |_____|		
5.3	In the last 12 months, how many donkeys, dogs, or cats were sick and died?				
		a. Donkeys	b. Dogs	c. Cats	
	i. Rabies (dogs only)		|_____| III |_____| Died		
	ii. Others (Specify)	|_____| _____ III |_____| _____ Died	|_____| _____ III |_____| _____ Died	|_____| _____ III |_____| _____ Died	

		|_____| _____ III |_____| _____ Died |_____| _____ III |_____| _____ Died	|_____| _____ III |_____| _____ Died |_____| _____ III |_____| _____ Died	|_____| _____ III |_____| _____ Died |_____| _____ III |_____| _____ Died

5.4	Where did your donkeys, dogs, and cats come from? How many:			
		a. Donkeys	b. Dogs	c. Cats
	i. Were born at home?			
	ii. Were purchased; If > 0, how much did you pay for each?			
	iii. Came to your house by themselves?			
	iv. Were a gift from another household?			
	v. Other? (Specify)			

6.1	Do you have a bank account?	Yes / No
6.2	Do you use services like M-Pesa, Airtel Money, or Tigo Pesa?	Yes / No
6.3	i. Have you ever received a loan from a bank or SACCOS?	Yes / No
	ii. Have you received a loan from another place (e.g., friends, family?)	Yes / No
	iii. Were you able to return the money you borrowed after you used it?	Yes / No
6.4	Do you usually receive money from family members in town?	Yes / No
6.5	What do you do for money if you have unanticipated important needs?	
7.1	Do you grow any crops?	Yes / No

7.2	How much ____ did you _____ last growing season?				
		a. Plant?	b. Harvest?	c. Sell?	d. Money you received on average? (Tsh/measure)
	i. Corn				
	ii. Beans				

	iii. Rice				
	iv. Squash				
	v. Peanuts				
	vi. Greens				
	vii. Potatoes/ Sweet potatoes				
	viii. Sorghum				

8.1	In the past 12 months, did any family members work outside of the house to receive a salary? How many?	Yes / No |_____|

8.2	i. Do any family members produce cultural goods to sell?	Yes / No
	ii. If yes, how many?	|_____| people
	iii. Usually, how much money do you receive from the sale of cultural goods per week?	|_____| Shillings/week
	iv. If yes, what is the money used for?	|_____|

9.1	What type of toilet does your family use? (1=Modern toilet, 2=Pit, 3=Improved pit, 4=None, 5=Other (specify))	|_____|

9.2	Do you boil your milk before drinking it?	Yes / No
	If yes, how often do you boil your milk?	Always / Often / Rarely

9.3	When do people in your family wash their hands?					
	After working with animals	After using the restroom	After waking up	Before eating	After eating	Other
	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
	How regularly do you wash your hands after each activity? (4=*Always,* 3=*Often,* 2=*Rarely,* 1=*Never*)					
	Do you use soap after each activity? 1 = Yes; 0 = No					
	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No

10.1	1. Did you vaccinate any of your livestock last year? Yes / No 2. Sign: a) Foot & Mouth Disease; b) Brucellosis; c) CBPP/CCPP; d) Lumpy skin disease; e) Rinderpest; f) Newcastle; g) Fowlpox; h) Rabies; i) Don't know; j) Other (Specify)					
	a. Cattle	b. Goats	c. Sheep	d. Chickens	e. Dogs	f. Others
	1. ____ _____ 2. ____ _____	1. ____ _____ 2. ____ _____	1. ____ _____ 2. ____ _____	1. ____ _____ 2. ____ _____	1. ____ _____ 2. ____ _____	1. ____ _____ 2. ____ _____

	3. ____ _____ 4. ____ _____	3. ____ _____ 4. ____ _____	3. ____ _____ 4. ____ _____	3. ____ _____ 4. ____ _____	3. ____ _____ 4. ____ _____	3. ____ _____ 4. ____ _____

10.2	a. How many times in the past 12 months did you receive advice from the Livestock Extension Officer?	|_____| times
	b. When did you last receive advice from the LEO?	|_____| last time / never received advice
10.3	a. Do you send your animals to the dip? If not, what route do you use to prevent tick disease? How many times do you treat them?	Yes / No Route: _____ |_____| times / (week / month / year)
	b. Which animals do you normally send to the dip/treat?	
	c. How long do you have to walk to arrive at the dip?	
11.1	Are there any children in your household attending school?	Yes / No

11.2	Age	Gender	Class	School fees/year

11.3	How many people live in your household? |_____|			
11.4	a. Your age:		b. Years of school finished:	
11.5	a. How many wives do you have?: ____	b. Age: 1. ____; 2. ____; 3. ____; 4. ____	c. School: 1. ____; 2. ____; 3. _____; 4. _____	
11.6	(Don't count yourself, your wives, and students again).			
		a. Number	b. # Females	c. School (≥ 4th grade)
	i. Adults (>18 yrs old)			
	ii. Youth (aged between 12 – 18)			
	iii. Children (aged between 1 – 12)			
	Under 1 year of age	**a. Age**	**b. Gender**	**c. Date of birth**
	1			

	2			
	3			
	4			

Participatory Epidemiology

12.1 What % of your herd was ill / healthy last year? (*Write the name of the disease on the line below the animal*)

a. Cattle

1.	2.	3.	4.	5.

b. Goats

1.	2.	3.	4.	5.

c. Sheep

1.	2.	3.	4.	5.

12.2 Circling disease

1.	2.	3.	4.	5.	6.	7.	8.

12.3 How long do you have to walk to fetch water in the wet season? In the dry season?

|_____| Wet season
|_____| Dry season

12.4 Where do you get your water in the wet season?

River/pond	Piped water	Canal	Dug well	Built well	Other
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No

How often do you treat your water before drinking it?
4 = Always, 3 = Frequently, 2 = Rarely, 1 = Never

12.5 Where do you get your water in the dry season?

River/pond	Piped water	Canal	Dug well	Built well	Other
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No

How often do you treat your water before drinking it?
4 = Always, 3 = Frequently, 2 = Rarely, 1 = Never

13.1 Phone number(s):
1 _____ 2 _____ 3 _____

FORM N02 – Food Security Version 9-8-2012

Sokoine Univ. of Ag/Univ. of New Mexico/UC Davis

Time points: Baseline, 6 mo post, 12 mo post, 18 mo post, 24 mo post

Supervisor review: _____ Data entry 1: _____ Data entry 2_____

Q	Information requested	Data
1.1	Date of interview (dd/mm/yy)	|___|___| / |___|___| / 20|___|___|
1.2	Visit number **1 = baseline, 2 = 6 mo post , 3 = 12 mo post, 4 = 18 mo post, 5 = 24 mo post**	|___| **Code**
2	Data collector identifier	|___|___| **Code/**_____ **(signature)**
3	All data are missing because family could not be located for data collection **1 = Yes, 2 = No**	|___| **Code If 1, fill in 4 then STOP. If 2, continue.**
4.1	Woman's study number	|____|____|____|-|____|-|____|
4.2	Head of household study number	|____|____|____|-|____|-|____|
5.1	In the past month, did you worry that your household would not have enough food? **1 = Yes, 2 = No, 9 = Unknown** ***Household = People living together & eating from the same pot***	|___| **Code If 1, go to 5.2. If 2 or 9, go to 6.1.**
5.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
6.1	In the past month, were you or any household member not able to eat the kinds of food you preferred because of a lack of resources? **1 = Yes, 2 = No, 9 = Unknown** ***Examples of preferred foods: rice, chapatti, beans, maize, meat, milk, eggs, fruits, etc.***	|___| **Code If 1, go to 6.2. If 2 or 9, go to 7.1.**
6.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
7.1	In the past month, did you or any household member have to eat a limited variety of foods due to a lack of resources? **1 = Yes, 2 = No, 9 = Unknown** ***Examples: ugali with kale instead of ugali with meat; monotonously eating ugali without changing with foods such as chapatti, rice, etc. for a long time***	|___| **Code If 1, go to 7.2. If 2 or 9, go to 8.1.**
7.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
8.1	In the past month, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? **1 = Yes, 2 = No, 9 = Unknown** ***For example: eating foods such as rice porridge, thin (liquid) porridge, thin (liquid) ugali, ugali with salt only, unripe unusual fruit, wild roots, etc.***	|___| **Code If 1, go to 8.2. If 2 or 9, go to 9.1.**
8.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
9.1	In the past month, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code If 1, go to 9.2. If 2 or 9, go to 10.1.**
9.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**

10.1	In the past month, did you or any other household member have to eat fewer meals in a day because there was not enough food? **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code** **If 1, go to 10.2. If 2 or 9, go to 11.1.**
10.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
11.1	In the past month, was there ever no food to eat of any kind in your household because of lack of resources to get food? **1 = Yes, 2 = No, 9 = Unknown** ***Note: milk is included as a food.***	|___| **Code** **If 1, go to 11.2. If 2 or 9, go to 12.1.**
11.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
12.1	In the past month, did you or any household member go to sleep at night hungry because there was not enough food? **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code** **If 1, go to 12.2. If 2 or 9, go to 13.1.**
12.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
13.1	In the past month, did you or any household member go a whole day and night without eating anything because there was not enough food? **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code** **If 1, go to 13.2. If 2 or 9, go to 14.1.**
13.2	How often did this happen? **1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown**	|___| **Code**
Now I would like to ask you about your household's food supply during different months of the year. When responding to these questions, please think back over the last 12 months, from now to the same time last year.		
14.1	Were there months, in the past 12 months, in which you did not have enough food to meet your family's needs? **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code** **If 1, go to 14.2. If 2 or 9, stop.**
14.2	Which were the months in the past 12 months during which you did not have enough food to meet your family's needs? **1 = Did not have enough food, 2 = Had enough food, 9 = Unknown** *This includes any kind of food from any source, such as own production, purchase or exchange, food aid, or borrowing.* ***Note to interviewer:*** Do not read the list of months aloud. Place a "1" in the box if the respondent identifies that month as one in which the household did not have enough food to meet their needs. Probe to make sure the respondent has thought about the entire past 12 months. Use a seasonal calendar if needed to help the respondent remember the different months. If the respondent **does not** identify that month, place a "2" in the box. If the respondent is not sure, place a "9" in the box.	January |___| **Code** February |___| **Code** March |___| **Code** April |___| **Code** May |___| **Code** June |___| **Code** July |___| **Code** August |___| **Code** September |___| **Code** October |___| **Code** November |___| **Code** December |___| **Code**

Comments:
_____

_____

FORM N03 – Woman's Diet Version 9-8-2012 Sokoine Univ. of Ag/Univ. of New Mexico/UC Davis

Time points: Baseline, 6 mo post, 12 mo post, 18 mo post, 24 mo post

Supervisor review: _____ Data entry 1: _____ Data entry 2: _____

Q	Information requested	Data
1.1	Date of interview (dd/mm/yy)	|___|___| / |___|___| / 20|___|___|
1.2	Visit number **1 = baseline, 2 = 6 mo post , 3 = 12 mo post, 4 = 18 mo post, 5 = 24 mo post**	|___| **Code**
2	Data collector identifier	|___|___| **Code/**_____ **(signature)**
3	All data are missing because the family could not be located for data collection **1 = Yes, 2 = No**	|___| **Code If 1, fill in 4 then STOP. If 2, continue.**
4	Woman's study number	|____|____|____|-|____|-|____|

Ask the woman: Please describe everything that you ate yesterday during the day or night.

a) Think about when you first woke up yesterday. Did you eat anything at that time? *If yes*: Please tell me everything you ate at that time. *Probe: "*Anything else?" until respondent says "nothing else*." If no, continue to question b).*

b) What did you do after that? Did you eat anything at that time? *If yes:* Please tell me everything you ate at that time. *Probe: "*Anything else?" until respondent says "nothing else*." **Repeat question b) until respondent says she went to sleep for the night (until the morning of today).***

If the respondent mentions mixed dishes like a porridge, sauce or stew, *probe:*

c) What ingredients were in that *(*mixed dish*)*? *Probe: "*Anything else?" until respondent says "nothing else*."*

As the respondent recalls foods, underline the corresponding food and mark '1' in the column next to the food group. If foods are used in small amounts for seasoning or as a condiment, include them under the condiments food group.

Once the respondent finishes recalling the foods that the she has eaten, read each food group where '1' was not marked and ask the following question: "Yesterday during the day or night, did you eat/drink any **(**food group items**)**? Mark '1' if respondent says yes, '2' if no and '9' if the respondent does not know if the food was eaten.

Morning:

Between meals:

Mid-day:

Between meals:

Evening:

Between meals:

5	Ugali (maize), maize, ugali (sorghum), ugali (millet), wheat chapatti, bread, rice, vitumbua (rice buns), noodles, or other foods made from grains **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**

6	Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
7	White potatoes/chips, white yams/sweet potato, manioc, cassava, plantains/green banana, nduma (arrowroot) or any other foods made from roots **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
8	Any dark green leafy vegetables (cowpea leaves, pumpkin leaves, kale, spinach, cassava leaves, sweet potato leaves) **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
9	Ripe mangoes, ripe papayas, or passion fruit **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
10	Any other fruits or vegetables **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
11	Liver, kidney, heart or other organ meats **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
12	Any meat, such as beef, goat, chicken, pork, lamb, mutton, or duck **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
13	Eggs from any type of bird **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
14	Fresh or dried fish, shellfish, or seafood **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
15	Any foods made from beans, peas (cowpeas), lentils, nuts (peanuts/ground nuts, peanut butter) or seeds (pumpkin seeds, sunflower seeds) **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
16	Cheese, yogurt or other milk products **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
17	Animal milk (tinned, powdered, or fresh) **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
18	Any oil (sunflower oil, groundnut oil, palm oil, cotton oil), fats, cream, or butter/margarine, or foods made with any of these **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
19	Any sugary foods such as sweets, candies, biscuits or soda **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
20	Condiments for flavor, such as chilies, spices, herbs or fish powder **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
21	Grubs, snails or insects **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
22	**Ask the woman:** Was yesterday a celebration or feast day where you ate special foods or where you ate more, or less than usual? **1 = Yes, 2 = No, 9 = Unknown**	|___| **Code**
23	**Ask the woman:** What is the primary source of obtaining food for your household? **1 = own production, gathering, hunting, fishing, 2 = purchased, 3 = borrowed, bartered, exchanged for labor, gift from friends or relatives, 4 = food aid, 5 = other _____, 9 = Unknown**	|___| **Code**
	Items eaten by the woman in the last month	
Ask the woman: Now I would like to ask you some questions about foods you ate in the last seven days. For each food group I ask about, please tell me which days you ***ate*** foods from that group in the last week. (***Note:*** it does not count if the woman made a sauce with meat, but did not actually eat the meat herself). Mark each day the respondent mentions. **Code** the number of days (0-7) OR 8 if the food was eaten, but the participant is not sure how many days OR 9 if the participant does not know if the food was eaten.		

Standard Operating Procedures: HALI Project

User guide for form: N05 (Woman's Health) **Version 5-24-2013 EY**

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Objective

An observer will fill out this form for women participating in the HALI project at baseline, 6 months post baseline, 12 months post baseline, 18 months post baseline and 24 months after baseline. It collects woman's health data. Using these data, we will assess participating women's health over the course of this study and provide referral if needed.

Responsible personnel

This form is to be completed by a trained interviewer who is a member of the HALI project.

Materials

- One N05 form for each of the five visits
- Pens, Clipboard
- Materials for hemoglobin measurement (see the Hemocue SOP)

General instructions

1. Some of the questions for this form are very sensitive, such as speaking of a child who may have died. It is important to find a private space for asking these questions.
2. Only those trained in using the Hemocue should be administering this form.

Procedures

Q	Information requested
1.1	Date of measurements **Enter the date that you interview the mother. Use the "dd/mm/yy" format as indicated. Include a zero before the number for dates under 10 (e.g. 09/03/2012).**
1.2	Visit number **1 = baseline, 2 = 6 months post baseline, 3 = 12 months post baseline, 4 = 18 months ,5 = 24 months** **Enter the code for the current visit.**
2	Data collector identifier **Interviewer, enter your two-digit at start of interview. Sign along the line only after the interview is complete, the form is finished being administered *and* you have reviewed it for errors.**
3	All data are missing because family could not be located for data collection **1 = Yes, 2 = No** **Enter "1" if family could not be located, then answer question 4 and STOP. If No, enter "2" and continue.**

4	Woman's study number **Enter the women's study number in the following format xxx-2-x.**
5	Haemoglobin (5.1 & 5.2) **See Hemocue SOP for instructions on how to obtain and record measurement(s).**
6.1	Does the mother have anemia (Hb < 11 g/dl if pregnant, Hb < 12 g/dl if not pregnant)? **1 = Yes, 2 = No, 9 = Unknown** **Enter 1 if answer is yes then continue to Q 6.2. If answer is No enter 2 or if Unknown enter 9; then skip Q 6.2 & go to Q 7.1. Pregnancy was determined during anthropometric measurement.** **If the answer is 1, then please inform the mother that she needs to receive treatment for anemia and provide her with health clinic information.**
6.2	Did the mother receive treatment (provide details in comments) at a health clinic for anemia after referral from study personnel? **Enter 1 for Yes, 2 for No and 9 for Unknown.** **The answer to this question must be filled in by the end of the next visit. Forms with referrals should be flagged to make sure that they are brought with to the next visit.**
Ask the woman the following questions: ***Note:*** For all "How long have you had…" frequency questions: *If less than 1 day, circle '1' for days AND record '00' days.* *If less than one month, circle '1' AND record number of completed days, from 01 to 31.* *If less than one year, circle '2' AND record number of completed months, from 01 to 12.* *Otherwise, circle '3' and record number of completed years from 01 to…* **Provide questions to help clarify answer. For example if woman responds with a couple of days ask her if it has been longer than or less than a month.**	
7.1	How many children do you have? ***Note:*** *Include babies who survived and babies who did not survive.* **Ask the mother if she had babies that are no longer alive? If so include this number in the total number and make a note of how many did not survive in the comments section. Record the total number, for example if three enter 03.**
7.2	How many of your children are less than 5 years old? ***Note:*** *Include only children who are currently alive.* **Enter the number of living children who are under the age of 5. If necessary, help the mother to determine the age of each child. Ask for clinic cards if they are available to help to determine ages. If the mother is not sure, use historical events, such as presidential elections, to help her determine her children's ages.**
8	Did you sleep under a mosquito net last night? **Enter 1 for Yes, 2 for No and 9 for Unknown.** **Emphasize that you are asking about sleeping under a net (not just having a net).**

9.1	Do you currently have a cough? **1 = Yes, 2 = No, 9 = Unknown** **Enter 1 if answer is yes then continue to Q 9.2. If answer is No enter 2 or if Unknown enter 9; then skip Q 9.2 & go to Q 10.1.**
9.2	How long have you had the cough? **Circle and record the corresponding response.**
10.1	Do you currently have a fever? **1 = Yes, 2 = No, 9 = Unknown** **Enter 1 if answer is yes then continue to Q 10.2. If answer is No enter 2 or if Unknown enter 9; then skip Q 10.2 & go to Q 11.1.**
10.2	How long have you had the fever? **Circle and record the corresponding response.**
11.1	Do you currently cough up blood or blood-stained sputum? **1 = Yes, 2 = No, 9 = Unknown** **Enter 1 if answer is yes then continue to Q 11.2. If answer is No enter 2 or if Unknown enter 9; then skip Q 11.2 & go to Q 12.1.**
11.2	How long have you coughed up blood or blood-stained sputum? **For sputum, ask the woman if her spit is red. Circle and record the corresponding response.**
12.1	Do you currently have night sweats? 1 = Yes, 2 = No, 9 = Unknown **Enter 1 if answer is yes then continue to Q 12.2 If answer is No enter 2 or if Unknown enter 9; then skip Q 12.2 & go to Q 13.1.** **If you need to clarify ask, "When you wake up are you wet from sweating?"**
12.2	How long have you had the night sweats? **Circle and record the corresponding response.**
13.1	Are you losing weight? 1 = Yes, 2 = No, 9 = Unknown **Enter 1 if answer is yes then continue to Q 13.2 If answer is No enter 2 or if Unknown enter 9; then skip Q 13.2 & go to Q 14.1**
13.2	How long have you been losing weight? **Circle and record the corresponding response.**
14.1	Do you have tuberculosis right now? **Enter 1 if answer is yes then continue to Q 14.2 If answer is No enter 2 or if Unknown enter 9; then skip Q 14.2 & go to 15.1.** **You can say both TB and the Swahili translation "kifuakikuu." We want to know if the person has been diagnosed and treated for TB.**
14.2	Who told you that you have tuberculosis? 1 = Health care worker (doctor/nurse), 2 = Friend/relative, 3 = No one (I decided myself), 4 = Other _____ 9 = I'm not sure

	Enter the corresponding code, if other write on this line and note in the comment section. If woman answers that she is not sure, ask her the following question(s): Where were you when you were told that you had TB?
14.3	Are you taking pills from a health clinic to treat the tuberculosis? **Enter 1 for Yes, 2 for No and 9 for Unknown.** **If pills are from some place other than a health clinic, please include this information in the comments.**
15.1	Have you had tuberculosis before? 1 = Yes, 2 = No, 9 = Unknown **Enter 1 if answer is yes then continue to Q 15.2 If answer is No enter 2 or if Unknown enter 9; then STOP interview.**
15.2	Who told you that you had tuberculosis? 1 = Health care worker (doctor/nurse), 2 = Friend/relative, 3 = No one (I decided myself), 4 = Other _____ 9 = I'm not sure **Enter the corresponding code, if other write on this line and note in the comment section. If woman answers that she is not sure, ask her the following question(s): Where were you when you were told that you had TB?**
15.3	Did you receive pills from a health clinic to treat the tuberculosis? 1 = Yes, 2 = No, 9 = Unknown **Enter 1 if answer is yes then continue to Q 15.4 If answer is No enter 2 or if Unknown enter 9; then STOP interview.**
15.4	What was the result of the treatment against the tuberculosis? 1 = Cured, 2 = Not cured, 9 = Unknown (did not go in for follow-up care or stopped treatment) **In this question, we are interested to know if a medical professional determined that the participant was cured. As a follow-up question, ask « How do you know that you are cured ? »**

After the observation is complete and the form is filled in, the observer should enter his/her two digit code, initials, and the date of the observation in the box at the top of the form.

For comments section, please enter any unusual situations that you encounter or any additional context that is needed to interpret the data.