A Survey of Agricultural Productivity and Nutritional Status in Rural South Wollo, Ethiopia

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A SURVEY OF AGRICULTURAL PRODUCTIVITY AND NUTRITIONAL STATUS IN RURAL SOUTH WOLLO, ETHIOPIA

by

Anne M. Cafer

A THESIS

Presented to the Faculty of
The Graduate College at the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Master of Arts

Major: Anthropology

Under the Supervision of Professor Mary S. Willis

Lincoln, Nebraska

May 2011
A SURVEY OF AGRICULTURAL PRODUCTIVITY AND NUTRITIONAL STATUS
IN RURAL SOUTH WOLLO, ETHIOPIA

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University of Nebraska, 2011

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Although many studies have focused on the plight, poverty, and severe malnutrition of rural Ethiopians, few have managed to incorporate qualitative and quantitative data to examine connections between health status and food production. This project is unique in that both types of data are combined and anthropometric measurements and a structured questionnaire are used to explore the link between agriculture, development, and nutrition. Additionally the research design incorporated feedback from local development agents, faculty and staff at an Ethiopian university, and community leaders. A survey of 120 households in seven villages within two districts of South Wollo revealed that a majority of households suffer from severe malnutrition. Anthropometric measures showed wasting and stunting to be prevalent, particularly in children. As part of the holistic approach, this project utilized farmers’ perceptions, and as a result, gaps between extension and health worker education services were uncovered. Additionally, further light was shed on the impact of agricultural inputs and livestock ownership on household well-being. Specifically it was determined that, although oxen are important to household well-being, they are not the single best predictor of health status. Instead, their influence appears to be limited to a correlation with the amount of food stored annually by households.
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ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Mary S. Willis for her tireless efforts in preparing me for my field work and manuscript preparation. I would also like to thank the members of my committee, Dr. Raymond Hames, Dr. Martha Mamo, Dr. Charles Francis, and Dr. Shimelis Beyene for their support and input during this process. Special thanks to Dr. Kent Eskridge and Dr. Daniel Osborne for their aid in statistical analysis and establishing anthropometric protocols. To the faculty and staff at Wollo University I extend special thanks for their hospitality and willingness to share their knowledge of the region, I am particularly grateful to Dr. Assefa Negwo, Dr. Yitbarek Woldehawariat, and Dr. Mohammed Assen for their help during data collection and writing. Their continued feedback has been a great asset to this project. Most importantly, I would like to thank the extension and development agents, as well as the farmers and their families, who participated. This research would not have been possible without their contributions. I would also like to thank the Department of Anthropology for research funds from the endowments established in memory of John Champe and Ward Weakly. Last, though certainly not least, I would like to thank Barbara Trail and Kathy Hellwege for their insight and understanding throughout my graduate career at UNL.
CHAPTER ONE: INTRODUCTION

“...more than 81% of Ethiopian peasants live under abject poverty, not relative but absolute poverty. That they starve three to six months every year when natural conditions are said to be normal, that they periodically sink from the precarious subsistence level into the abyss of famine, and that they are unable to sell their labour seasonally for some cash or grain are not exceptional but regular conditions of existence. Especially during the critical “hungry season”, the daily affirmation of the penury and helplessness in the face of the humiliating misery and suffering of their wives and children drives them into debt.”


Famine is an international epidemic. According to the World Food Program (WFP), a major contributor of food aid globally, more than one billion people are classified as hungry worldwide (WFP 2011). Ninety-eight percent of the world’s hungry live in developing countries, 75% of these live in rural areas, and at least half of those who are starving are from farming families (WFP 2011). Although women make up only 50% of the world’s population, they constitute 60% of the world’s hungry (WFP 2011). One in four children in developing countries is underweight and this fact has severe consequences in adulthood as stunting can cause an individual to lose 5-10% of their possible lifetime earnings (WFP 2011). Poverty and disease are also global problems, and are intensified by famine. Globally cholera, measles, and malaria affect 220,000,
164,000, and 225 million people respectively (WHO 2009; 2010). Tuberculosis (TB), Human Immunodeficiency Virus (HIV), and Acquired Immunodeficiency Syndrome (AIDS), though perhaps on the rise globally, affect relatively few individuals in developing nations; TB only affects 170 people in 1000 while HIV/AIDS only affects 8 in 1000 (WHO 2010). But because 25% of the world’s population was living on less than $1.25 US per day in 2005, all rates of disease contribute to famine disproportionately (World Bank Group 2011).

In Sub-Saharan Africa many of these global conditions are concentrated. Of the one billion who are hungry, approximately 265 million live in Sub-Saharan Africa. This number is second only to those who are starving in the Asia-Pacific region (WFP 2011). More than half of Sub-Saharan Africa’s population, 51%, lives on less than $1.25 USD per day and three quarters live on less than $2 USD per day (World Bank Group 2011). Sixty-three percent of Sub-Saharan Africans live in rural areas, and despite agriculture-based livelihoods, are more prone to hunger (World Bank Group 2011). Also the HIV/AIDS infection rate in Sub-Saharan Africa is high, affecting 49 people per 1000. But the rate of TB incidence is even higher, such that 480 people per 1000 are infected (WHO 2010). Thus the years-of-life-lost due to communicable disease is roughly 80 years (WHO 2010). ‘Neglected tropical diseases’ (NTDs) also contribute to a shortened lifespan in that they impact health and nutrition status, particularly in the developing nations of Sub-Saharan Africa (Hotez and Kamath 2009). NTDs have an estimated burden equal to twice that of TB in Sub-Saharan Africa and are often disabling and disfiguring. Such outcomes have an additional negative impact on agricultural productivity (Hotez and Kamath 2009). Many NTDs are caused by helminth infections,
such as hookworm, and infect an estimated 50 million school-aged children. Another such disease, schistosomiasis, affects more than 192 million people in Sub-Saharan Africa (Hotez and Kamath 2009). Thus Sub-Saharan Africans carry a large disease burden for easily-treated helminthic infections, but also have a significant number of non-helminth NTDs, including human African trypanosomiasis, visceral leishmaniasis, and trachoma. All of these non-helminthic NTDs are linked to protozoans and bacteria (Hotez and Kamath 2009).

Sixty-five percent of the world’s hungry live in seven countries, one of which is The Federal Democratic Republic of Ethiopia (FDRE or Ethiopia) (WFP 2011). Ethiopia, situated in the Horn of Africa, is a culturally and geographically diverse country with more than 85 living languages spoken in this single East Africa country (Lewis 2009). Ethiopia shares similar topography with bordering nations, Eritrea, Djibouti, Somalia, Kenya, and Sudan, and is characterized by temperate high plateaus, mountain regions, and dry lowland plains (US State Department 2011). Eighty three percent of Ethiopians live in rural areas and because a substantial number of the world’s hungry live outside urban centers, it is not surprising that 10% of the 74 million people living in Ethiopia qualify to receive food aid annually (Croppenstedt and Muller 2000; Makombe et al. 2007; WFP 2011). Hunger is often a product of poverty and Ethiopia is the world’s third poorest country, with 44% of the population below the international poverty level (World Bank Group 2011). At least 39% of Ethiopians live on less than $1.25 USD per day and 78% live on less than $2 USD per day (World Bank Group 2011). Hunger, malnutrition, and poverty also make Ethiopians more vulnerable to disease. Even necessary resources such as water can be a significant source of infection. For example, more than 30,000
Ethiopians contracted cholera in 2006, and malaria was responsible for 3% of deaths nationwide (WHO 2009). Measles, a disease easily prevented through vaccination, resulted in 4% of deaths within Ethiopia (WHO 2009). Although the HIV/AIDS rate in Ethiopia is less than half that of Sub-Saharan Africa, affecting just 21 of every 1000 people, it accounts for 12% of deaths in the country (WHO 2009; 2010). By contrast, TB is a much more prevalent condition, affecting 560 of every 1000 people, but accounts for just 4% of deaths in Ethiopia (WHO 2009; 2010). Other significant sources of illness include respiratory infection, which is responsible for 12% of deaths in adults, and diarrheal disease and pneumonia, which are responsible for 17% and 22% of deaths in children under five respectively (WHO 2009).

The United Nations’ Development Program (UNDP) converts all elements such as disease, illness, mortality, and health status into a single value to determine human development potential for each of 183 countries. The UNDP then measures human development using a statistic that combines measures for health, education, and living standards into the Human Development Index (HDI) (UNDP 2010). Thus life expectancy at birth, mean expected years and completed years of education, and gross national income (GNI) per capita are used to calculate a ratio between 0 and 1, with 0 being the lowest human development potential and 1 being the highest (UNDP 2010). Of 183 countries measured, Ethiopia ranked 157th in the general HDI (Fig. 1). A second measure of human development potential is structured around health. The percent of the population that is undernourished, the percent of the gross domestic product (GDP) that is spent on health, the mortality rate of children under five, and the life expectancy at birth are used to calculate the health HDI ratio (UNDP 2010). Again, Ethiopia is ranked quite
low on this scale, 156th out of 183 countries in health HDI trends (UNDP 2010). These combined rankings have made Ethiopia a long-targeted candidate for development. In addition, because Ethiopia’s population is mostly rural and 85% are engaged in subsistence agriculture, development projects are often designated for the agricultural sector of the country (Makombe et al. 2007).

![Graph showing HDI trends](image)

**Figure 1.** Rank Order for The United Nations’ Human Development Index Including Ethiopia, Sub-Saharan Africa, and the World

Adapted from United Nations Development Program (UNDP 2011); Rank values begin at 0 and end at 1, the highest possible HDI rank.

Ethiopian farmers must tackle human disease, flooding, drought, and agricultural constraints in the context of a poor national infrastructure and lack of economic development (Lee 2004; Ogbaharya 2009). Thus farmers’ major concerns center around
frequent rain shortages, soil erosion, shortages of farmland, water conservation, lack of grazing land and fertilizers, crop disease, pest control, and poor access to markets, all of which are major constraints to agricultural production (Bekele 2006). These constraints are aggravated by land over-grazing, land-use changes, expansion, resettlement, and an increasing national population (Anbessa and Bejiga; 2002 Assefa et al. 2008). But continued population growth and soil degradation make Ethiopians highly vulnerable to seasonal climate variations, particularly the occurrence of drought. This also contributes to the perpetual state of poverty and food insecurity throughout the nation (Bekele 2006; Lee 2004).

Severe drought, which results in massive livestock and crop loss, in addition to a significant loss of human life on a national scale, is a significant contributor to poor health and low agricultural productivity. This type of drought occurs every eight to ten years in Ethiopia, with three major episodes over the last fifty years—1973-74; 1983-84; 2000 (Croppenstedt and Muller 2000; Salama et al. 2001; Kebede 2008). Perhaps less severe but nevertheless damaging, **seasonal** drought is a consequence of rainfall shortage during the growing season and generates varied amounts of crop and livestock loss. Seasonal drought occurs approximately every two years in Ethiopia (Desalegn et al. 2006). Thus between 1970 and 1996 there were 25 drought, famine, or food shortage events throughout Ethiopia which resulted in the death of over 1.2 million people (Desalegn et al. 2006). In the northern regions of Tigray and Wollo, 300,000 people died as a result of drought conditions in a four year period—1969-1973 (Little et al. 2002). Gode, located in the Somali region of Ethiopia (5°57’ N 43°27’E), was the epicenter of the 2000 drought. More than 77% of the deaths that took place in Gode occurred before
relief intervention even began (Salama et al. 2001). This trend has implications for other regions of Ethiopia, particularly in highland areas such as South Wollo (Fig. 3) where drought is more pronounced (Desalegn et al. 2006). Such pronounced drought has earned South Wollo a reputation as the “buckle of the country’s famine belt” (Little et al. 2002: p.1). Farm families in highland areas are often the least food secure (Little et al. 2004). Historically these families also tend to lose fewer livestock and experience fewer deaths during drought compared to rangeland and intermediate areas. This may be due to household adaptation to drought conditions (Seaman et al. 1978; Little et al. 2004). An increase in variability of rainfall can result in an increase in crop production unpredictability; as such, drought mitigation, e.g. non-farm income, migration, and increased use of inputs, is a natural part of existence in Ethiopia and requires individuals, households, and communities to take action in advance to reduce long-term risk (Bryceson 1999; Little et al. 2001, 2004; Copper et al. 2008). But income diversification as a way to increase household resilience to drought is not unique to agriculturalists; pastoralists also seek non-farm employment as a way to mitigate climate fluctuations and animal disease, and thus limit food and nutrition insecurity (Little et al. 2001). Ideally, these mitigation actions should come in the form of government policies and programs targeted toward household drought resistance, particularly those households with the threat of future water scarcity. However, needs at the local level do not necessarily translate into policy at the national level; consequently, Ethiopia has failed to achieve effective drought mitigation (Tefera 2004; Desalegn et al. 2006). In order to develop effective drought mitigation strategies at the local, regional, or national level, it is important to understand the effects drought and food insecurity have on household well-
being. Agriculture, natural resource conservation, and other social and economic factors influence the impacts that severe drought has on households; consequently, an appreciation for how these variables interact, and how households view and value health, are important to the overall success of drought mitigation programs.

Figure 2. Map of Ethiopia with Amhara Region
Map is Adapted from the United Nations Development Program’s Emergencies Unit for Ethiopia (UNDP EUE 1999)

This project was designed to examine effects of drought and food and nutrition insecurity on household well-being. To gain a better understanding of these factors, it was necessary to examine issues such as health, access to care, nutrition, food aid, conservation, and agriculture. The combined use of anthropometric measures to assess
health status, and qualitative data collection to determine household wealth and farming success, is an approach used by few previous scholars. This investigation was conducted in seven rural communities of the drought-prone Amhara region in Ethiopia (Fig. 2). An emphasis on agricultural productivity and health status from the farmers’ perspectives provided a more comprehensive understanding of how development and aid could be designed for maximum efficacy. Additionally, as part of the applied piece of this research, all data were provided in the form of immediate feedback to those members of the community who participated in the study. Although nutritional assessments are nothing new to rural Sub-Saharan African populations, participants often provide information for a project without receiving feedback about nutritional status and suggested improvements for altering health status. As well, development agents are seldom provided with information on those aspects of life which has the largest effect on household well-being for use in extension education programs. For example, the presence of a correlation between health and drought mitigation strategies could be important for understanding how local communities view and value health. Such data might be an important tool for policy makers and community leaders when planning ‘food for work’ (FFW) initiatives or for developing and implementing health policies at the local level. An investigation of the water-borne disease, trachoma, provides an illustration of work which has applied value. Trachoma causes infection of the eye and is spread through person-to-person contact. Collaboration between researchers, healthcare workers, and school officials indicated that the use of clean water, and soap provided to students in Ethiopian K-12 schools, could lessen disease prevalence (Hall et al. 2008).
Based upon previous studies both in and near South Wollo, data from this study were expected to reveal severe malnutrition, expressed through low body mass index (BMI) and stunting. Livestock, particularly oxen, the use of fertilizer and irrigation, and the production of cash crops were also expected to be positively associated with BMI. Most households were expected to use the cereals they produced for household consumption. The use of native, drought resistant crops such as *Eragrostis tef* (*teff*), used to make the food staple *injera*, and *Sorghum bicolor* (sorghum) were expected to be most popular among farmers. It was also expected that households with fewer hectares of land, and headed by the elderly or females would be the most common recipients of food aid.
CHAPTER TWO: BACKGROUND AND LITERATURE REVIEW

Nutrition and Health

Many studies measure household well-being in terms of poverty or BMI. Health is often viewed as an indicator of household wealth in developing regions, with the overall health of the household being a good predictor or substitute for household welfare outcomes; BMI specifically was shown to be a good surrogate for poverty level (Hoddinott and Kinsey 2000; Kodama 2006). In addition, height has been demonstrated to be a good proxy for health in children (Hoddinott and Kinsey 2001). Household well-being is also an important indicator of a household’s ability to produce agricultural products. Social, medical, economic, agricultural, and political factors that influence a household’s well-being or health are often the major foci within studies of household well-being (Croppenstedt and Muller 2000). Of the many factors which are a part of such analyses, land ownership, sex, age, and education of the head of household, household composition, sources of income, social and development activities, agricultural inputs, and medical conditions have been the most frequently explored. The sex of the head of household is an important variable in that female-headed households are more likely than male-headed ones to fall below the poverty line (Blaney et al. 2008). Still, women caregivers are associated with more positive nutritional outcomes for the household, particularly regarding food aid receipts (Frank 1999; Carter et al. 2004; Blaney et al. 2008). Previous scholars have argued that land ownership is the most important determinant of well-being, though five acres (0.40 ha) seems to be the threshold (Bashaasha et al. 2006). Non-agricultural sources of income, such as firewood, and household assets, such as jewelry or tools, were economic factors shown to have
significant positive effects on overall household health (Croppenstedt and Muller 2000; Bashaasha et al. 2006). Other predictors of household well-being included participation in development activities, incidence of past shocks (i.e. crop loss during a drought), and distance to a water source (Croppenstedt and Muller 2000; Bashaasha et al. 2006). The number of crops sold, access to extension services, and the use of improved seed were not demonstrated to be significant predictors of household health (Bashaasha et al. 2006).

Chronic illness, and conditions such as fever and cough, had significant negative effects on household well-being in rural Uganda (Bashaasha et al. 2006; Wamani et al. 2006). In fact, stunting, wasting, and being underweight were all positively associated with fever episodes. But being underweight was also associated with coughing fits while stunting was associated with lack of household latrines and failure to de-worm (Wamani et al. 2006). Stunting, wasting, and being underweight describe children under five in six regions of Ethiopia, at 64%, 8% and 47% respectively. Access to care and health services were found to be the best predictors of length for age, but were also an indicator of stunting (Croppenstedt and Muller 2000; Blaney et al. 2008). Considering that school-aged children in developing countries rarely experience catch-up growth, and subsequently accrue greater height deficits with age, the returns on nutrition at an early age are very high (Croppenstedt and Muller 2000; Friedman et al. 2005). More significantly, wasting was found to contribute to 72% of all deaths among children under five in Gode during the 2000 drought (Salama et al. 2001). In addition to malnutrition, the prevalence of diarrheal disease, respiratory and eye infection, and parasitic conditions such as malaria and cholera, are important sources of nutritional and energetic stress for populations in developing nations (Utzinger et al. 2009). This is the case for most of Sub-
Saharan Africa, including Ethiopia, and is especially common in the Awash Valley region which includes South Wollo (Desalegn et al. 2006; Utzinger et al. 2009). The ability of Ethiopians to recover from illness is limited as even after a good harvest, they may not consume enough calories to cover daily expenditures (Tefera 2004; Devereux 2000). Because most Ethiopians living in highland areas are engaged in subsistence farming, where poor nutritional status is reflected in low productivity, illness can obliterate gains made after drought (Little et al. 2007). As such, health in Ethiopia, particularly as it relates to household well-being, remains a constant issue for development and health organizations.

Drought, Food Security, and Food Aid

Famine, according to Dirks (1980), is both a social and biological phenomenon. In Ethiopia, famine and hunger are often products of drought and weakly developed economic and political infrastructures (Bekele 2006). In Sub-Saharan Africa, there are between 10 and 14 million people in need of food aid across any six food-aid receiving countries (Lee 2004). By itself, Ethiopia has that many people who require food aid to prevent starvation (Lee 2004). On average, Africans spend 57% of their household income on food, while food aid measured in kilograms per capita, accounts for 10% of their total household food resources (Downing et al. 1997). East Africans have slightly lower levels of household expenditures on food, just 37%, but rely less heavily on food aid; only 4% of the total households use food aid as a resource (Downing et al. 1997). Although this may be due to the large percentage of households who engage in agricultural activities, it does not demonstrate the importance of food aid receipts and targeting in Ethiopia. There are three types of “food poverty” in Ethiopia: (1) transitory,
often the result of drought or war; (2) seasonal, the result of discrepancies in rainfall during the short and rainy seasons; and (3) chronic, which is the result of political factors (i.e. land tenure, government policies) and a weak natural resource base (Devereux 2000). These three types of food poverty have serious political and economic consequences, especially for a country that as of 1996 was receiving 20% of all of the food aid sent to Africa (Jayne et al. 2000; Quisumbing 2003).

Several methods of food targeting have been described in the literature including administrative, self targeting, and community (Quisumbing 2003). Administrative food aid, usually cereals, powdered milk, oil, and clothing, is often a gift to the household and does not require labor remuneration (Jayne et al. 2000; Moges and Holden 2007). Administrative targeting is based on age and sex of the head of household, the number of household assets, or amount of livestock retained by the household (Quisumbing 2003). This is usually broadly determined by the Federal Government based on region and income, then passed to the woreda, or administrative district, where aid trickles down to the kebele or the farmers’ association level (Jayne et al. 1999; Quisumbing 2003). In the latter, aid is ultimately distributed at the discretion of the community leaders (Clay et al. 1999; Jayne et al. 2000; Quisumbing 2003). By contrast, self and community-based targeting are mostly in the form of FFW programs. Self-targeting allows a household to determine the extent of participation in both time and number of household members, whereas community-based targeting can determine eligibility to participate in FFW based on landholdings, livestock, and assets (Jayne et al. 2000).

Food aid targeting is a very political matter in Ethiopia and reviews of its efficiency are mixed. Ethiopia’s official food aid policy dictates that no able-bodied
person should receive food aid without working on a community project. The goal is to discourage dependency and promote self-sufficiency and preservation of household assets (Clay et al. 1999; Moges and Holden 2007). For areas inside the traditional famine zones, such as Tigray and South Wollo, the Federal Government’s use of regional need as a criterion for support often means that aid fails to reach farmers who actually need it (Clay et al. 1999). Specifically, the use of age and sex of the head of household as criteria for food support causes households at the extremes, i.e., the least and most food secure, to receive aid regardless of need (Jayne et al. 2000). This may promote vulnerability by enabling a community to become reliant on handouts, and for some, this suggests that there is no significant association between food security and food aid receipts; hence food aid is not described as well-targeted (Jayne et al. 2000). Recent studies show that 78% of the needy in Ethiopia do not receive food aid or assistance; nevertheless some still maintain that food aid is sent to the sites where it is most needed (Devereux 2000; Quisumbing 2003; Tefera 2004). Even among those who do receive aid, it is usually in small amounts and often comes too late and is pulled too early, creating an atmosphere where the asset-poor fall below the poverty line and remain there (Little et al. 2002; Desalegn et al. 2006; Moges and Holden 2007; Little 2008). Consequently, the poor are much more active in buying livestock when their own herd dies during drought or they were forced to sell livestock to buy food and cannot rely on breeding to replenish numbers (Little et al. 2004). But not all asset-poor families have the same response to drought events. Those who received aid from wealthy kin or via other social networks had a much more rapid recovery, which may be why food aid is less significant in drought recovery for poor families (Little et al. 2002, 2004).
Several social factors have been tied to food security and food aid receipts. FFW programs, due to their prevalence, are one of the more significant influences. These programs have been shown to be well-targeted to poor families, with greater participation from larger households (Clay et al. 1999; Quisumbing 2003). They also have an overall positive effect on height-for-weight; however, households with increased levels of malnourishment tend to have decreased participation in FFW programs (Quisumbing 2003). Irrigation is another factor that has been positively associated with food security. For example, 70% of irrigators versus only 20% of rain-fed agriculturalists were food secure in one study conducted in the Oromo region located in eastern Ethiopia (Tesfaye et al. 2008). Negative predictors of food security are impediments to land accessibility, technology, decision-making, and being from a female-headed household (Frank 1999; Quisumbing 2003). Female heads of household often suffer from a lack of farmland and plowing oxen, meaning they rely upon family or neighbors to plow, plant, and harvest their fields (Frank 1999) This means planting and harvesting may not be completed on time, resulting in decreased productivity and subsequent food insecurity (Frank 1999).

Because national responses to drought tend to be crisis management oriented rather than based in preparedness, many efforts have been made to develop an early warning system to help dampen the effects of drought and prepare for harsh conditions (Tadesse et al. 2008). To date the best predictor of drought comes from understanding the El Nino-Southern Oscillation (ENSO), a weather pattern in the northern hemisphere (Dilley 2000; Korecha and Barnston 2007). By observing this weather phenomenon, drought can be predicted and is usually found to occur in the following year, though not universally (Dilley 2000; Korecha and Barnston 2007). This may or may not provide the
time necessary for aid agencies to organize their resources to provide food aid far enough in advance to protect household assets. Still in southern Africa, many countries utilized information on the 1997 El Niño to develop national preparedness plans, issue guidance for preparedness to communities, and begin stockpiling food in preparation of drought conditions (Dilley 2000). Though drought conditions did not occur in the area, this illustrates the importance of early warning systems in food security and disaster planning in Sub-Saharan Africa.

**Natural Resources, Conservation, and Energy**

In a country where 50% of the gross domestic product is comprised of agricultural outputs, there are national as well as individual incentives to make the most out of limited or scarce resources (Makombe et al. 2007). Ethiopia, as a developing country, relies heavily on climatic resources, namely water and soil, and the exploitation of these resources plays an important role in national progress (Downing et al. 1997; Dejene 2003; Bekele 2006; Desalegn et al. 2006). However, this exploitation often comes with a host of environmental and conservation concerns, particularly water table depletion and soil degradation. Although water is an abundant resource in Ethiopia, its spatial and temporal distribution (seasonal rivers, droughts, and flooding) make it a scarce commodity. Increased climate variability exacerbates this issue by altering water balances, particularly the spatial distribution of water (Downing et al. 1997). This in turn limits the agricultural productivity of the country and makes socio-economic development a challenge (Desalegn et al. 2006). This also means that water, being a critical resource in short supply, is a significant source of conflict (Desalegn et al. 2006). Water conservation is a key concern for farmers, as 85% of water usage in the county is
dedicated to agriculture; this means water is necessarily tied to economic losses accrued during drought (Bekele 2006; Desalegn et al. 2006). This is a concern held by both farmers using irrigation and those using rain-fed systems. There are current conservation practices, such as dams and water harvesting, which farmers manage in their agricultural activities (Desalegn et al. 2006). Regardless of these conservation practices, which rely heavily on rainfall, the problem of drought still remains a significant source of apprehension for many farmers (Desalegn et al. 2006).

Soil is an important resource for Ethiopian farmers, not only for its obvious role in agricultural production but for its role in energy production. The lack of a well-established national infrastructure in Ethiopia means only four percent of the population is connected to some type of electric grid (Dejene 2003). Seventy-seven percent of the energy supplied to Ethiopian citizens comes in the form of biomass; in particular woody biomass, with crop residue and dung both close to the 10% mark (Dejene 2003). South Wollo alone consumes between 200,000 and 350,000 tons of biofuel each year (World Bank 2004). A reduction in availability of wood, due to deforestation and soil degradation, means farmers are keenly aware of soil conditions in their area. Ethiopians in the southern part of the country often use crop yield, crop performance, and various soil characteristics (i.e. texture, color) as indicators of soil degradation (Moges and Holden 2007). Farmers are also aware of possible solutions to soil degradation and cited construction of terraces and planting trees and shrubs as ways to improve the soil; however, less than 50% of participants actually performed these tasks (Moges and Holden 2007). Rain-fed farmers in the Upper Awash Basin use contour bunding, improved tillage practices, strip cropping, construction of bench terraces, altered planting
dates, weed control, reduction of cultivated area, and the use of drought-tolerant crops, e.g., chickpeas and lentils, in their conservation efforts (Desalegn et al. 2006). However, knowledge of the problem does not necessarily dictate that farmers will adopt conservation practices, particularly if there is expense involved and no guarantee they will have sufficient product to repay their debt (Moges and Holden 2007). Uncertainty often deters farmers from engaging in conservation practices (Gebremedhin and Swinton 2003).

Conservation in Africa, regardless of history or political tensions, has often been rooted in overcrowding, over-production, soil erosion and drought (Anderson 1984). In many African nations, conservation practices are often associated with colonial domination; however, this is not the case for Ethiopia (Anderson 1984). Alternatively, a reliance on Western influences in agriculture during the 1960s has likely had an impact on Ethiopian conservation policies (Anderson 1984; Messing and Skoggard 1998). At the household level, perceptions of soil degradation, and therefore efforts to mitigate it, are negatively affected by an increase in the amount of land an individual has at his/her disposal to cultivate (Shiferaw and Holden 1998). Additionally, households with less land to cultivate, or those where there is significant population pressure, are more likely to remove conservation structures in the absence of appropriate policies and technology (Shiferaw and Holden 1998). This suggests that a balance between manpower and available farmland must be reached in order to maintain effective conservation mechanisms. Participation in soil conservation activities without incentives may be limited as farmers see these activities as the responsibility of the authorities. In response to the lack of incentives or means to engage in soil conservation, the Ethiopian
Government has incorporated soil conservation as a part of their food aid, in particular the FFW program, where conservation activities are usually carried out as a means of manual labor remuneration. Ideally this strengthens the local infrastructure, but it can also lead to dependency, regardless of measures taken by the Ethiopian Government to prevent such a relationship (Moges and Holden 2007). Other measures taken by the Government include the establishment of the Participatory Demonstration and Training Extension System (PADETES) and the Sustainable Agriculture and Environment Rehabilitation Program (SAERP) which reaches roughly 37% of the population (Devereaux 2000). This may be an indication that development and conservation require a grassroots approach (Bekele 2006).

The Ethiopian highlands in South Wollo, at 2500 to 2700 meters above sea level, are the focus of this study and home to significant portions of both the country’s livestock and people (Dejene 2003). With a significantly higher concentration of Ethiopian farmers (90%) and an increase in concentrations of livestock and grain production, soil degradation and infertility are principle concerns in this northern region (Rosell and Holmer 2007). Fifty percent of the highlands, which comprise 45% of the entire country, are highly eroded, compared to 65% of land in Sub-Saharan Africa which is subject to soil degradation (Dejene 2003; Rockström et al. 2009). Another 25% of these areas are severely eroded, and 5% are no longer able to sustain crops (Dejene 2003).

Agriculture

Forty-seven percent of the East African gross national product (GNP) is reliant upon agriculture, compared to only 30% in Sub-Saharan Africa and 2% in the United Kingdom (Downing et al. 1997). Rain-fed agriculture is particularly important in Sub-
Saharan Africa as it supplies 90% of staple food products (Copper et al. 2008). This is the case for Ethiopia as well, particularly in the highlands, where agriculture is also a rain-fed operation and typically associated with low productivity in comparison to irrigated agriculture (Devereaux 2000). As a result, consumption is often directly impacted by the amount and timeliness of rainfall for a given household (Dercon and Krishnan 2000).

Even minor changes mean harvest quality and quantity are reduced (Dercon and Krishnan 2000; Rosell and Homer 2007). This situation becomes particularly threatening during drought as the average land holdings for many are insufficient to provide enough food for the family even after a good harvest (Deveraux 2000). Fertilizer, irrigation, seed sources, and income diversification all play crucial roles in the productivity of Ethiopian farms (Bekele 2006; Little et al. 2004). As a consequence of environmental degradation, both from increased climate variability and poor management, soil nutrient depletion has a negative impact on food production potential (Bekele 2006; Rosell and Holmer 2007).

Although fertilizer is a popular means globally to boost soil fertility in the face of such severe soil nutrient loss, only a minority of farmers can use it (Bekele 2006). African farmers use, on average, only 12 kilograms of fertilizer per hectare, compared to the 350 kilograms per hectare used by farmers in developed nations such as the United Kingdom (Downing et al. 1997). In North Wollo, an area in the highlands of the Amhara region of Ethiopia, only 40% of the farmers use fertilizer and most apply diammonium phosphate (Negatu and Parikh 1999; Assefa et al. 2008). Few farmers purchase fertilizer due to the high cost, but for those farmers who do use this input, it can have the added benefit of reducing pest loads on agriculturally important crops such as sorghum (Wale et al. 2006; Assefa et al. 2008). Education, farm size, and income per unit of cultivated land also tend
to have a positive correlation with the use of fertilizer in a farmer’s production system in the Amhara region of Ethiopia (Negatu and Parikh 1999; Assefa et al. 2008). One proposed solution to the limited application of fertilizer is the extension of credit which would allow farmers to purchase such inputs (Holden et al. 2004). An increased grain production would increase household food security and hence a household’s overall welfare. However, provisions for credit to purchase fertilizer do not reduce the need to buy grain during drought. There are also potential negative effects in terms of conservation (e.g. lack of incentives to maintain soil conservation structures such as terraces), but these could be mitigated by attaching conservation incentives to the loans (Holden et al. 2004). Inorganic fertilizer alternatives in the form of manure or cabbage oil can be used but are not always available (Assefa et al. 2008).

Pests have been suggested by Ethiopian farmers as a major constraint to crop production and have been a major concern (Tefera 2004). However pesticide, in terms of global use, is lowest in Africa and many farmers in Ethiopia have never applied a pesticide due to the limited availability or cost (Abate et al. 2000; Tefera 2004). Knowledge of pests and pest control are varied, resulting in a variety of prevention and treatment methods. Many farmers in Africa, Ethiopia included, rely on natural or indigenous methods of pest control such as intercropping, which has potential for being an extremely effective pest management mechanism (Abate et al. 2000; Fininsa and Yuen 2001; Assefa et al. 2008). Intercropping involves planting two crops in close proximity to each other, often with positive outcomes, such as reduced pest and weed burden, or soil nitrogen fixing (Bender 1994). Intercropping was found to reduce the incidence and severity of infestation by 25% and 16% respectively in 91% of research plots in the
Hararghe region, in eastern Ethiopia (Fininsa and Yuen 2001). Visual assessments can also be an effective method of detection and treatment for fungal infections which would allow farmers to determine the quality of the crop and take measures against the infestation (Chala et al. 2003). Furthermore, some pests are much more economically significant. *Trypanosoma brucei*, a parasitic protozoan, has been identified as the reason that farmers abandoned their farmland completely in the Ghibe Valley of southwestern Ethiopia (Reid et al. 2000). *Trypanosoma brucei*, which causes sleeping sickness in humans and death in livestock, is a pervasive parasitic disease that requires extensive medical and veterinary care (CDC 2010). This pest is simply too expensive for farm families to manage (CDC 2010).

Irrigation, not surprisingly, is closely correlated with food security and its use is an ancient tradition in Ethiopia (Bekele and Tilahun 2006; Tesfaye et al. 2008). However, currently only 3-4% of arable land is irrigated within Ethiopia’s current borders (Bekele and Tilahun 2006; Tesfaye et al. 2008). Contemporary irrigations systems have only been in place since the 1960s (Aberra 2004). These 1960s systems are often constructed by farmers with their own resources, with little help from entities tied to government or non-governmental organizations (NGOs) (Bekele 2006). The farmers’ irrigation schemes are often rudimentary in their construction with temporary headwork, unlined canals and storage ponds (Bekele 2006). These schemes are done on a small scale, and are typically washed away annually by floods during the rainy season, only to be reconstructed later (Aberra 2004; Makombe et al. 2007). Ethiopia’s increased variability in annual rainfall means rain-fed farmers are only able to grow one *teff* crop every other year (Rosell and Homer 2007). Irrigation allows farmers to grow more than one crop per year or produce
other lucrative water-intensive crops (Rosell and Homer 2007; Tesfaye et al. 2008). In fact, farmers who use irrigation often produce more agricultural products worth a greater monetary value on fewer hectares than rain-fed farmers (Tesfaye et al. 2008). Yet irrigation systems are vulnerable to water loss through evaporation as a result of poor scheduling, e.g., watering during mid-day as opposed to evening (Bekele and Tilahun 2006). Correspondingly, as farm size increases, the use of irrigation in the production scheme tends to decrease, but the incorporation of irrigation systems is correlated with owning a greater number of livestock, at least in the Rift Valley area of Ethiopia (Bekele and Tilahun 2006; Makombe et al. 2007; Tesfaye et al. 2008). Secondary salinisation is also a very real concern for farmers using irrigation systems. Tigray, in northern Ethiopia, has an extensive community of micro-dam based irrigation schemes, approximately sixty to date (Kebede 2008). This may be of great benefit in the short-term, with increased production and greater access to water resources, but irrigation adds salt to the soil (Kebede 2008). In its early stages, increased salt in the soil leads to reduced productivity and eventually, complete soil infertility (Kebede 2008). Vegetation will fail to grow and there can be a great decrease in biodiversity and habitat as the land becomes barren (Kebede 2008).

Few cultivators in Africa use modified seeds, such as Monsanto corn or sorghum seeds, which are staples in American agriculture. A pest resistant form of cotton is the only genetically modified crop to become semi-commercialized in Africa, and to date is only found in two Sub-Saharan African countries (Dowd-Uribe and Bingen 2011). Poor farmers in Ethiopia are no exception as they are simply unable to pay the royalties even if they could afford the costly inputs (e.g., fertilizer, pesticides, and insecticides) associated
with the use of GMCs (Gebre Egziabher 2003; Abule et al. 2005). The costs attached to
the use of GMCs, combined with poor market integration, means farmers would not
make enough return on their investment to support a household (Gebre Egziabher 2003).

Most seed used in Ethiopia, particularly in eastern Ethiopia, is produced by the farmers
themselves or through informal channels, such as other farmers (McGuire 2008).

External inputs and modern genetic varieties are limited, but farmer-developed varieties
have a large range (McGuire 2008). Furthermore, farmers may have to re-sow their crops
depending on the rain variability. This requires that a large quantity of seed be on hand,
especially for lowland farmers (i.e., 1900 meters below sea level) who have larger plots, a
decreased yield, and unpredictable rain (McGuire 2008). Seed shortfalls are common in
Ethiopia and farmer-to-farmer exchanges fill the gaps, making kinship and reciprocal ties
very important for agriculture (McGuire 2008). However, biological kinship is not
always a factor in seed exchanges, as farmers in need of seed may often look to other
farmers because they can purchase seed on much more favorable terms, particularly in
eastern Ethiopia (McGuire 2008). Additionally, they often know the farmer they are
purchasing from and engage in mutual activities to cement their reciprocal bond, e.g.
labor, oxen sharing, or participation in local institutions (McGuire 2008). Some may
argue that this reciprocal seed transaction is a social tool to gain power, but the land
tenure system and weak market development prevents wealthier farmers from enriching
themselves to the point where they can break free of local social networks (McGuire
2008). There are also alternative methods for purchasing seed, such as buying seed from
the Ethiopian Government or from seed merchants, but these are often less desirable
sources. In addition to being less desirable, they also require cash, which is not
necessarily something rural farmers have on hand—particularly before the planting season (McGuire 2008). Formal sector seed supply has little impact in most developing countries because of market failure, or lack of integration, and ineffective policies (McGuire 2008). There are emergency seed systems in place supported by assistance programs to aid in agricultural recovery following a crisis (McGuire 2008). However, these emergency system designs fail to account for the social ties and the consequences involved in seed exchange, which inhibits efficiency and often means that useful varieties, i.e., those that are drought resistant, higher yield, or suitable to certain conditions, do not reach farmers (McGuire 2008). Unfortunately seed aid in Ethiopia, which has occurred every year since 1974, is based on food security assessments rather than a clear understanding of how farmers maintain seed stocks (Makombe et al. 2007).

Because agriculture for many Ethiopian farmers is not conducted for commercial purposes, any cash that households would need must come from the sale of one’s own livestock, alternative crop products (i.e. crops not grown for household consumption), or paid labor (Desalegn et al. 2006). Some individuals trade vegetables or other materials for cash (Bekele 2006). Still others opt for more lucrative crops such as teff, fruits, and vegetables. *Teff* is the single most staple crop preferred by farmers because of its drought tolerance and higher market price (Rosell and Holmer 2007). *Teff* also has a ninety day growing period which makes it suitable for the short rainy season (Rosell and Holmer 2007). Yet it has also been demonstrated that a household’s chance of poverty is most likely decreased by planting export crops such as coffee and *Catha edulis (khat)* (Bigsten et al. 2002). In Ethiopia, *khat* is an important plant culturally and socially. *Khat* is used for recreation purposes and as a stimulant, but farmers often chew *khat* when extended
work hours require one to forgo sleep and meals. There is also the *wodaja*, a type of prayer utilized in many rural communities in South Wollo (personal communication with Wollo faculty June 17, 2011), and *khat* use is an important part of this ceremonial process for many Amhara. Wealthier households were found to engage in a variety of income-generating activities and households who diversified income after a drought recovered more quickly (Block and Webb 2001). As the reliance on rain-fed agriculture is combined with a decrease in income diversification, the risk of poverty becomes overwhelming (Little et al. 2006).

**Economic, Social, and Political Issues**

National policies play a large and varied role in the agricultural and food security issues facing Ethiopians. The land tenure system was created during the *Derg* period (i.e., the mid-1970s to mid-1980s) and in this time, all land became property of the state (Ogbaharya 2009). The land tenure system resettled individuals based on ethnic affiliation and hence created ethnic regionalism (Abule et al. 2005). Ethiopia is a very diverse country culturally, and as such there are now approximately 11 such ethnic regions, including ones for the Amhara, Tigray, Oromo, Somali, Afar, and southern peoples. This system also provided each household with a given parcel of land based on household size, which the family must farm in order to retain land use rights (Bigsten et al. 2002). But a lack of distinct boundaries has resulted in conflict, which is a substantial drain on household resources (Abule et al. 2005). The land tenure system has also prevented the building of wealth through the accumulation of land. Consequently, livestock have become a very important economic tool as well as an indicator of wealth. In South Wollo, the average farm size is 0.82 hectares, smaller on average than other
highland areas in Ethiopia (Little et al. 2004). This scarcity of land may contribute to the apprehension many farmers have regarding land redistribution; consequently their small land holdings are nicknamed “starvation plots” (Little et al. 2004; 2006). Land tenure and the resulting lower incomes have had a significant negative impact on other cultural practices such as polygyny. Although once common, polygyny is rarely practiced among highland families in South Wollo (Little et al. 2006).

Poverty is a common condition in Ethiopia, particularly for rural households. After accounting for food aid receipts, 78% of the rural population is below the national poverty level, while nearly 14% of residents in North and South Wollo are destitute (Little et al. 2006). Because the land tenure system provides everyone with land, livestock holdings are used to measure poverty. As was observed in South Wollo, “everybody has land, but the poor have no animals” (Little et al. 2004: p. 1). Thus families who owned at least one ox can avoid sharecropping. Still, 38% of farmers in the South Wollo region do not own a single ox (Little et al. 2006). Although oxen tend to be the favored asset of researchers when analyzing poverty, other factors can be indicators of household well being. The amount of cultivated land, the number of off-farm activities, household size, distance to market, age of the head of household, food stocks, dependence on rain-fed agriculture, a reduction in income diversification, and even whether a male or a female is head of household are also important factors in assessing household poverty and related health status (Bigsten et al. 2002; Little et al. 2006).

Gender plays a significant role in access to land, household well being, and food aid receipts. On average, female-headed households tend to control less land and own less livestock, which may be a result of the patrilineal descent system practiced by the
Amhara people; cattle often pass from the father to the children, more specifically male children (Messing and Skoggard 1998; Carter et al. 2004). Thus female-headed households must rely on family members to help them farm (Frank 1999; Little et al. 2007). Although, one’s gender was found to be irrelevant to livestock growth it has been demonstrated that the gender of the head of household is the single most significant factor in predicting household poverty throughout Ethiopia (Bigsten et al. 2002; Carter et al. 2004). Yet resources controlled by women in developing nations are positively associated with better educational and nutritional outcomes, particularly for children (Quisumbing, 2003). Thus the World Food Program, a major contributor to food aid in Africa, now requires that 80% of food programs be targeted at women, allowing them to control any food receipts for the household (Quisumbing 2003).

Migration is an important response of many families to reduced rainfall and poverty in the drought prone rural areas of Ethiopia (Ezra and Kiros 2001). With no credit, many households have no choice but to send young males, and increasingly young females, out to work as day laborers for Government FFW programs, industry, or other farms in exchange for food, grain, or cash so that they can send earnings home (Ezra and Kiros 2001; Bekele 2006; Desalegn et al. 2006). Twenty-five percent of households in the Amhara region had one or more members of the family migrate during the dry season to work (Tefera 2004). This is often seen as a normal process in rural farm life, where chronic food shortages are common. But it is also reflective of community as well as individual vulnerability (Ezra and Kiros 2001). Other short-term coping mechanisms include credit services, past savings, sale of assets (i.e. livestock and their products), and off-farm activities such as charcoal and firewood production (Abule et al. 2005; Desalegn
et al. 2006). Still, five percent of farmers using rain-fed agriculture in the Rift Valley have not reported mechanisms for coping with drought (Makombe et al. 2007).

Ethiopia is a country characterized by paradox. Eighty-five percent of the population engages in subsistence farming, yet Ethiopia is the largest recipient of food aid in Africa. Ethiopia is abundant in water resources, but the people regularly experience drought conditions. As a result, drought mitigation and off-farm employment are becoming increasingly necessary for the well-being of farming households. These contradictions contribute to the economic disparity and poverty, and a subsequent decline in health status in the country, yet they are often the springboard for various development agencies and initiatives which are ongoing in Ethiopia. Still, many initiatives and development projects fail to incorporate a holistic approach to researching food and drought-related problems, leaving out the knowledge and perceptions of farmers and household members all together. The goal of this project is to examine food security in a more holistic framework, examining both social and biological aspects of the food security issue.
CHAPTER THREE: METHODS

This research was conducted in South Wollo—11°8'N 39°38'E (Fig. 3), a zone within the northern Amhara region of Ethiopia. South Wollo is often referred to as South Wello in both the literature and by the people indigenous to the area. Data were collected during May, June, and July of 2010. To aid in the collection of survey responses, data collectors who were proficient in written and oral English were selected for each of the three sections of the questionnaire: nutritional, agricultural, and economic. All data collectors were from the study area and familiar with the study population and culture of South Wollo. Before administering surveys, each data collector filed a research confidentiality agreement (see Appendix C) with the lead primary investigator. Site selection was conducted in late May 2010 with officials from both Addis Ababa University, in the capital city of Addis Ababa, and Wollo University, located in Dessie, Ethiopia, and with the data collecting team. Several Wollo faculty members have ongoing research projects which involve all of the communities in this study. Wollo University faculty and staff members conduct research in areas such as plant and animal science, soil and water resource management, veterinary medicine, environmental health, biology, chemistry, and statistics (See Appendix I). Their expertise in these varied disciplines, and ties to the study communities, made them extremely important collaborators for this project. Additionally several NGOs have a long established presence in the area (see Appendix I) and work with Wollo University to improve production and health, particularly the use of alternative crops and sanitation. NGOs are also responsible for many of the extension and health outreach programs in these areas, which influenced
many of the responses collected in the nutritional and agricultural sections of the questionnaire.

![Map of Administrative Zones in the Amhara Region](image)

**Figure 3. Map of Administrative Zones in the Amhara Region**

Note: Star indicates South Wollo Zone. Adapted from United Nations Office for the Coordination of Humanitarian Affairs (OCHA 2005)

Researchers assessed crop production techniques and possible differences in resources between villages. Study sites were selected based on several attributes of interest to the project: location near health services, presence of NGOs—particularly those associated with health and agriculture, differences in income levels, crops grown, altitude, topography, proximity to Wollo University, accessibility, and willingness of farmers to participate. In all, seven sites were selected for participation in the study.
Figure 4. Map of All Seven Study Sites in South Wollo

Locations are approximate and unofficial
Adapted from Google Maps
Study Site

All study sites were located in the Debub Wollo or South Wollo zone of the Amhara region in north central Ethiopia (Fig. 3, 4). There are several identified ethnic groups in Ethiopia of which Oromo is the most populous (Oromo, Amahra, Tigre, Somali, Sidama, Gurage, Wolaita, Afar, and the Southern ethnicities) (US State Department 2011). Ninety-eight percent of South Wollo's households self-identified as being of the Amhara ethnic group. The remaining two percent of regional citizens self-identified as Oromo or Tigray (CSA 1994). In South Wollo, there are comparable numbers of Muslim and Orthodox families; however, rural South Wollo is largely Muslim, comprising 73% of the population (CSA 1994). South Wollo is located in a semi-arid ecozone, characterized by a bimodal rainfall pattern (Fig. 5) (Assefa et al. 2008).

Figure 5. Long-term Average Annual Rainfall for Ethiopia (mm).

Note: Star indicates South Wollo Zone (approximate)
Adapted from UN Food and Agriculture Organization, Grasslands and Pasture Crops Group
This bimodal rainfall results in two growing seasons and a dry period (Rosell and Holmer 2007). The short rainy growing season is known locally as *belg* and lasts from approximately March to April or May (Rosell and Holmer 2007). The long rainy season is known as *meher* and lasts from July to September (Rosell and Holmer 2007). All villages utilize both rainy seasons for crop production, with the exception of one study village, Alasha, where farmers grow exclusively in the *belg* season. The *woredas*, or administrative districts visited, included Kutaber, Dessie Zuria (Zurya), and Tehuledere (Fig. 6). Sixty households were selected from both the highland and lowland areas. Fifteen households were selected from each of the highland villages (Boru Meda, Alasha, Gerado, and Agala) and 20 households were selected from each village in the lowlands (Hitacha, Amumo, Bishaniko) (Table 1).

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**Figure 6.** Study Site *Woredas*: Tehuledere, Kutaber, and Dessie Zuria

Adapted from United Nations Development Program Emergencies Unit for Ethiopia (UNDP-EUE 1996)
Site One

Woreda: Dessie Zuria; Kebele: 013; Boru: Boru Meda

Located 10 km from Dessie Town, and is one of the rural communities surrounding the small urban center (Table 1; Fig 4). All have been grouped together into the administrative district, Dessie Zuria. Although population numbers are available for Dessie Zuria as a whole, many of the individual villages are not represented in the data from the Central Statistics Agency of Ethiopia’s census (CSA 2007). Dessie Zuria has a total population of 157,679 as of 2007, all of which were classified as rural inhabitants. Boru Meda is located in the highlands of the Amhara region at 2500 meters above sea level, with an approximate annual rainfall of 1188mm (Rosell and Homer 2007). Farmers in Boru Meda grow mostly barley and maize during the short rainy season and add haricot beans (*Phaseolus vulgaris*) to the rotation during the longer rainy season (Table 1).

The Boru Meda Hospital is also located in the village. Originally established by missionaries from the United States for treatment of mental health patients, the hospital now serves both rural and urban Ethiopians in need of general health treatment. The hospital established chlorine-treated water sources and made vaccines readily available to rural families. There is also a leprosy treatment clinic in the village, hence a large and disproportionate number of leprosy patients live in Boru Meda. Most of the villagers reside on the steep slope off the main road from Dessie town to Kutaber. The flat plains that flood every July through October are reserved for cattle grazing, except during the *belg* season when they are used for barley and maize production. Additionally, the farmers of Boru Meda engage in a local insurance policy initially started by the
Government and non-governmental organization (NGOs) officials. Farmers pay into the insurance fund, and receive a payout from the fund to mitigate the cost of lost crops.

Site Two

**Woreda:** Kutaber; **Kebele:** 03; **Boru:** Alasha

Alasha, formerly a village within the Dessie Zuria district, is now part of the Kutaber woreda (Table 1; Fig. 4). This village is approximate 3 km from Kutaber town and approximately 10 km from Boru Meda. Like Boru Meda, village level population statistics are unavailable, but of the 95,410 residents of the Kutaber woreda, approximately 90,470 live in rural areas (CSA 2007). Alasha is the pinnacle of highland farming in this sample, at 2700 meters above sea level, and receives on average 1133 mm of rain annually (Rosell and Homer 2007). According to local development agents (interview with agent, June 14, 2010), the large flat areas located near the village are used as communal grazing lands and often owned and maintained by local farmers’ associations. Members rotate their livestock, mostly sheep and cattle, for grazing on these community plots. In addition to livestock, farmers produce barley and maize, primarily for household consumption, and almost exclusively during the **belg** season (Table 1). During interviews it was noted that a few alternative crops were being tested in small patches by a select number of farmers, e.g., potatoes, to determine which crops grow well in the colder region and can be stored for several months.

Site Three

**Woreda:** Dessie Zuria; **Kebele:** 015; **Boru:** Gerado

Gerado is located 3 km from the market south of Dessie town (Table 1; Fig 4). Gerado is also the closest of the Dessie Zuria villages to the market. Like Boru Meda,
community population statistics for this village are unavailable. Farmers here produce
during both growing seasons—belg and meher. Belg crops of choice include grains,
mostly wheat, barley, and maize, with some vegetable production (Table 1). The meher
season is used to grow teff and to a lesser extent wheat. Gerado is located at 2500 meters
above sea level and receives 1188 mm of rain annually (Rosell and Homer 2007). Many
families here are headed by females, something not seen in many of the other villages,
with the exception of Bishanako.

Site Four

Woreda: Dessie Zuria; Kebele: 016; Boru: Agala

Agala is located further into the mountain range and 3 km from market (Table 1; Fig. 4). Community population statistics are unavailable for this village. Agala is located
at 2500 meters above sea level and receives 1188 mm of rain annually (Rosell and Homer
2007). Agala grows during both the belg and meher seasons (Table 1). Maize and a
variety of Vicia (vetch) species are grown early in the year and followed up with teff,
wheat, and some beans. Vetch is a nitrogen-fixing crop used for animal fodder. Agala’s
household economics are characterized by low incomes and production output fails to
meet household needs (interview with Addis Ababa faculty May 29, 2010). In reaction to
low productivity in the area, NGOs have a highly visible presence and engage farmers in
agricultural activities such as the development and maintenance of community gardens,
nurseries, and the use of alternative crops.
Site Five

*Woreda:* Tehuledere; *Kebele:* 08; *Boru:* Hitacha

The *boru* of Hitacha has a population of approximately 3,800 (CSA 2007). Hitacha is located 8 km from the market (Table 1; Fig. 4). At 1900 meters above sea level, Hitacha was the first of the low/mid-land villages visited (Rosell and Homer 2007). This village receives approximately 1169 mm of rain (Table 1) annually and both growing seasons are dedicated to *teff* and wheat (Rosell and Homer 2007). Hitacha is also known throughout the region for its *khat* production, a highly lucrative and water intensive crop which often requires irrigation (Getahun and Krikorian, 1973). Hitacha’s location also provides the ideal market place for *khat*. The town is divided into two main parts by a major thoroughfare that carries traffic from Kombolcha in the southern region to Hyke in the northern part of the South Wollo. Hitacha’s location near a water bottling company and a small café have earned the village a reputation as a “truck stop.” The stop provides an opportunity for *khat* growers to sell their product to passengers traveling from towns, such as Hyke, in the south, to Dessie as taxis stop to buy supplies.

Site Six

*Woreda:* Tehuledere; *Kebele:* 08; *Boru:* Amumo

Amumo, located one kilometer south of Hitacha and on the same road is 8km from the market (Table 1; Fig. 4). Amumo’s population in 2007 was slightly higher than Hitacha at 4,000 citizens (CSA 2007). Amumo is 1900 meters (Table 1) above sea level and receives 1169mm of rain annually (Rosell and Homer 2007). Crop production in Amumo is much more diverse than other villages surveyed. Farmers in Amumo grow chickpea, *teff*, vetch, and wheat during the *belg* season, and another *teff* or wheat crop in
the *meher* season (interview with agent July 6, 2010). Much like Hitacha, Amumo engages in *khat* and fruit, specifically orange, production in addition to their grain products. Amumo has its own local grain mill to process crops.

**Site Seven**

*Woreda*: Tehuledere; *Kebele*: 09; *Boru*: Bishaniko

Bishanako is home to several “model” farmers and is located 1km from the market in Hyke, the major city of Tehuledere *woreda* (Table 1; Fig. 4). Model farmers obtain experimental seed from government agencies and use “government-approved” production techniques. In return they are compensated with plots of land and contemporary building materials for their homes (interview with agent July 11, 2010). Population statistics are unavailable for Bishaniko, and this may be due to its proximity to the “capital” of the *woreda*, Hyke. As with Hitacha and Amumo, Bishaniko is 1900 meters (Table 1) above sea level and receives 1169mm of rain annually (Rosell and Homer 2007). Farmers in Bishaniko grow crops very similar to Amumo. Chickpea, *teff*, vetch, and wheat dominate *belg* production whereas teff and wheat are preferred for the *meher* season. Because these farmers obtain experimental seed from Ethiopian Government agencies and use “government-approved” production techniques, they are often rewarded with plots of land and “mode” homes. One such farmer even had cable in his home. Farmers in Bishanako also engage in livestock production, mostly cattle, and take their animals to community fields for grazing.
TABLE 1: Village Agricultural and Economic Characteristics

<table>
<thead>
<tr>
<th>Woreda (district)</th>
<th>Boru (village)</th>
<th>Altitude (meters)</th>
<th>Households per Village</th>
<th>Belg Rainfall</th>
<th>Meher Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dessie Zuria</td>
<td>Boru Meda</td>
<td>Highland Alt. 2500</td>
<td>15</td>
<td>276mm</td>
<td>912mm</td>
</tr>
<tr>
<td>Kutaber</td>
<td>Alasha</td>
<td>Highland Alt. 2700</td>
<td>15</td>
<td>206mm</td>
<td>927mm</td>
</tr>
<tr>
<td>Dessie Zuria</td>
<td>Agala</td>
<td>Highland Alt. 2500</td>
<td>15</td>
<td>276mm</td>
<td>912mm</td>
</tr>
<tr>
<td>Dessie Zuria</td>
<td>Gerado</td>
<td>Highland Alt. 2500</td>
<td>15</td>
<td>276mm</td>
<td>912mm</td>
</tr>
<tr>
<td>Tehuledere</td>
<td>Hitacha</td>
<td>Lowland Alt. 1900</td>
<td>20</td>
<td>341mm</td>
<td>828mm</td>
</tr>
<tr>
<td>Tehuledere</td>
<td>Amumo</td>
<td>Lowland Alt. 1900</td>
<td>20</td>
<td>341mm</td>
<td>828mm</td>
</tr>
<tr>
<td>Tehuledere</td>
<td>Bishanako</td>
<td>Lowland Alt. 1900</td>
<td>20</td>
<td>341mm</td>
<td>828mm</td>
</tr>
</tbody>
</table>

Literature

The literature review was conducted over a period of nine months and recent publications were emphasized, i.e. articles published in the past ten years. Key words such as development, agriculture, food aid, USAID, development in Ethiopia, South Wollo, conservation, resources, and nutrition were used. The literature could be categorized into four topical areas: (1) Nutrition and Health (2) Food security and food aid, (3) Natural Resources, Conservation, and Agriculture, and (4) Economic, social, and political issues. Most relevant information was obtained from nutrition, health, and agricultural journals, but also grey literature. *Irrigation & Drainage Systems, Africa Development*, and *Public Health Nutrition* were major sources of information for the project’s background. Several briefs from governmental development agencies such as
the United States Agency for International Development (USAID) and the United Kingdom’s Department for International Development (DFID) provided a substantial amount of information on social and development issues concerning Ethiopia.

Internal Review Board and Collaborative Institutional Training Initiative

To insure compliance with University of Nebraska-Lincoln (UNL) research policies and the federally-mandated ethical treatment of research subjects, Institutional Review Board (IRB) approval was obtained and the online Collaborative Institutional Training Initiative (CITI) was completed. The IRB, which works to insure the ethical treatment of human research participants, requires all projects and research involving human subjects to submit proposals for approval. Documentation that indicated procedures for research administration included a confidentiality agreement (see Appendix C) for individuals who may be involved in the research process but are exempt from undergoing the CITI training. In the case of this project, confidentiality agreements were obtained from all data collectors and translators. Additionally, informed consent and parental informed consent forms (see Appendix A, B) were constructed as per the requirements of the Human Research Protections Program Policies (HRPPP) 9.001, 9.002, and 5.004 (HRPPP 2008). Lastly, it was established as per the UNL’s HRPPP 5.004 that the research project would not expose children to risk beyond the scope of a routine physical or psychological exam (HRPPP 2008). As per the IRB requirements for approval, the lead primary investigators underwent CITI training, also hosted by the University of Nebraska-Lincoln’s Office of Research and Economic Development. IRB approval was granted 25 March 2010. Project ID: 10613. Approval number: 20100310613EP.
Obtaining Local Permission:

Due to political tensions that arose during the national election which was held a few weeks prior to data collection, it was imperative to obtain permission from local officials before conducting the study. Wollo University representatives, data collectors, and the lead primary investigator met with local agricultural officials in each of the three woredas: Dessie Zuria, Kutaber, and Tehuledere. A copy of the survey instrument and a comprehensive list of measurements were provided to each agricultural office and assurances were made that all data and analyses resulting from the study would be provided to their offices upon completion.

Appointments were made for data collection to ensure the presence of development agents at each of the villages. Development agents aided in organizing families to be measured and interviewed and acted as guides. In most cases, due to the hierarchical system of many of the farmers’ associations, development agents organized the households prior to the researchers’ visit. Many farmers refused to participate if not given direct consent from development agents or another agricultural officer. Development agents were pivotal in developing good rapport with the participating community and often provided insight into certain contextual situations which may influence data collection and survey responses.

Data Collection and Field Experiences:

Interviews were conducted in Amharic (or Amharingna), the native language of people from the Amhara region (Central Statistical Agency 1994). Five households were interviewed each day and translations were completed. All translated material was reviewed by the primary investigator before data coding was conducted. A household was
considered to be a group of individuals residing in the same home. Often this included extended family members (i.e., uncles, grandparents, nieces, nephews, and grandchildren). In several cases individuals who may not necessarily be a part of the household were introduced into the study as a result of their presence at the time of data collection. For example, servants are not necessarily biologically related to the household but were included in the anthropometric measurements if they lived within the household full-time during the study period. Informed consent was obtained from each adult in the household after the agreement was orally presented by a translator. Parental informed consent was also obtained for each child in the household after the agreement was orally presented to the parent, guardian, or caretaker of the children participating in the study. Gender of head of household was determined by the individual in control of family resources. Female-headed households were those households where the husband or father had died, left the marriage, or was disabled and no longer able to make decisions regarding family resources. Male-headed households were those households where the father or husband controlled family resources.

Sample randomization, although ideal, was not possible in this study. Other, similar studies have grappled with this issue and resulting techniques are varied. For example, farmers have been selected randomly in a given district regardless of village or income, a given number of households has been selected based on ranges of income (poor, middle, and better off), convenience samples have targeted schools, accessibility samples have been used, and even bottle spinning has been employed (Tefera 2004; Little et al. 2006; Wamani et al. 2006; Assefa 2008; Hall et al. 2008). In this study, samples were stratified according to geographic region; 60 households were selected in a high
altitude region and 60 households were chosen from a middle/lowland region. The sample was then stratified according to village, or boru. In the highland region, four borus were selected, Boru Meda, Alasha, Agala, and Gerado. Another three borus were selected in the middle/lowland region, Hitacha, Amumo, and Bishanako. Each boru is known for various production types and income levels. Within each boru, villagers were randomly selected by development agents. The employed method of stratification provides samples from the major economic and production types—short and long rainy season, irrigated and rain-fed, cereals versus cash crops, and highland and mid/low-land.

Quantitative Assessment:

Anthropometric measurements provide a straightforward, non-invasive snapshot of a population’s nutritional status (Food and Agriculture Organization, 1996). Thus height and weight of all participants were taken using the Seca model 217 stadiometer which has a range of 20-205 centimeters and a standard mechanical bathroom scale with a 270 pound maximum in one pound increments, respectively (Table 2). Participants were asked to remove shoes and head scarves for the height measurements. Standard research protocol (see Appendix D) was followed for all cases with the exception of infants who were weighed with their mothers. The mother’s weight was then subtracted from the total combined weight for infant and mother combined. Mid-upper arm circumference (MUAC) and arm span were taken using a tactile measuring tape with increments in both inches and centimeters (Table 2). Skin folds at the triceps and biceps were taken using a Lange skin fold caliper (Table 2). Skin folds were taken of triceps and biceps and only on children under the age of 19. Skin-fold measurements on the back and thigh, particularly for adult participants were restricted as participants were
uncomfortable with exposing those areas of their body. All measures were taken to the nearest centimeter, pound, or millimeter. During the pilot study all measurements were taken twice and an average for each set was recorded. With no difference between the two measurements, the accuracy of the equipment and the procedure was established.

Some individuals in households were unable to be measured due to issues such as absences, handicap, or age.

**TABLE 2: Equipment Characteristics and Sources**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Range</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seca 217 Stadiometer</td>
<td>20-205 cm</td>
<td>Health Check Systems (USA)</td>
</tr>
<tr>
<td>Standard Bathroom Mechanical Scale</td>
<td>0-270 lbs</td>
<td>Health Check Systems (USA)</td>
</tr>
<tr>
<td>Lange Skin Fold Caliper</td>
<td>0-60 mm</td>
<td>Balego &amp; Associates, Inc. (USA)</td>
</tr>
<tr>
<td>Tactile Tape Measure</td>
<td>0-152 cm</td>
<td>Magnifying Aids (USA)</td>
</tr>
</tbody>
</table>

De Lucia et al. (2002) classified participants by ethnic group. However, the homogeneity in responses regarding ethnicity during the pilot study made this difficult.

Most studies incorporate equipment calibration in the field as well (De Lucia et al. 2002) However, this study, due to its short duration and the simplicity of field equipment, did not require re-calibration procedures. The mechanical scale was repaired once while in the field and was subsequently checked for accuracy with the help of a local pharmacy.

BMI and weight for height are common assessments in studies of food security as they tend to be better indicators of recent food shortages and malnutrition as opposed to
indicators of chronic malnutrition (Magkos, 2004). This study focused primarily on BMI. Weight-for-age and height-for-age scatter plots were calculated for children ages five and under. Body mass index, a measure of weight for height, and an indicator of wasting, was calculated in Microsoft Excel using the following equation:

\[
\text{BMI} = \frac{\text{WEIGHT IN POUNDS} \times 703}{\text{HEIGHT IN INCHES} \times \text{HEIGHT IN INCHES}}
\]

Height in centimeters was converted to inches using the conversion rate of: 1 in = 2.5 cm

**Qualitative Assessment:**

Changes were made to the questionnaire based on input from Wollo University faculty working in the target areas, data collectors’ previous experiences, and information gathered from development agents to ensure that questions were relevant and culturally appropriate. The survey was conducted by means of a structured questionnaire (see Appendix E) during May, June, and July of 2010. The questionnaire survey covered three core areas, nutrition, agriculture, and economics and was a compilation of information from several surveys used by previous authors, but also topics not addressed in the literature. The questionnaire was designed to take approximate forty-five minutes total, an amount of time Tefera (2004) noted as typical in similar studies. The questionnaire was administered in most cases to participants inside the home or home compound. However, as villages became more dispersed it was more efficient to bring families to a central location where participants could be interviewed. All participants were compensated for their time, with a gift of approximately $2 USD.
**Questionnaire Section: Nutritional**

The nutrition portion of the questionnaire (see Appendix E) targeted females as they were most likely to be aware of the various health conditions of the family. The questionnaire also incorporated information on food preparation and food storage as these are responsibilities that often fall upon the eldest female in the home. A female data collector was selected to collect responses for this particular portion of the questionnaire so that female participants were more comfortable and more likely to participate. If the female head of household was absent or unable to participate in the study due to illness, the male head of household or eldest female, if appropriate, was asked to respond to the nutritional questionnaire.

A form of 24-hour recall was used to study nutrient intake (Ulyaszek 2004). According to Ulyaszek (2004) an estimated food record is a “[r]ecord of all food and beverages as eaten … over periods from one to seven days (p.122)” at which point the food is then converted to nutrients. This study was less concerned with the specific nutrients in the diet and more concerned with content intake of calories (i.e. meat, injera, bread, grains, and vegetables). Additionally, an important indicator of household welfare, according to Little et al. (2006), is food stocks; particularly the estimated number of months of food for household consumption, thus this element was also incorporated into the nutrition questionnaire.

The United States Department of Agriculture’s (USDA) Household Food Security Scale was used to assess household food security. Because there is no international standard, this scale is sufficient for addressing broad food security issues (Blaney 2008). These guidelines allow researchers to tailor questions to their local community and
provide flexibility in responses from participants. The following scales are those measures deemed appropriate for the study population:

1. Perceptions by the respondent that the food eaten by household members was inadequate in quality or quantity [Bickel et al. 2000:8]

2. Adjustments to normal food use, substituting fewer and cheaper foods than usual [Bickel et al. 2000:8]

3. Instances of reduced food intake by adults in the household, or consequences of reduced intake such as the physical sensation of hunger or loss of weight [Bickel et al. 2000:8]

In addition to questions concerning food and food security, the nutrition questionnaire included questions about immunizations, general illnesses affecting the family at the time of the interview, and questions about the use of Western medicine versus traditional healers. Many have found this latter issue to be extremely relevant to type and extent of healthcare access, Wollo University faculty among them (Addis et al. 2002). Although the effects of diarrhea, measles, respiratory issues, iron deficiencies, and parasites, including malaria, were not included in this questionnaire these conditions were independently self-reported by respondents (Salama et al. 2001; Hall et al. 2008; Wander et al. 2008). Wander et al. (2008) also notes that many of these conditions, namely iron deficiencies, can be compounded by other factors, particularly diarrhea. Lastly, the data collectors asked respondents about involvement in various religious, social, and governmental organizations, following Bogale and Korf (2009).
Questionnaire Section: Agriculture

Both the economic and agricultural portions of the questionnaire were given to heads of household, male or female, or the oldest present male. To determine household welfare, asset ownership has been determined to be a better predictor than estimated income (Little et al. 2006). Additionally, the agricultural questionnaire includes average landholdings, income spent on livestock, irrigation, pest management, seed and fertilizer use, and a variety of conservation practices which many studies have focused on independently (Tefera 2004; Little et al. 2006; Assefa 2008; Bogale and Korf 2009). Because seed distribution has been demonstrated to be an important means of building social capital, farmers were asked from where they secured their seed stock (McGuire 2008).

Questionnaire Section: Economic

The economic section of the questionnaire included other forms of income, including wage labor, cash crops, sale of livestock, and remittances (Little et al. 2004; Bogale and Korf 2009). Some studies have relied on a household's ability or inability to purchase a “basket” of goods and supplies that represent the cost of a typical household's needs as a method to measure household well-being (Bogale and Korf 2009). Because this methodology fails to account for livelihood needs such as veterinary and medical costs, it was not employed in this study.

Wollo faculty made a considerable contribution to the elements of the economic questionnaire by providing insight into the costs associated with various religious holidays and subsequent financial obligations for community feasts. Tesfaye et al. (2008) noted that the distance farmers had to travel to market also played an important role in
household poverty and income. Thus this issue was accounted for in the questionnaire. Lastly, as a major objective of this study, questions to determine the types of development programs available and those perceived as needed were incorporated.

Analysis:

Data were entered into a Microsoft Excel spreadsheet and labels were given to each variable in the data set (see Appendix F). The master excel sheet was then imported into SPSS Statistics 17.0. Descriptive statistics were calculated for all quantitative and most qualitative variables. Additionally, non-parametric analyses were used to determine significance of variation in several qualitative variables. Mixed Model and Linear Regression analyses were run in SPSS to test the significance and weight of the influence of qualitative variables on BMI for the household or other important social factors, such as household food stores, and use of irrigation. Mixed Model analysis accounted for factors related to sampling technique. Following Wamani et al. (2006) analysis included examining height-for-age and weight-or-age, indicators of stunting and being underweight respectively.
CHAPTER FOUR: RESULTS

In this section, anthropometric and questionnaire results are organized into five groups. The first four groups correspond to the anthropometric and questionnaire foci discussed in methods; (1) anthropometrics and household demographics, (2) nutrition and health, (3) food security and food aid issues, and finally (4) agriculture and economics. The concluding section is a combined analysis of the above-mentioned qualitative factors on nutritional status as measured through body mass index (BMI). WHO standards were used for comparative purposes, as they offer the most comprehensive selection of international data on BMI (Table #), height-for-weight, and weight-for-age.

**TABLE 3: The World Health Organization’s International Classification of Adult BMI Values**

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (Principle Cut-Off Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.50</td>
</tr>
<tr>
<td></td>
<td>&lt;16.00</td>
</tr>
<tr>
<td>Moderate Thinness</td>
<td>16.00-16.99</td>
</tr>
<tr>
<td>Severe Thinness</td>
<td>&lt;16.00</td>
</tr>
<tr>
<td>Mild Thinness</td>
<td>17.00-18.49</td>
</tr>
<tr>
<td>Normal Range</td>
<td>18.50-24.99</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥25.00</td>
</tr>
</tbody>
</table>

Note: Adapted from the World Health Organization International Classification 2010 (WHO 2010)

**Anthropometric and Household Demographics**

As a measure of household and individual well-being, height, weight, and arm span measurements were taken. Subsequently, height and weight were then used to calculate BMI for each study participant. Figure 7 depicts the percentages of severe, moderate, and mild thinness, as well as the percentage of normal BMI values, for all adult
males (n=98) (Fig. 7a) and adult females (n=122) (Fig. 7b) in this study. Fifteen percent of adult males, 15 male respondents in total, have BMI values classified as ‘normal’ by the WHO international standard, compared to only 9% of female participants, 11 in total. By contrast, most adults in the study sample fall into the severely thin category. Forty-five percent of males, or 44 respondents, and 63% of females, or 77 respondents, can be described as severely thin. As figure 7a and 7b illustrate, there are clear differences in BMI values by sex. At an individual level, males, on average, are less likely to fall within the severe to moderately thin categories (64%), whereas females are more likely to be thin or moderately so (77%). However, fewer females fall within the mildly thin category.

![Figure 7a: Percentage of Males in Each WHO International Body Mass Index Category](image)

![Figure 7b: Percentage of Females in Each WHO International Body Mass Index Category](image)

Figure 7: Percentage of Males (7a) and Females (7b) in Each WHO International Body Mass Index Category

In this study it was also important to determine difference in nutritional status by village. The descriptive statistics for male and female body weight, height, arm span, and BMI by village are summarized in Table 4. Arm span was a difficult measure to take for some, usually due to a physical handicap. As such, sample size values are listed for males and females in each village (Table 4). Males in Agala and females in Alasha have the
highest mean body weights at 48.99 kilograms and 41.68 kilograms, respectively. Also, these same men and women have the highest BMIs (Table 4). Males from Amumo and females from Bishaniko have the lowest overall body weights; 43.35 kilograms for males and 37.41 kilograms for females. They also have the smallest BMI values at 15.09 and 15.66 in the severe thinness category respectively (Table 4).

**TABLE 4: Means and Standard Deviations for Adult Males and Females of each Body Measurement by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Weight (kg)</th>
<th>Height (cm)</th>
<th>Arm span (cm)</th>
<th>BMI†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Boru Meda</td>
<td>44.50</td>
<td>41.11</td>
<td>165.60</td>
<td>155.25</td>
</tr>
<tr>
<td>(6.19)</td>
<td>(6.51)</td>
<td>(11.16)</td>
<td>(6.86)</td>
<td>(9.66)</td>
</tr>
<tr>
<td>Alasha</td>
<td>47.94</td>
<td>41.68</td>
<td>168.62</td>
<td>155.06</td>
</tr>
<tr>
<td>(5.98)</td>
<td>(6.24)</td>
<td>(7.24)</td>
<td>(6.75)</td>
<td>(8.55)</td>
</tr>
<tr>
<td>Gerado</td>
<td>44.75</td>
<td>40.75</td>
<td>166.38</td>
<td>156.25</td>
</tr>
<tr>
<td>(5.29)</td>
<td>(5.02)</td>
<td>(7.32)</td>
<td>(4.51)</td>
<td>(9.61)</td>
</tr>
<tr>
<td>Agala</td>
<td>48.99</td>
<td>41.45</td>
<td>166.86</td>
<td>159.91</td>
</tr>
<tr>
<td>(7.77)</td>
<td>(5.67)</td>
<td>(5.17)</td>
<td>(9.31)</td>
<td>(6.91)</td>
</tr>
<tr>
<td>Hitach</td>
<td>44.91</td>
<td>40.13</td>
<td>169.03</td>
<td>157.76</td>
</tr>
<tr>
<td>(4.20)</td>
<td>(6.15)</td>
<td>(4.22)</td>
<td>(6.21)</td>
<td>(5.37)</td>
</tr>
<tr>
<td>Amumo</td>
<td>43.35</td>
<td>39.94</td>
<td>169.42</td>
<td>155.95</td>
</tr>
<tr>
<td>(4.06)</td>
<td>(5.37)</td>
<td>(5.39)</td>
<td>(4.93)</td>
<td>(7.18)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>44.86</td>
<td><strong>37.41</strong></td>
<td>170.30</td>
<td><strong>154.47</strong></td>
</tr>
<tr>
<td>(5.74)</td>
<td>(5.03)</td>
<td>(6.55)</td>
<td>(4.59)</td>
<td>(6.64)</td>
</tr>
</tbody>
</table>

Notes: Nm = sample size for males; Nf = samples size for females

*Bolded* terms indicate highest values;

*Iitalicized* terms indicate lowest values;

Numbers in parentheses are standard deviations

† Average for all individuals within a village aged 18 or older
The tallest males are from Bishaniko, 170.30 centimeters on average in height, while the tallest women are from Agala where they average, 159.91 centimeters (Table 4). Males from Boru Meda and females from Bishaniko were the shortest in stature at 165.60 centimeters and 154.47 centimeters respectively (Table 4).

The greatest arm span lengths were found among males from Alasha, 181.90 cm and females from Hitacha, 167.13 cm. By contrast, shorter average arm span lengths were found in males from Boru Meda, 171.39 cm, and females from Gerado, 154.80 cm. It was only in females from Gerado where arm span length exceeded height (Table 4). In all other cases, one’s height is typically XX cm longer than one’s arm span (Table 4). For two villages, height and arm span were nearly equal for both men and women.

BMI values for all participants in all villages fall within the underweight category. Males from Hitacha, Amumo, and Bishaniko, and only females from Bishaniko fall under the severe thinness classification, whereas all other groups fall in the moderately thin category (Table 3). There is also major difference in BMI between men and women. In all villages except Agala, females have higher average BMI values than men. This result contrasts with the overall analysis for men, which shows them as being less likely to fall within the severe to moderately thin categories (Table 3, Fig. 7a). In addition to gender, age had a considerable impact on BMI values. The difference in BMI by gender and across age cohorts is presented in Table 5. Although females tend to have higher BMI values than men as adults, this is not the case with children (Table 5). Until puberty, males, on average, tend to have higher BMI values (Table 5).
TABLE 5: Male and Female Body Mass Index by Age Cohorts

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>11.92 (N=29)</td>
<td>12.43 (N=32)</td>
</tr>
<tr>
<td>6-11</td>
<td>11.83 (N=50)</td>
<td>12.30 (N=41)</td>
</tr>
<tr>
<td>12-17</td>
<td>13.49 (N=21)</td>
<td>13.42 (N=24)</td>
</tr>
<tr>
<td>18+</td>
<td>16.47 (N=122)</td>
<td>16.09 (N=98)</td>
</tr>
<tr>
<td>Unknown</td>
<td>16.99 (N=11)</td>
<td>16.63 (N=5)</td>
</tr>
</tbody>
</table>

Note: Bolded terms indicate age of transition
Normal WHO BMI = 18.50-24.00

But between the ages of 12 and 17, male and female BMI values tend to be relatively equal. BMI values for the 0-5 age cohort were compared to data collected for similar areas by WHO; 38% of girls and 48% of boys from 0-5 years fell below the 3rd percentile for WHO estimates of height-for-age (see Appendix G). In addition, 91% of girls and 81% of boys were below the 3rd percentile for WHO estimates of weight-for-age in the 0 to 5 year old age category (see Appendix F).

Household BMI was the measure used in this study to represent overall household well-being. Household BMI was calculated by summing the BMI values of all individuals measured in the household and then dividing that sum by the total number of individuals measured. Household BMI allowed the researcher to account for both adult and child BMI values. The differences between adult and child BMI values are outlined in Table 5, while values in Table 6 demonstrate the impact children have on household BMI scores. The minimum and maximum BMI values for each village, and the standard deviation of those values, are also listed in Table 6.
Minimum values for each village are well below the normal BMI range as categorized by WHO; however there are two villages, Agala (17.57) and Hitacha (15.98) where even the maximum value for household BMI is below normal (Table 6). This is most likely due to the low BMI values for children living within each of these villages. Although Amumo had the highest maximum value for household BMI, Boru Meda had the highest average household BMI at 16.29 and Hitacha had the lowest such value at 13.99. All of the villages had an average household BMI that falls within the category of severely thin. All household BMI values are much lower than those values recorded as average for adults by village (Table 4). This reflects the distinct differences in adult and child BMI values.

Other important demographic information included the number of females and males residing in the home. This has implications for the completion of household duties, production capabilities, and household wealth. Descriptive statistics for the total number of males and females in the household for each village are recorded in Table 7. The
number of females ranges from one to seven, whereas average number of males ranges from zero to six (Table 7). Thus the average number of males and females are relatively comparable in all villages with the exception of Bishaniko (Table 7). Agala and Amumo have the largest percentage of females per household and Alasha the lowest number of female household members. Amumo also has the largest percentage of males per household. By contrast, Bishaniko, where almost half of the households are headed by females, has the smallest average number of males.

**TABLE 7: Means and Standard Deviations for Females and Males per Household by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Females in the Household</th>
<th>Males in the Household</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Boru Meda</td>
<td>2.53 (1.30)</td>
<td>1-6</td>
</tr>
<tr>
<td>Alasha</td>
<td>2.40 (1.06)</td>
<td>1-5</td>
</tr>
<tr>
<td>Gerado</td>
<td>2.67 (1.23)</td>
<td>1-5</td>
</tr>
<tr>
<td>Agala</td>
<td>2.80 (1.32)</td>
<td>1-5</td>
</tr>
<tr>
<td>Hitacha</td>
<td>2.60 (1.50)</td>
<td>1-7</td>
</tr>
<tr>
<td>Amumo</td>
<td>2.80 (1.11)</td>
<td>1-5</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>2.45 (1.39)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values
*Italicized* terms indicate lowest value

Descriptive statistics for household size, age of household size and economic ratio for all households by village are available in Table 8. Average household size ranges from 5.35 in Amumo, to 4.93 in Boru Meda and Alasha (Table 8). Boru Meda also has the oldest average age for the head of household, at 62.33 years. This of course has
implications for the amount of farming experience available to the household and the productivity which can be expected. Hitacha, with an average age for the household head of 34.90, has the youngest such age for an individual in this position. Ranges for age of household head vary greatly across villages, but the three largest ranges are found in the villages of Alasha, Bishaniko, and Boru Meda, where all of those who head the household are in excess of 50 years of age. These villages also happen to have the oldest heads of household as well.

**Table 8:** Descriptive Statistics for Household Size, Age of Household Head, and Economic Ratio for All Households by Village

<table>
<thead>
<tr>
<th>Village</th>
<th>N</th>
<th>Household Size Mean (SD)</th>
<th>Min Max</th>
<th>Head of Household Age Mean (SD)</th>
<th>Min Max</th>
<th>Economic Ratio Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>15</td>
<td>4.93 (2.28)</td>
<td>1-9</td>
<td>62.33 (19.83)</td>
<td>32-87</td>
<td>0.37 (0.23)</td>
</tr>
<tr>
<td>Alasha</td>
<td>15</td>
<td>4.93 (1.83)</td>
<td>2-8</td>
<td>49.27 (17.60)</td>
<td>26-95</td>
<td>0.56 (0.22)</td>
</tr>
<tr>
<td>Gerado</td>
<td>15</td>
<td>5.00 (1.36)</td>
<td>3-8</td>
<td>40.87 (6.77)</td>
<td>30-52</td>
<td>0.54 (0.16)</td>
</tr>
<tr>
<td>Agala</td>
<td>15</td>
<td>5.33 (1.54)</td>
<td>3-9</td>
<td>45.60 (13.08)</td>
<td>30-67</td>
<td>0.48 (0.14)</td>
</tr>
<tr>
<td>Hitacha</td>
<td>20</td>
<td>5.10 (1.94)</td>
<td>2-9</td>
<td><strong>34.90</strong> (6.71)</td>
<td>24-45</td>
<td>0.49 (0.16)</td>
</tr>
<tr>
<td>Amumo</td>
<td>20</td>
<td>5.35 (1.76)</td>
<td>2-8</td>
<td>48.80 (11.85)</td>
<td>35-74</td>
<td>0.64 (0.22)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>20</td>
<td><strong>4.25 (2.15)</strong></td>
<td>1-9</td>
<td>50.85 (18.77)</td>
<td>25-85</td>
<td>0.62 (0.28)</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values

*Italicized* terms indicate lowest value

Economic ratio, which is calculated by dividing the number of economically active household members (aged 15-65) by the total number of individuals in the
household, is similar to consumer-producer ratios used in other studies. Values for household economic ratios ranged from 0.37 in Boru Meda to 0.64 in Hitacha An economic ratio of 0.50 would mean there are equal number of economically active (aged 15-65) or producers and economically inactive (<15, >65) or consumers in the household. A high economic ratio means the household is able to take advantage of economic resources, such as off-farm employment, more successfully than a household with a low economic ratio.

A second set of descriptive statistics for household size, age of household head, and economic ratio are summarized in Table 9. This set of statistics reflects multi-person households only. Individuals living alone are generally older and can skew data, particularly for average age of head of household and average household economic ratio. The analysis demonstrates that the only two villages where changes occurred in household size, average age of household head, and economic ratio were Boru Meda and Bishaniko (Table 9). In Boru Meda, the average household size increased from 4.93 persons per household to 5.54 (Table 8 and 9). This means that when controlling for single member households, who tend to be older individuals living alone, Boru Meda has the largest family size. Boru Meda, in this analysis, shows a decrease in average age of household head from 62.33 to 59.61, again because single member households tend to be occupied by older individuals. However, Boru Meda still remained the village with the oldest head of household. Economic ratio in Boru Meda also increased, from 0.37 to 0.43, however it still had the smallest value for economic ratio when compared to the other six villages. Similar trends were found in Bishaniko, but the changes were much
less noticeable and did not drastically affect Bishaniko's ranking in any category summarized in Table 8.

**TABLE 9: Means and Standard Deviations for Household Size, Age of Household Head, and Economic Ratio in Multi-Person Households by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>N</th>
<th>Household Size</th>
<th>Head of Household Age</th>
<th>Economic Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Range</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Boru Meda</td>
<td>13</td>
<td>5.54 (1.76)</td>
<td>3-9</td>
<td>59.61 (19.97)</td>
</tr>
<tr>
<td>Alasha</td>
<td>15</td>
<td>4.93 (1.83)</td>
<td>2-8</td>
<td>49.27 (17.60)</td>
</tr>
<tr>
<td>Gerado</td>
<td>15</td>
<td>5.00 (1.36)</td>
<td>3-8</td>
<td>40.87 (6.77)</td>
</tr>
<tr>
<td>Agala</td>
<td>15</td>
<td>5.33 (1.54)</td>
<td>3-9</td>
<td>45.60 (13.08)</td>
</tr>
<tr>
<td>Hitacha</td>
<td>20</td>
<td>5.10 (1.94)</td>
<td>2-9</td>
<td>34.90 (6.71)</td>
</tr>
<tr>
<td>Amumo</td>
<td>20</td>
<td>5.35 (1.76)</td>
<td>2-8</td>
<td>48.80 (11.85)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>18</td>
<td>4.61 (1.94)</td>
<td>2-9</td>
<td>50.33 (18.73)</td>
</tr>
</tbody>
</table>

**Notes:** **Bolded** terms indicate the highest values
*Italicized* terms indicate lowest value

The percent of male versus female-headed households, Muslim versus Orthodox households, as well as rates of participation in governmental organizations and social or religious organizations by village are summarized in Table 10. These variables are essential to understanding the household access to resources, but also to understanding livestock ownership in the case of sex of the head of household. They are also indicators of resource stress, e.g. obligations to sponsor religious festivals associated with Muslim holidays.

Agala and Hitacha have the fewest number of female-headed households; they each possess a single such household. By contrast, 45% of households in Bishaniko are headed by a female (Table 10). Overwhelmingly the study population self-identified as Muslim.
Only five of the 120 households identified themselves as Orthodox (Christian) and these households were concentrated in the lowlands. There were three in Agala, and one each in the villages of Amumo and Bishaniko.

**TABLE 10: Percentage of Households in Selected Social Categories**

<table>
<thead>
<tr>
<th>Village</th>
<th>Sex of Household Head</th>
<th>Religion</th>
<th>Participation in Government</th>
<th>Participation in Social/Religious</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (%)</td>
<td>Female (%)</td>
<td>Muslim (%)</td>
<td>Orthodox (%)</td>
</tr>
<tr>
<td>Boru Meda (15)</td>
<td>11</td>
<td>4</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Meda</td>
<td>(73)</td>
<td>(27)</td>
<td>(100)</td>
<td>(0)</td>
</tr>
<tr>
<td>Alasha</td>
<td>13</td>
<td>2</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>(15)</td>
<td>(87)</td>
<td>(13)</td>
<td>(100)</td>
<td>(0)</td>
</tr>
<tr>
<td>Gerado</td>
<td>12</td>
<td>3</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>(15)</td>
<td>(80)</td>
<td>(20)</td>
<td>(100)</td>
<td>(0)</td>
</tr>
<tr>
<td>Agala</td>
<td>14</td>
<td>1</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>(15)</td>
<td>(93)</td>
<td>(7)</td>
<td>(80)</td>
<td>(20)</td>
</tr>
<tr>
<td>Hitacha</td>
<td>19</td>
<td>1</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>(20)</td>
<td>(95)</td>
<td>(5)</td>
<td>(100)</td>
<td>(0)</td>
</tr>
<tr>
<td>Amumo</td>
<td>17</td>
<td>3</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>(20)</td>
<td>(85)</td>
<td>(15)</td>
<td>(95)</td>
<td>(5)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>11</td>
<td>9</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>(20)</td>
<td>(55)</td>
<td>(45)</td>
<td>(95)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

**Notes:** Bolded terms indicate highest value
*Italicized* terms indicate significant pattern.

Rates of participation in governmental organizations, namely the farmers’ association, were similar for each village, with the exception of Boru Meda. In Boru Meda, there was a relatively even distribution of those households who participated in the farmer’s association versus those households who did not participate in a governmental organization. The lowland villages, Hitacha, Amumo, and Bishaniko, each had two households who reported that they do not participate in governmental organizations (Table 10). Households who reported not participating in the local farmers’ association
often claimed that age or disability was the reason for their lack of participation. Only four households in the entire sample of households reported not participating in religious or social organizations. Again these households tended to be concentrated in the lowlands and in the village of Boru Meda.

Health and Nutrition

During the nutritional portion of the survey respondents were asked to describe their current health status. Respondents were asked to self-identify as being healthy, okay, or not healthy. Additionally, respondents were asked to indicate if they had been visited by a health worker recently. The results of the perceptions which each respondent held of their own health status are presented in Table 11.

**TABLE 11: Perceptions of Self Health Status and Health Worker Visits by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Self-Reported Health Status (%)</th>
<th>Visits by Health Worker (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Healthy</td>
<td>Okay</td>
</tr>
<tr>
<td>Boru Meda</td>
<td>0.0</td>
<td>66.7</td>
</tr>
<tr>
<td>Alasha</td>
<td>0.0</td>
<td>73.3</td>
</tr>
<tr>
<td>Gerado</td>
<td>0.0</td>
<td>66.7</td>
</tr>
<tr>
<td>Agala</td>
<td>0.0</td>
<td>60.0</td>
</tr>
<tr>
<td>Hitacha</td>
<td>10.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Amumo</td>
<td>0.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>0.0</td>
<td>55.0</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values. *Italicized* terms indicate lowest value.

Less than 2% of all respondents in all villages self-identified as healthy and all of these lived within the village of Hitacha (Table 11). A majority of households, 69%, self-identified as okay, with the remaining 29% of respondents self-identifying as not healthy. The largest concentrations of respondents reporting that they were not healthy were found
in the villages of Bishaniko, Boru Meda, and Alasha. The latter two were also the only villages to experience some irregularities in health workers’ visits. Thirty-three percent of households in Boru Meda and 13% of households in Alasha reported that they had not been visited by a health worker at any time (Table 11). In the remaining villages, all households reported having been visited by a health worker in the last year.

Though several health concerns were reportedly addressed by healthcare workers in each village, many of them were village-specific concerns. The top four to six health concerns for each village are listed in Table 12. Three health-related issues that were common to most villages and included environmental sanitation, pit latrines, and basic health services (see bolded concerns listed in Table 12). Pit latrines were a topic rated among the top five responses for all villages. Personal hygiene, HIV/AIDS, common or communal disease, and food and water sanitation were other common topics addressed by many of the health workers in the communities interviewed. Three additional health concerns, vision and eye problems, heart disease and related problems, and headache, were the most mentioned health issues facing participants and their families in all villages. Malaria was only rated among the top concerns in the mid/lowland villages, whereas gastric and stomach issues, typhoid, typhus, tuberculosis (TB), and HIV were common concerns for most rural families in this sample. Although not mentioned by most participants, complications due to female genital cutting (FGC) was listed as a health issue, mostly by mothers in lowland villages, including Hitacha, Amumo, and Bishaniko. Whether FGC is of concern to other respondents is unclear. Community health workers, even if they discuss this issue, do not visit all households in all villages hence many are unable to get information related to this topic and issue.
### TABLE 12: Health Worker Foci and Self Reported Health Problems by Village

<table>
<thead>
<tr>
<th>Village</th>
<th>Addressed by Health Worker</th>
<th>Reported Household Health Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>Environmental Sanitation</td>
<td>Vision/Eyes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bronchitis</td>
</tr>
<tr>
<td></td>
<td>Personal Hygiene</td>
<td>Heart Disease/Problems</td>
</tr>
<tr>
<td></td>
<td>Basic Health Services</td>
<td>General Pain</td>
</tr>
<tr>
<td></td>
<td>Pit Latrines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Common Diseases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIV/AIDS</td>
<td></td>
</tr>
<tr>
<td>Alasha</td>
<td>Pit Latrines</td>
<td>Headache</td>
</tr>
<tr>
<td></td>
<td>Personal Hygiene</td>
<td>Vision/Eyes</td>
</tr>
<tr>
<td></td>
<td>HIV/AIDS</td>
<td>Coughing</td>
</tr>
<tr>
<td></td>
<td>Environmental Sanitation</td>
<td>Gastric Condition</td>
</tr>
<tr>
<td>Gerado</td>
<td>Pit Latrines</td>
<td>Headache</td>
</tr>
<tr>
<td></td>
<td>Environmental Sanitation</td>
<td>Gastric Condition</td>
</tr>
<tr>
<td></td>
<td>Basic Health Services</td>
<td>Typhoid</td>
</tr>
<tr>
<td></td>
<td>Common Diseases</td>
<td>Typhus</td>
</tr>
<tr>
<td></td>
<td>Personal Hygiene</td>
<td>Heart Problems</td>
</tr>
<tr>
<td>Agala*</td>
<td>Basic Health Services</td>
<td>Gastric Condition</td>
</tr>
<tr>
<td></td>
<td>Common Disease</td>
<td>Headache</td>
</tr>
<tr>
<td></td>
<td>Safer Drinking Water</td>
<td>Dental Issues</td>
</tr>
<tr>
<td></td>
<td>Pit Latrines</td>
<td>HIV</td>
</tr>
<tr>
<td></td>
<td>Food Hygiene</td>
<td>TB</td>
</tr>
<tr>
<td>Hitachi*</td>
<td>Common Health/Disease</td>
<td>Headache</td>
</tr>
<tr>
<td></td>
<td>Pit Latrines</td>
<td><em>Malaria</em></td>
</tr>
<tr>
<td></td>
<td>Environmental Sanitation</td>
<td>Kidney Disease</td>
</tr>
<tr>
<td></td>
<td>HIV/AIDS</td>
<td>Gastric Condition</td>
</tr>
<tr>
<td></td>
<td>Child/Mother Health</td>
<td>Eyes/Vision</td>
</tr>
<tr>
<td></td>
<td>Malaria</td>
<td>General Pain</td>
</tr>
<tr>
<td>Amumo*</td>
<td>Environmental Sanitation</td>
<td>Headache</td>
</tr>
<tr>
<td></td>
<td>Basic Health Services</td>
<td>Kidney Disease</td>
</tr>
<tr>
<td></td>
<td>Communal Disease</td>
<td>Heart Issues (BP)</td>
</tr>
<tr>
<td></td>
<td>Pit Latrine</td>
<td><em>Malaria</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Typhoid</td>
</tr>
<tr>
<td>Bishaniko*</td>
<td>Pit Latrines</td>
<td>Headache</td>
</tr>
<tr>
<td></td>
<td>Personal Hygiene</td>
<td><em>Malaria</em></td>
</tr>
<tr>
<td></td>
<td>Basic Health Services</td>
<td>Typhoid</td>
</tr>
<tr>
<td></td>
<td>Food Hygiene</td>
<td>Vision/Eyes</td>
</tr>
<tr>
<td></td>
<td>Disease Prevention</td>
<td>Heart Problems</td>
</tr>
</tbody>
</table>

**Notes:**
- **Bolded** terms seen in most/all villages
- **Italicized** found only in mid/lowland villages
- * Indicates a village where problems associated with Female Genital Cutting were reported
In order to measure preferences for treatment, respondents were asked to indicate where they would first seek treatment for an illness. Overwhelmingly, 72.5% of respondents stated that their first preference for treatment is at a hospital (Fig. 8).

![Figure 8: Treatment Site Preferences in Order of Priority](image)

The preference for treatment at a hospital is particularly high in Boru Meda; however this may be due to the very close proximity of a biomedical facility or hospital (Table 13). The second most popular means of care for the sample as a whole includes home remedy and prayer (Fig. 8). Each of these health service options accounts for approximately 10% of respondents’ preferences; however, home remedy accounts for about one-third of the responses in the village of Agala (Table 13). Pharmacy and over-the-counter (OTC) medications make up five of the remaining 7.5% of preferred treatment sites, but these options are only preferred in three of the seven villages (Table 13). Visiting a traditional healer was the least preferred place to seek treatment, 2.5%, and all responses were in the village of Gerado. Gerado has the lowest associated cost for the use of traditional healers (1.33 Ethiopian Birr) as opposed to the 5.00 or more Ethiopian...
Birr (ETB) paid by residents of Boru Meda and Hitacha (Table 14). At the time of the study $1 was equivalent to ETB 13.7.

**TABLE 13: Households Indicating Preference for Source of Health Treatment by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Prayer N (%)</th>
<th>Hospital N (%)</th>
<th>Traditional Healer N (%)</th>
<th>Home Remedy N (%)</th>
<th>OTC/Pharmacy N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>0 (0)</td>
<td>15 (100)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Alasha</td>
<td>0 (0)</td>
<td>13 (87)</td>
<td>0 (0)</td>
<td>2 (13)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Gerado</td>
<td>13 (87)</td>
<td>11 (73)</td>
<td>1 (7)</td>
<td>1 (7)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Agala</td>
<td>20 (100)</td>
<td>5 (33)</td>
<td>0 (0)</td>
<td>5 (33)</td>
<td>2 (13)</td>
</tr>
<tr>
<td>Hitacha</td>
<td>15 (75)</td>
<td>13 (65)</td>
<td>0 (0)</td>
<td>1 (5)</td>
<td>3 (15)</td>
</tr>
<tr>
<td>Amumo</td>
<td>5 (25)</td>
<td>18 (90)</td>
<td>0 (0)</td>
<td>1 (5)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>5 (25)</td>
<td>16 (80)</td>
<td>0 (0)</td>
<td>2 (10)</td>
<td>1 (5)</td>
</tr>
</tbody>
</table>

Notes: **Bold**ed terms indicate the highest values
*Italicized* terms indicate lowest value

The only village where a respondent reported not using Western medicine or a Western-style medical hospital was in Hitacha (Table 14). Households in the other six villages all reported using Western biomedical facilities. The village of Amumo, with an average cost of ETB 287.5, has the highest cost associated with hospital visits. Boru Meda has the lowest associated cost, with an ETB of 58.83 (Table 14). The highest utilizations of a traditional healer were reported in Hitacha, while the fewest respondents reporting use of a traditional healer were in the villages of Alasha and Agala. Hitcha also has the highest cost associated with visits to a traditional healer, with an average cost of ETB 5.13 (Table 14).
TABLE 14: Usage of Western and Traditional Doctors and Associated Costs by Village

<table>
<thead>
<tr>
<th>Village</th>
<th>Use of Western Doctor (%)</th>
<th>Average Cost (ETB)</th>
<th>Use of Traditional Healer (%)</th>
<th>Average Cost (ETB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>0</td>
<td>58.83</td>
<td>No</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>Yes</td>
<td>20</td>
</tr>
<tr>
<td>Alasha</td>
<td>0</td>
<td>62.67</td>
<td>No</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>Yes</td>
<td>7</td>
</tr>
<tr>
<td>Gerado</td>
<td>0</td>
<td>125.67</td>
<td>No</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>Yes</td>
<td>20</td>
</tr>
<tr>
<td>Agala</td>
<td>0</td>
<td>136.93</td>
<td>No</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>Yes</td>
<td>7</td>
</tr>
<tr>
<td>Hitacha</td>
<td>5</td>
<td>158.75</td>
<td>No</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>95</td>
<td></td>
<td>Yes</td>
<td>40</td>
</tr>
<tr>
<td>Amumo</td>
<td>0</td>
<td>287.5</td>
<td>No</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>Yes</td>
<td>15</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>0</td>
<td>53.23</td>
<td>No</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>Yes</td>
<td>25</td>
</tr>
</tbody>
</table>

Notes: Bolded terms indicate the highest value
Italicized terms indicate lowest value
At time of study $1 USD = 13.7 ETB

Because preventable diseases such as measles are prevalent in Ethiopia,
households were asked if they had ever had a member of the household vaccinated and
when that vaccination occurred. Sixty-four percent of households noted that one or more
of the members of their household had a positive vaccination status (Fig. 9). Vaccination
status simply indicates that a member of the household had received a vaccine in the last
ten years; thus the presence of one child who had been vaccinated would result in a
positive vaccination status. Vaccines are provided free of charge by local NGOs and the
Ethiopian Government so the high percentage of families with no vaccinated members
suggests that perhaps vaccines are not well targeted in particular regions and/or among rural populations.
The age of the head of the household had the largest effect on the likelihood that individuals within a household would be vaccinated (Table 15). The assessment model indicates that as the age of the head of household increases, the likelihood that vaccinations have been received decreases. The second largest effect was seen in the household’s distance from market and this also had a positive effect. This result suggests that households further from market are more likely to receive vaccinations, or have a member in the household vaccinated. One’s home village also has a significant positive effect on vaccination status, although this effect is less substantial than the distance to market (Table 15). Also, although significant, head of household’s sex and household size have less demonstrable effects on vaccination status according to this model. Head of household age, distance from market, household size, economic ratio, village, and gender of household head explain approximately 42.5% of the variation seen in vaccination status at the household level.
TABLE 15: Linear Regression of Influences on Household Vaccination Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Standardized Coefficients</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>N = 120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.443</td>
<td>0.254</td>
</tr>
<tr>
<td>Head of Household Age</td>
<td>-0.012</td>
<td>0.002</td>
</tr>
<tr>
<td>Distance from Market</td>
<td>0.042</td>
<td>0.012</td>
</tr>
<tr>
<td>Household Size</td>
<td>0.050</td>
<td>0.020</td>
</tr>
<tr>
<td>Economic Ratio</td>
<td>-0.494</td>
<td>0.163</td>
</tr>
<tr>
<td>Village</td>
<td>0.051</td>
<td>0.019</td>
</tr>
<tr>
<td>Gender Household Head</td>
<td>0.196</td>
<td>0.095</td>
</tr>
</tbody>
</table>

Notes: F = 13.672; \( R^2 = 0.425 \); *p < 0.05; **p < 0.01

Having water which had been obtained from a hospital was an occurrence found only within Boru Meda. All respondents from the village of Boru Meda reported obtaining pretreated water from the Boru Meda Hospital, a facility formerly known of as the American clinic (Table 16). This water is treated by the hospital using chlorine. Tube-wells and boreholes, which are maintained by one household, or possibly a small cooperative of households, were only used in the village of Alasha. Because the maintenance of tube-wells and boreholes are the responsibility of the farmer, there is a much smaller risk of contamination from animals or human waste if these water sources are properly maintained. A majority of respondents indicated that they obtain water for household purposes from a pipe (Table 16). This is a closed well system, and as such is less vulnerable to contamination. Additionally, many piped water sources are pretreated. Few households used water from a spring or river, though all respondents in the village of
Agala obtained their household water supply from a spring or river. In general, water obtained from these sources is very susceptible to contamination from both human and animal fecal matter.

**TABLE 16: Water Sources by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Hospital</th>
<th>Tube well/Bore Hole</th>
<th>Pipe</th>
<th>Spring/River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Alasha</td>
<td>0.0</td>
<td>13.3</td>
<td>26.7</td>
<td>60.0</td>
</tr>
<tr>
<td>Gerado</td>
<td>0.0</td>
<td>0.0</td>
<td>93.3</td>
<td>6.7</td>
</tr>
<tr>
<td>Agala</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Hitacha</td>
<td>0.0</td>
<td>0.0</td>
<td>90.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Amumo</td>
<td>0.0</td>
<td>0.0</td>
<td>90.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values
**Italicized** terms indicate lowest value

Sixty-one percent of respondents obtained water for use in the home from a community pipe. This was mostly true for the village of Gerado and the villages located in the mid/lowlands (Table 16, Fig. 10). Twenty-four percent of participants obtained their water from a spring or river, sources which are not typically treated prior to use (Fig. 8). The remaining individuals, exclusively in the villages of Boru Meda and Alasha, obtained their water from either a hospital or from their own bore hole or tube well (Table 16, Fig. 10).
Roughly 37.5% of the study sample uses untreated water in the home, for everything from cooking, to washing, and bathing (Fig. 11). The use of untreated water, particularly from community sources such as a spring or river, can lead to outbreaks of waterborne illnesses. Such illnesses can cause diarrhea and vomiting and impact nutritional status. Residents of both Alasha and Agala use untreated water sources for household consumption and use.

In the village of Alasha, a majority of farmers and their families use treated water (Table 17). However 40% of respondents used an untreated source, and failed to treat...
water at home, leaving them vulnerable to a waterborne illness. Waterborne illnesses were reported by several members of the community. Similarly, those living in Agala also obtain their water from a spring or river. A clear majority (53%) of the households in Agala do not treat water before use, thus waterborne illnesses are very common (Table 17). The reports of waterborne illness are interesting given that Alasha and Agala have the highest reported percentages of water treated at home. In the village of Hitacha, 90% of households fail to treat water before using it in the home; however the use of water from a community pipe may limit the amount of contamination introduced from human and animal waste products. Residents of Boru Meda used the nearby treated water from the nearby hospital where the water is treated using chlorine. In all villages, women were generally responsible for safe drinking water and commonly used filtration, the addition of chlorine, and a product common in Ethiopia called “WuhaAgar” to sterilize water at home. Often, treated water, and particularly water treated with WuhaAgar, was combined with a powdered electrolyte drink.

**TABLE 17: Use of Treated Water by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Not Treated</th>
<th>Treated At Source</th>
<th>Treated At Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>0.0</td>
<td>100.0</td>
<td>6.7</td>
</tr>
<tr>
<td>Alasha</td>
<td>40.0</td>
<td>13.3</td>
<td>46.7</td>
</tr>
<tr>
<td>Gerado</td>
<td>73.3</td>
<td>0.0</td>
<td>26.7</td>
</tr>
<tr>
<td>Agala</td>
<td>53.3</td>
<td>0.0</td>
<td>46.7</td>
</tr>
<tr>
<td>Hitacha</td>
<td>90.0</td>
<td>10.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Amumo</td>
<td>10.0</td>
<td>90.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values
*Italicized* terms indicate lowest value
Food Security and Food Aid Issues

All households in the sample typically reported eating three meals each day and reported a daily intake of the Ethiopian flat-bread, *injera*. Other commonly consumed foods included *wat*, a type of stew, *shero wat*, a paste made from mashed peas, *dabo*, similar to a French roll, *kollo*, typically made from roasted barley, and to a lesser extent roasted grains such as maize, wheat, and beans. The combination of roasted or cooked grains was seen exclusively in the mid/lowland villages of Hitacha, Amumo, and Bishaniko. Food stocks were measured in *quintals*, which is equivalent to 100 kilograms (kg) and respondents were asked, based on their household needs, approximately how long these food stores would last (Table 18).

**TABLE 18: Average Household Food Stores and Storage Duration by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>N</th>
<th>Amount of Food Stored (Quintals)</th>
<th>Duration of Food Stores (Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>15</td>
<td>3.53 (1.94)</td>
<td>5.10 (2.87)</td>
</tr>
<tr>
<td>Alasha</td>
<td>15</td>
<td>4.93 (2.43)</td>
<td>4.60 (3.97)</td>
</tr>
<tr>
<td>Gerado</td>
<td>15</td>
<td>2.77 (1.32)</td>
<td>3.63 (2.19)</td>
</tr>
<tr>
<td>Agala</td>
<td>15</td>
<td>4.63 (1.80)</td>
<td>7.13 (2.64)</td>
</tr>
<tr>
<td>Hitacha</td>
<td>20</td>
<td>3.63 (2.00)</td>
<td>5.35 (3.34)</td>
</tr>
<tr>
<td>Amumo</td>
<td>20</td>
<td>1.98 (0.91)</td>
<td>4.30 (2.46)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>20</td>
<td>1.20 (0.77)</td>
<td>2.68 (1.48)</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values  *Italicized* terms indicate lowest value

Although people in the village of Alasha store the most food, households in Agala, on average tend to make their food stores last for the longest period of time (Table 18). Only six of 120 households responded that they “ate as they needed to,” and only four of those individuals acknowledged that they “ate as they wanted to.” All but one of
these respondents lived in the village of Boru Meda, which also has the third highest male BMI, the second highest female BMI, and the highest aggregate BMI. Households in the villages of Agala, Hitacha, and Boru Meda, on average, tend to store enough food to last at least five months. Households within the villages of Alasha, Gerado, and Amumo would run out of food in three to four months, while Bishaniko families would deplete their stores in approximately 2.5 months without additional grain purchases (Table 18). Families in Bishaniko also store the least amount of food (Table 18).

A regression model for food stocks was designed to incorporate several agricultural, economic, and social factors to examine the weight and significance of their influence on the amount of grain households stored after each growing season (Table 19).

<table>
<thead>
<tr>
<th>Variable Factors</th>
<th>Non-Standard Coefficients</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 120</td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Constant</td>
<td>3.178</td>
<td>0.683</td>
</tr>
<tr>
<td>Village</td>
<td>-0.288</td>
<td>0.076</td>
</tr>
<tr>
<td>Use of Crop Rotation</td>
<td>0.773</td>
<td>0.262</td>
</tr>
<tr>
<td>Cost of Fertilizer</td>
<td>0.003</td>
<td>0.001</td>
</tr>
<tr>
<td>Horses Owned</td>
<td>1.073</td>
<td>0.286</td>
</tr>
<tr>
<td>Use of a Traditional Healer</td>
<td>-1.056</td>
<td>0.340</td>
</tr>
<tr>
<td>Presence of Migrant Worker</td>
<td>1.033</td>
<td>0.320</td>
</tr>
<tr>
<td>Oxen Owned</td>
<td>0.636</td>
<td>0.194</td>
</tr>
<tr>
<td>Use of Compost</td>
<td>-0.553</td>
<td>0.273</td>
</tr>
</tbody>
</table>

Notes: F = 18.529; R² = 0.576; *p < 0.05; ** p < 0.01
Results of this model suggest that village identification had a significant negative impact on food stocks; lowland households are less likely to have larger foods stocks, on average, than highland households (Table 19). Other factors significant at the 0.05 level were the use of a traditional healer and use of compost. These factors had the smallest impact on the amount of food stored compared with other variables. Use of a seasonal rotation for crops, the household cost of fertilizer, the number of horses a household owned, the number of oxen a household owned, and the presence of migrant workers all had significant positive effects on household food stocks ($p < 0.05$). By contrast, cost of fertilizer and the number of horses and oxen had the largest positive impacts on the amount of food households were able to store. The entire model explains approximately 57.6% of the variation seen in household foods stocks (Table 19), suggesting that Government officials and extension agents wishing to increase food security through increasing quantities of grain stored annually should focus on these agricultural and social factors.

A second model, which explains 48% of the variation seen in the sample, was designed to examine the influence of similar factors on the duration of household food stocks. Not surprisingly, the amount of food stocks had a significant positive influence on duration of food stocks, and also had the largest impact ($p < .05$). However, this is not always necessarily the case; the village of Agala. Agala did not show this pattern (Table 20). Instead food stocks in Agala appear to last much longer when compared to households with similar quantities of stored grain, likely due to better rationing of food stores.
Table 20: Regression of Influences on Duration of Household Food Stocks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Standard Coefficients</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Constant</td>
<td>1.911</td>
<td>1.207</td>
</tr>
<tr>
<td></td>
<td>0.523</td>
<td>0.119</td>
</tr>
<tr>
<td>Food Stocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household Cost of Fertilizer</td>
<td>0.004</td>
<td>0.001</td>
</tr>
<tr>
<td>Rotation of Crops by Season</td>
<td>1.437</td>
<td>0.488</td>
</tr>
<tr>
<td>Distance to Market</td>
<td>0.202</td>
<td>0.077</td>
</tr>
<tr>
<td>Gender of Household Head</td>
<td>-1.143</td>
<td>0.576</td>
</tr>
</tbody>
</table>

Notes: F = 13.908; R² = 0.379; *p < 0.05; ** p < 0.01

Household cost for fertilizer, crop rotation by season, and distance to market also had significant positive effects on the duration of food stocks at the 0.05 level; with crop rotation by season having the highest impact. However, since household cost of fertilizer and crop rotation by season were also significant in the first model, it is possible that the effect seen in this model is indirect. The only significant negative influence on the duration of household food stocks was the gender of the head of household. This indicates that females, on average, tend to increase the duration of food stocks more so than do males as heads of a household.

Because many homes are unable to store food for more than a few months, emergency food resources such as extra grain purchased at market and food aid are important for household well-being and nutritional status. Fifty-eight percent of households purchase grain yearly; Respondents living in Boru Meda, Alasha, Amumo,
and Bishaniko were most likely to make annual grain purchases (Fig. 12). Households who rarely purchased grain make up approximately 32% of the sample, though they are mostly concentrated in the villages of Hitacha and Gerado (Fig. 12; Table 21). Although Amumo has a few respondents who indicated they never purchase grain, a majority of respondents from this village do purchase grain yearly.

![Graph](image)

**Figure 12: Frequency of Extra Grain Purchases by Village**

There were very few respondents that reported never buying extra grain. Only 7% of all households stated that they never buy grain and these were generally found in the villages of Agala and Hitacha. These are the same villages where households commonly managed to make food stocks last over seven months. Some households, 3%, reported purchasing extra grain, but did not indicate the frequency. Clearly, food aid receipts are a drought mitigation strategy for several households. Families who relied on food aid receipts were generally found in the villages of Gerado, Hitacha, and Amumo (Fig. 13).
Some villages had comparable numbers of households receiving food aid versus those who do not, but the villages of Boru Meda and Bishaniko declined to utilize food aid receipts as part of a drought mitigation strategy.

When comparing the frequency of extra grain purchases to the utilization of food aid receipts, three villages stand out. Bishaniko, a village where food stocks last, on average, less than two months, have the smallest percentage of households that receive food aid (Table 21). Instead, it appears that the households in Bishaniko have the income needed to make extra grain purchases in lieu of receiving food aid. By contrast, households in the village of Hitacha, which have the largest percentage of farmers who rarely purchase grain, also have the highest percentage of households receiving food aid. Households in the village of Gerado also exhibit this pattern although they appear to
follow it to a lesser extent. Though nine of the fifteen households reported purchasing grain rarely, twelve households indicated that they receive food aid.

**TABLE 21: Grain Purchases and Food Aid Participation by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>N</th>
<th>Never</th>
<th>Rarely</th>
<th>Yearly</th>
<th>Yes, Degree Noted</th>
<th>Recipient of Food Aid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>15</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Alasha</td>
<td>15</td>
<td>0</td>
<td>3</td>
<td>12</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Gerado</td>
<td>15</td>
<td>0</td>
<td>9</td>
<td>6</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Agala</td>
<td>15</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Hitacha</td>
<td>20</td>
<td>2</td>
<td>10</td>
<td>8</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Amumo</td>
<td>20</td>
<td>1</td>
<td>6</td>
<td>13</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>20</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>4</td>
<td>17</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values

*Italicized* terms indicate lowest value

Linear regression modeling demonstrated that a household’s cost of fertilizer, a proxy for the amount of fertilizer used, and the economic ratio, had significant negative effects on the frequency of extra grain purchases for households (Table 22) (p < 0.05). Participation in religious organizations as well as village both had significant positive influences (p < 0.05). Yet, the model only explains roughly 25% of the variation seen in household grain purchases.
TABLE 22: Influences on Household Grain Purchases

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Standard Coefficients</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 120</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.694</td>
<td>0.364</td>
</tr>
<tr>
<td>Cost of Fertilizer</td>
<td>-0.001</td>
<td>-0.331</td>
</tr>
<tr>
<td>Participation in Religious Organizations</td>
<td>0.879</td>
<td>0.237</td>
</tr>
<tr>
<td>Economic Ratio</td>
<td>-0.852</td>
<td>-0.284</td>
</tr>
<tr>
<td>Village</td>
<td>0.094</td>
<td>0.284</td>
</tr>
<tr>
<td>Farming Experience</td>
<td>0.012</td>
<td>0.188</td>
</tr>
</tbody>
</table>

Notes: F = 7.530; R² = 0.248; *p < 0.05; ** p < 0.01

Linear regression modeling also suggests that the degree of crop loss due to drought, a household’s participation in development and community initiatives, and the general water source for the household all had significant positive effects on the likelihood that a household would also participate in or receive food aid (Table 23).

Additionally, drought mitigation activities pursued by households had a significant impact on their participation in food aid programs. Nevertheless, the model only explains 20% of the variation seen in food aid receipts at the household level.

Table 23: Influences on Household Participation in Food Aid Programs

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-standard Coefficients</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 120</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.591</td>
<td>---</td>
</tr>
<tr>
<td>Degree of Crop Loss</td>
<td>0.104</td>
<td>0.380</td>
</tr>
<tr>
<td>Head of Household’s Age</td>
<td>-0.006</td>
<td>-0.206</td>
</tr>
</tbody>
</table>

Notes: F = 14.964; R² = 0.204; *p < 0.05; ** p < 0.01
Agriculture and Economics

In most cases, with the exception of farmers in the villages of Agala and Amumo, farmers in South Wollo are attempting to make a living on less than one hectare of land (10,000 m$^2$) (Table 24). On average, farmers in Agala tend to farm the largest plots (1.33 ha); consequently they also have the largest sections of cropland and land dedicated to other purposes, such as grazing, or cash crop production. The village of Bishaniko has the largest percentage of cultivated land (i.e., cropland/total farmland); however, they also have one of the smallest average plot sizes. The village of Alasha has the most farmland dedicated to forest, but households in Boru Meda have the greatest allotment of forest which may be the result of money-making activities. Overall, there is a significant difference the average amount of land controlled by female heads of household (0.70 hectares) and male heads of household (0.95 hectares) ($p < 0.05$).

Table 24: Average Land Holdings and Usage by Village (hectares)

<table>
<thead>
<tr>
<th>Village</th>
<th>N</th>
<th>Total Farmland</th>
<th>Cropland</th>
<th>% Cultivated</th>
<th>Forest</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>15</td>
<td>0.74</td>
<td>0.45</td>
<td>62</td>
<td>0.27</td>
<td>0.03</td>
</tr>
<tr>
<td>Alasha</td>
<td>15</td>
<td>0.97</td>
<td>0.55</td>
<td>63</td>
<td>0.29</td>
<td>0.13</td>
</tr>
<tr>
<td>Gerado</td>
<td>15</td>
<td>0.62</td>
<td>0.44</td>
<td>69</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Agala</td>
<td>15</td>
<td>1.33</td>
<td>0.72</td>
<td>56</td>
<td>0.24</td>
<td>0.37</td>
</tr>
<tr>
<td>Hitacha</td>
<td>20</td>
<td>0.89</td>
<td>0.61</td>
<td>70</td>
<td>0.15</td>
<td>0.13</td>
</tr>
<tr>
<td>Amumo</td>
<td>20</td>
<td>1.05</td>
<td>0.70</td>
<td>71</td>
<td>0.18</td>
<td>0.17</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>20</td>
<td>0.77</td>
<td>0.64</td>
<td>86</td>
<td>0.03</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values
*Italicized* terms indicate lowest value

When asked about problems facing their farms, farmers reported drought to be one of the two major concerns in every village except Gerado and Bishaniko. Frost was
also a major concern for villages, but in particular the highland villages of Boru Meda, Alasha, Gerado, and Agala. For mid/lowlad villages, including Hitacha, Amumo, and Bishaniko, the major farming problem reported by participants was the eradication of pests. Pest included worms and mammals other than livestock, such as *Papio anubis* or the common baboon.

Most villages grow crops during the short (*belg*) and long (*meher*) rainy seasons, with the exception of households in the village of Alasha (Table 25). There is a distinct difference in production types for highland and lowland, with Gerado and Agala as transition villages between the highest altitude villages and the actual lowlands. Highland villages, particularly Boru Meda and Alasha, focus on grains—barley and maize mostly with some wheat production. Farmers in Boru Meda grow beans during the second rainy season, but not much else, while Alasha farmers rarely grow crops during the *meher* season. Farmers in Gerado and Agala produce mostly barley, wheat, maize, and some *vetch* during the short rainy, *belg*, season, with beans, *teff*, and wheat during the *meher* season. The lowland villages grow several crops each season. The *Belg* season is mostly dedicated to chickpeas, *teff*, *vetch*, and wheat, with *teff* or wheat during the *meher* season (Table 25).
When comparing highland and lowland villages, a fairly distinct pattern emerges. Farmers in the highlands prefer grains during the short rainy season—maize, barley and wheat (Table 26). Their second crop is usually comprised of teff or a nitrogen-fixing crop such as beans or peas (Table 26). During both seasons, the lowlands focus on teff and wheat primarily with some emphasis on vetch and chickpea during the \textit{Belg} season.
Table 26: Crops Grown by Season in Highland and Mid/Lowland Areas

<table>
<thead>
<tr>
<th></th>
<th>Beleg Season</th>
<th></th>
<th>Meher Season</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crop</td>
<td>Number of</td>
<td>Crop</td>
<td>Number of</td>
</tr>
<tr>
<td>Highland</td>
<td></td>
<td>Farmers</td>
<td></td>
<td>Farmers</td>
</tr>
<tr>
<td>(2500-2700 Meters Above Sea Level)</td>
<td>Maize</td>
<td>42</td>
<td>Teff</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Barley</td>
<td>35</td>
<td>Beans</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Wheat</td>
<td>29</td>
<td>Wheat</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Vetch</td>
<td>06</td>
<td>Pea</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>Chickpea</td>
<td>04</td>
<td>Oat</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td>Potato</td>
<td>03</td>
<td>Barley</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>Oat</td>
<td>02</td>
<td>Lentil</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>Teff</td>
<td>02</td>
<td>Vetch</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>Bean</td>
<td>01</td>
<td>Chickpea</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maize</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sorghum</td>
<td>02</td>
</tr>
<tr>
<td>Lowland</td>
<td>Wheat</td>
<td>40</td>
<td>Teff</td>
<td>58</td>
</tr>
<tr>
<td>(1900 Meters Above Sea Level)</td>
<td>Teff</td>
<td>40</td>
<td>Wheat</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Vetch</td>
<td>35</td>
<td>Sorghum</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Chickpea</td>
<td>29</td>
<td>Vetch</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Bean</td>
<td>10</td>
<td>Maize</td>
<td>09</td>
</tr>
<tr>
<td></td>
<td>Oat</td>
<td>05</td>
<td>Chickpea</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td>Barley</td>
<td>01</td>
<td>Bean</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>Lentil</td>
<td>01</td>
<td>Lentil</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>Maize</td>
<td>01</td>
<td>Oat</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pea</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Barley</td>
<td>01</td>
</tr>
</tbody>
</table>

Note: Bolded terms indicate the most common

There were three sources where farmers obtained their seed; (1) market, (2) their own production, and (3) the agricultural office. A majority of households (63.6%) obtain their seed from their own plants and farms (Fig. 14), from an agricultural office, and from the market being the second and third most popular sources respectively.
Seed from the agricultural office was either purchased by farmers, or in some cases, was a free gift to farmers. Farmers also termed this seed “Best Seed,” though whether it is because this is the name of a seed company or because it is better quality seed is undetermined. Farmers in Gerado, Agala, and Hitacha all use seed from the agricultural office in the highest concentrations (Table 27). They also tend to have more even distributions across seed sources. The highest concentration of respondents obtaining seed from the market is in Bishaniko; however this village is also the closest to its respective market center, at just over one kilometer away.

Table 27: Seed Source by Village

<table>
<thead>
<tr>
<th>Village</th>
<th>Market</th>
<th>Own Production</th>
<th>Begging/Neighbor</th>
<th>Agricultural Office</th>
<th>Own Production + Agricultural Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>1</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alasha</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gerado</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Agala</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Hitacha</td>
<td>3</td>
<td>9</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Amumo</td>
<td>2</td>
<td>16</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>9</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes: Bolded terms indicate highest values
Italicized terms indicated lowest values
Years of farming experience, percent of farmers using irrigation, the average cost to maintain irrigation, the percent of farmers using fertilizer, and the average cost for fertilizer per household are summarized in Table 28. Average years of farming ranged from 30.27 years in Alasha to 16.65 years in Hitacha (Table 28).

Table 28: Farm Characteristics by Village

<table>
<thead>
<tr>
<th>Village</th>
<th>Years Farming Experience</th>
<th>% of Farmers Using Irrigation</th>
<th>Average Cost to maintain Irrigation (ETB)</th>
<th>% of Farmers Using Fertilizer</th>
<th>Average Cost of Fertilizer per Household (ETB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>30.13 (9.01)</td>
<td>20</td>
<td>0</td>
<td>13</td>
<td>167.5</td>
</tr>
<tr>
<td>Alasha</td>
<td>30.27 (6.41)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gerado</td>
<td>22.47 (7.77)</td>
<td>100</td>
<td>5.33</td>
<td>73</td>
<td>211.36</td>
</tr>
<tr>
<td>Agala</td>
<td>24.00 (11.64)</td>
<td>73</td>
<td>4.55</td>
<td>93</td>
<td>404.86</td>
</tr>
<tr>
<td>Hitacha</td>
<td>16.65 (9.52)</td>
<td>50</td>
<td>141</td>
<td>85</td>
<td>319.88</td>
</tr>
<tr>
<td>Amumo</td>
<td>25.35 (9.68)</td>
<td>80</td>
<td>103.75</td>
<td>80</td>
<td>204.69</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>26.35 (14.12)</td>
<td>50</td>
<td>64</td>
<td>55</td>
<td>134.73</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate highest values.
*Italicized* terms indicate lowest values.

Farmers in Boru Meda and Alasha using irrigation the least often, compared to Gerado where all farmers employ irrigation in their agricultural systems (Fig. 15). In the villages that did report using irrigation, the lowest costs were found in Boru Meda, Alasha, and Gerado. However, in the highlands, the cost to maintain irrigation is significantly higher, nearly 20 times the cost experienced by farmers in Boru Meda, Alasha and Gerado (Table 28).
Figure 15: Household Use of Irrigation by Village

The number of farmers using fertilizer was varied, but fertilizer use seemed to increase in the lowland villages (Fig 16). The average cost of fertilizer per household also rose in the lowland villages with the exception of Bishaniko, where costs ranged from ETB 0 in Alasha, to more than ETB 400 in the village of Agala.

Alasha is an interesting case, as farmers in this village do not employ irrigation or the use of fertilizer in their agricultural schemes. By contrast, all farmers in the remaining villages use irrigation and a large percentage use fertilizer. This is an interesting pattern given the proximity of these villages to each other (Fig. 4). Although, there are similar numbers of farmers using irrigation, the cost between villages is significantly different. Generally farmers in the villages of Gerado and Agala maintain the irrigation systems themselves, and therefore cover most associated costs, such as digging boreholes and trenches. However, in the villages of Hitacha, Amumo, and Bishaniko, the work is often “contracted” out. Bishaniko farmers actually form co-operatives that come together to
pay for labor. This may explain the noticeably lower cost associated with irrigation compared to what is spent in the villages of Hitacha or Amumo. Households in Agala spend more money on fertilizer than any other village; they are also one of only two villages to have more farmers use fertilizer than irrigation.

![Household Use of Fertilizer by Village](image)

**Figure 16: Household Use of Fertilizer by Village**

Linear regression modeling implies that household size, the use of fertilizer, and the household cost to maintain the irrigation system all have significant positive effects on a household’s use of irrigation (Table 29) (p < 0.05). The use of fertilizer had the largest impact on household size with the household cost of irrigation following in order. The model explains approximately 24% of the variation in use of irrigation among farmers.
Table 29: Influences on Household Use of Irrigation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Standard Coefficients</th>
<th>Standardized Coefficient</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B Standard Error</td>
<td>Beta t</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.044 0.120</td>
<td>--- 0.368 0.714</td>
<td></td>
</tr>
<tr>
<td>Use of Fertilizer</td>
<td>0.330 0.084</td>
<td>0.325 3.915 0.000**</td>
<td></td>
</tr>
<tr>
<td>Household Size</td>
<td>0.054 0.022</td>
<td>0.201 2.460 0.015*</td>
<td></td>
</tr>
<tr>
<td>Household Cost to Maintain Irrigation System</td>
<td>0.001 0.000</td>
<td>0.220 2.673 0.009*</td>
<td></td>
</tr>
</tbody>
</table>

Notes: F = 12.139; $R^2 = 0.239; *p < 0.05; **p < 0.01

Participants were asked about conservation methods they employ on their own farms. A summary of conservation efforts as self-reported by farmers is listed in Table 30.

In many cases specific conservation practices, such as planting trees and terracing, could be considered protection of steep slopes. However, because farmers denoted them as being separate, they are reported as such in this study.

**TABLE 30:** Number of Farmers Utilizing Conservation Methods by Village

<table>
<thead>
<tr>
<th>Village</th>
<th>Protection of Steep Slopes</th>
<th>Tree Planting</th>
<th>Terracing</th>
<th>Intercropping</th>
<th>Leaving of Crop Residue</th>
<th>Contour Bunding</th>
<th>Contour Plowing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>11</td>
<td>13</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alasha</td>
<td>13</td>
<td>15</td>
<td>14</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gerado</td>
<td>0</td>
<td>13</td>
<td>14</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Agala</td>
<td>5</td>
<td>14</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Hitacha</td>
<td>14</td>
<td>18</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Amumo</td>
<td>12</td>
<td>16</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>9</td>
<td>17</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>
Tree planting and terracing were the most practiced conservation methods in every village (Table 30). Practices to protect steep slopes were seen in every village, except in the villages of Gerado and Bishaniko. Although the combination of contour plowing and contour bunding are most prevalent in the mid/lowlands, Agala and Gerado have the largest proportions of farmers practicing contour plowing and contour bunding respectively. Boru Meda and Agala have the fewest types of conservation practices utilized by farmers in the community. Farmers in highland villages all practice tree planting, terracing, and with the exception of Gerado, some form of protection for steep slopes. Additionally, the villages of Alasha and Agala practice intercropping and leaving crop residual on the field for added nutrients. Mid/lowland villages all practice protection of steep slopes, terracing, tree planting, contour bunding, and contour plowing.

Crop loss due to drought has a significant influence on the amount of food households can store and thus requires some consideration. Generally, villages in the highlands tend to report either an average loss or very high loss of crops due to drought, whereas the lowland villages tend to report no loss or a partial loss of crop due to water limitations. This may be due in part to the common presence of the use of irrigation in the lowlands, although farmers from Alasha generally reported what they perceived as an “average loss” and they do not use irrigation. While farmers in Bishaniko store the least amount of grain, they also have the largest percent of farmers reporting no loss during the past drought.

Pest control really seemed to be an issue for the lowland villages but especially the village of Agala (Table 31). For each of these villages, between 15-20% of crops are lost at any given time due to pest damage. However, only farmers in Amumo and
Bishaniko appear to have pest control mechanisms in use, and are commonly chemicals (Table 31).

**TABLE 31: Average Household Crop Loss Due to Drought and Pests by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Degree of Crop Loss Due to Drought (%)</th>
<th>Pest Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Loss</td>
<td>Partial Loss</td>
</tr>
<tr>
<td>Boru Meda</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Alasha</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Gerado</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Agala</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Hitachcha</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Amumo</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>65</td>
<td>20</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values

*Italicized* terms indicate lowest value

Farmers tend to gravitate toward one of three chemicals for pest control; (1) Malathion, (2) Dazinon, or (3) Rogor. Malathion is classified by the Occupational Safety and Health Administration (OSHA) and the National Fire Protection Association as a moderate health hazard, or hazardous materials identification system (HMIS) level 2 (Loveland Products Inc., 2004). By contrast, Dazinon is considered slightly safer with a hazard rating of one (Platte Chemical Company 2003). Rogor is a hazardous systemic insecticide for garden use (Envirogreen Pty Ltd 2002). All the insecticides used are toxic to aquatic environments, but are not labeled as potential carcinogens. Although they were not identifiable by their common names or specific to the crops they affect, farmers listed
several common pests, including *atako* (a corn pest), *dayi-mereche, aze, keyi-mita,* and teff worms. Additionally several farmers reported frost and wind to be significant "pests."

Because livestock are an important part of a rural Ethiopian livelihood in South Wollo, counts of all livestock types were taken for each household (Table 32). Alasha had the highest average livestock holdings for sheep, chickens, horses, and mules and donkeys (Table 32). The villages of Gerado and Agala had the highest average for oxen. Boru Meda, with its dairy production, not surprisingly, had the largest number of cows per household (Table 32). Although there were few households who reported keeping goats, Agala had the highest concentration. The lowlands, in general, tended not to have particularly high numbers of any livestock type.

**TABLE 32: Mean and Standard Deviation for Livestock with Associated Cost by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Cow</th>
<th>Oxen</th>
<th>Sheep</th>
<th>Chicken</th>
<th>Horse</th>
<th>Goat</th>
<th>Mule/Donkey</th>
<th>Cost (ETB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>2.63</td>
<td>0.93</td>
<td>2.20</td>
<td>3.13</td>
<td>0.67</td>
<td>0.40</td>
<td>0.07</td>
<td>18.73</td>
</tr>
<tr>
<td></td>
<td>(1.73)</td>
<td>(0.96)</td>
<td>(2.78)</td>
<td>(2.75)</td>
<td>(0.82)</td>
<td>(1.30)</td>
<td>(0.26)</td>
<td>(15.04)</td>
</tr>
<tr>
<td>Alasha</td>
<td>2.53</td>
<td>0.93</td>
<td>6.33</td>
<td>4.07</td>
<td>0.93</td>
<td>0</td>
<td>1.47</td>
<td>33.67</td>
</tr>
<tr>
<td></td>
<td>(1.41)</td>
<td>(0.70)</td>
<td>(6.21)</td>
<td>(2.71)</td>
<td>(0.80)</td>
<td>(0)</td>
<td>(1.46)</td>
<td>(22.79)</td>
</tr>
<tr>
<td>Gerado</td>
<td>2.47</td>
<td>1.00</td>
<td>1.80</td>
<td>2.73</td>
<td>0.20</td>
<td>0.13</td>
<td>0.60</td>
<td>28.67</td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(0.65)</td>
<td>(1.57)</td>
<td>(2.52)</td>
<td>(0.56)</td>
<td>(0.52)</td>
<td>(0.63)</td>
<td>(49.55)</td>
</tr>
<tr>
<td>Agala</td>
<td>1.20</td>
<td>1.00</td>
<td>1.07</td>
<td>3.33</td>
<td>0</td>
<td>1.13</td>
<td>1.40</td>
<td>4.09</td>
</tr>
<tr>
<td></td>
<td>(1.42)</td>
<td>(0.85)</td>
<td>(2.09)</td>
<td>(2.56)</td>
<td>(0)</td>
<td>(1.96)</td>
<td>(0.99)</td>
<td>(3.18)</td>
</tr>
<tr>
<td>Hitachha</td>
<td>1.30</td>
<td>0.95</td>
<td>0.35</td>
<td>3.90</td>
<td>0</td>
<td>0.60</td>
<td>0.05</td>
<td>3.31</td>
</tr>
<tr>
<td></td>
<td>(1.08)</td>
<td>(0.76)</td>
<td>(0.81)</td>
<td>(4.13)</td>
<td>(0)</td>
<td>(1.10)</td>
<td>(0.22)</td>
<td>(6.16)</td>
</tr>
<tr>
<td>Amumo</td>
<td>1.35</td>
<td>0.75</td>
<td>0.75</td>
<td>3.85</td>
<td>0</td>
<td>0.80</td>
<td>0.15</td>
<td>1.56</td>
</tr>
<tr>
<td></td>
<td>(10.9)</td>
<td>(0.64)</td>
<td>(1.29)</td>
<td>(3.07)</td>
<td>(0)</td>
<td>(2.19)</td>
<td>(0.37)</td>
<td>(2.08)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>1.65</td>
<td>0.70</td>
<td>1.10</td>
<td>2.55</td>
<td>0</td>
<td>0.25</td>
<td>0.15</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>(1.57)</td>
<td>(0.80)</td>
<td>(1.33)</td>
<td>(2.16)</td>
<td>(0)</td>
<td>(0.64)</td>
<td>(0.37)</td>
<td>(1.21)</td>
</tr>
</tbody>
</table>

Note: **Bolded** terms indicate the highest values
Because many studies have reported the significance of oxen in agricultural productivity, a summary was made for each village on the number of households owning no oxen, one ox, or two oxen (Table 33). Thirty-four percent, 41%, and 24% of the study population owned no, one, and two oxen respectively.

**TABLE 33: Percentages of Household with Oxen by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>No oxen</th>
<th>1 oxen</th>
<th>2 oxen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>47</td>
<td>13</td>
<td>40</td>
</tr>
<tr>
<td>Alasha</td>
<td>27</td>
<td>53</td>
<td>20</td>
</tr>
<tr>
<td>Gerado</td>
<td>20</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>Agala</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Hitacha</td>
<td>30</td>
<td>45</td>
<td>25</td>
</tr>
<tr>
<td>Amumo</td>
<td>35</td>
<td>55</td>
<td>10</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>50</td>
<td>30</td>
<td>20</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values  
*Italicized* terms indicate lowest value

Fifty percent of households in the village of Bishaniko have no oxen, with Boru Meda following at a close second with 47%. However, the village of Boru Meda has the highest percentage of households with two oxen (40%) while Amumo has the lowest percentage of farmers owning oxen (10%). Overall Gerado has the largest percentage of the population with oxen, whereby 80% of farmers have at least one ox. Sex of the head of household is a significant factor in livestock ownership. Men heading households universally owned more livestock in each category than did comparable female-headed households (Table 34).
TABLE 34: Livestock Owned by Gender of Head of Household

<table>
<thead>
<tr>
<th>Gender</th>
<th>Cow</th>
<th>Oxen</th>
<th>Sheep</th>
<th>Chicken</th>
<th>Horse</th>
<th>Goat</th>
<th>Mule/Donkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1.97</td>
<td>0.98</td>
<td>1.87</td>
<td>3.64</td>
<td>0.25</td>
<td>0.59</td>
<td>0.52</td>
</tr>
<tr>
<td>Female</td>
<td>1.13</td>
<td>0.48</td>
<td>1.48</td>
<td>2.26</td>
<td>0.13</td>
<td>0.04</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Participants were also asked about services they might need from local development agents, and extension offices (Table 35). Although, many issues were reported, the top-ranked issues for each village are reported in Table 35. Across all villages, fertilizer and seed systems were among the top five issues mentioned by farmers. Composting was also mentioned by households, in all villages, except in Boru Meda. Veterinary services and other livestock-related issues were very common responses to the survey, in addition to alternative crops and production systems.
TABLE 35: Development and Agricultural Extension Issues by Village

<table>
<thead>
<tr>
<th>Village</th>
<th>Top Development Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>Sustainable Farming</td>
</tr>
<tr>
<td></td>
<td>Fruit/Vegetable Production</td>
</tr>
<tr>
<td></td>
<td>Modern Planting Methods</td>
</tr>
<tr>
<td></td>
<td>Modern Farming</td>
</tr>
<tr>
<td></td>
<td>Fertilizer/Seed Dist.</td>
</tr>
<tr>
<td>Alasha</td>
<td>Fertilizer</td>
</tr>
<tr>
<td></td>
<td>Water Harvesting</td>
</tr>
<tr>
<td>Gerado</td>
<td>Fertilizer</td>
</tr>
<tr>
<td></td>
<td>Seed</td>
</tr>
<tr>
<td></td>
<td>Modern Planting</td>
</tr>
<tr>
<td></td>
<td>Compost</td>
</tr>
<tr>
<td></td>
<td>Veterinary Services</td>
</tr>
<tr>
<td>Agala</td>
<td>Fertilizer</td>
</tr>
<tr>
<td></td>
<td>Modern Farming Methods</td>
</tr>
<tr>
<td></td>
<td>Veterinary Services</td>
</tr>
<tr>
<td></td>
<td>Seed</td>
</tr>
<tr>
<td></td>
<td>Compost</td>
</tr>
<tr>
<td>Hitacha</td>
<td>Fertilizer</td>
</tr>
<tr>
<td></td>
<td>Composting</td>
</tr>
<tr>
<td></td>
<td>Animal Rearing/Fattening</td>
</tr>
<tr>
<td></td>
<td>Drought Resistant Crops</td>
</tr>
<tr>
<td></td>
<td>Pesticides</td>
</tr>
<tr>
<td>Amumo</td>
<td>Fertilizer</td>
</tr>
<tr>
<td></td>
<td>Improved Seed</td>
</tr>
<tr>
<td></td>
<td>Modern Agriculture</td>
</tr>
<tr>
<td></td>
<td>Natural/Animal Resources</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>Fertilizer</td>
</tr>
<tr>
<td></td>
<td>Composting</td>
</tr>
<tr>
<td></td>
<td>Modern Planting</td>
</tr>
<tr>
<td></td>
<td>Improved Seed</td>
</tr>
</tbody>
</table>

Notes: Bolded terms seen in most/all villages

Drought mitigation is an important, even necessary part of rural life in Ethiopia. Drought mitigation strategies vary widely by household but some patterns can be discerned between villages and highland/lowland groups (Appendix G). Boru Meda and Hitacha have by far the most variation in drought mitigation strategies, while farmers in Gerado have the least. Food aid is the primary drought mitigation strategy reported by respondents for all villages except for those of Boru Meda and Bishaniko. Farmers in Boru Meda rely heavily on savings and Government aid, but not necessarily food aid,
whereas households in Bishaniko either do not have drought mitigation strategies or do not need them. Sale of alternative crops (e.g. fruits, vegetables, and firewood), livestock, and migration for paid labor are all popular means of surviving drought in the study site. Many households rely on migration as a source of income in lean times (Table 36).

**TABLE 36: Households Which Include Day Labor Migration**

<table>
<thead>
<tr>
<th>Village</th>
<th>Household Member Migrates for Daily Labor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO</td>
</tr>
<tr>
<td>Boru Meda</td>
<td>87</td>
</tr>
<tr>
<td>Alasha</td>
<td>60</td>
</tr>
<tr>
<td>Gerado</td>
<td>73</td>
</tr>
<tr>
<td>Agala</td>
<td>53</td>
</tr>
<tr>
<td>Hitacha</td>
<td>70</td>
</tr>
<tr>
<td>Amumo</td>
<td>90</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>100</td>
</tr>
</tbody>
</table>

*Note: Bolded terms indicate highest values*

None of the households in Bishaniko reported having a member migrate for paid labor (Table 36, Fig. 17). However, this village is less than one kilometer from the market and respondents may not consider working away from the farm at this short distance as migration. The village of Agala had the highest percentage of households reporting that they have members who migrate for labor. Generally this labor included service-type jobs, such as a waitress or store clerk. Other paid labor included spending the day at market with forest products for construction.
Boru Meda had the highest annual cost associated with festival contributions, while the village of Hitacha had the lowest cost (Table 37). Farmers reported contributing mostly to religious festivals and New Year’s celebrations. Most festivals celebrated were tied to the Muslim religion, primarily the “birth of the prophet Mohammed,” Ramadan, and Eid-Al-Adha (the Festival of Sacrifice). Individuals who lack the means to support such heavy costs are excused from contributing.

**TABLE 37: Annual Cost Contributed to Festivals by Village**

<table>
<thead>
<tr>
<th>Village</th>
<th>Annual Cost Contributed to Festivals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boru Meda</td>
<td>619.64 (407.17)</td>
</tr>
<tr>
<td>Alasha</td>
<td>463.33 (127.43)</td>
</tr>
<tr>
<td>Gerado</td>
<td>518.33 (340.23)</td>
</tr>
<tr>
<td>Agala</td>
<td>589.29 (214.99)</td>
</tr>
<tr>
<td>Hitacha</td>
<td>433.68 (285.68)</td>
</tr>
<tr>
<td>Amumo</td>
<td>565.00 (240.67)</td>
</tr>
<tr>
<td>Bishaniko</td>
<td>422.22 (241.46)</td>
</tr>
</tbody>
</table>

Notes: **Bolded** terms indicate the highest values

*Italicized* terms indicate lowest value
Generally speaking, households engage in a large variety of activities to earn extra income (see Appendix G). The villages of Bishaniko and Alasha have the least amount of variety. Households in Alasha engage in one of three activities, including the sale of firewood, sale of livestock, and sale of vegetables. Similarly households in Bishaniko rely on the sale of trees and vegetables, but also the sale of fruit and khat. For Boru Meda, Alasha, and Agala, firewood and the sale of trees for use in construction are the most popular ways of earning income outside of agriculture-related work. Villages in the mid/lowlands and in Agala tend to favor khat and vegetable production; however, Bishaniko relies heavily on the sale of trees. The sale of vegetables and trees appear to be the mainstay of money-making activities and are the only activities reported in all seven villages.

Significant Influences on Nutritional Status

A mixed model analysis was used to determine the effect of certain agricultural, economic, and social factors on household BMI (Table 38). This model was used to account for sampling design and was run by creating two nested variables—household within village, and village within highland/lowland.

The nested variables help to account for any unexpected variation between household and villages. All variables except the newly created, nested variables were designated as fixed factors. Consequently, in order of increasing significance, village, religion, number of sheep owned by the household, household use of fertilizer, degree of crop loss during the last drought, seed source, household use of irrigation, the number of
mules or donkeys owned by the household, economic ratio, and gender of the head of household all have significant relationships to household BMI.

**TABLE 38: Influence on Household Body Mass Index (Mixed Model)**

<table>
<thead>
<tr>
<th>Source</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>358.08</td>
<td>0.000**</td>
</tr>
<tr>
<td>Village</td>
<td>2.41</td>
<td>0.025*</td>
</tr>
<tr>
<td>Gender of Head of Household</td>
<td>18.210</td>
<td>0.000**</td>
</tr>
<tr>
<td>Degree of Crop Loss During Last Drought</td>
<td>3.351</td>
<td>0.008**</td>
</tr>
<tr>
<td>Use of Fertilizer</td>
<td>6.155</td>
<td>0.015*</td>
</tr>
<tr>
<td>Use of Irrigation</td>
<td>8.092</td>
<td>0.005**</td>
</tr>
<tr>
<td>Seed Source</td>
<td>3.888</td>
<td>0.006**</td>
</tr>
<tr>
<td>Religion</td>
<td>5.516</td>
<td>0.021*</td>
</tr>
<tr>
<td>Economic Ratio</td>
<td>21.995</td>
<td>0.000**</td>
</tr>
<tr>
<td>Sheep Owned</td>
<td>5.809</td>
<td>0.018*</td>
</tr>
<tr>
<td>Mules or Donkeys Owned</td>
<td>11.313</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

Note: *p < 0.05; **p < 0.01

A second model using linear regression was used to determine the magnitude of the relationship between household BMI and certain agricultural, economic, and social factors (Table 39). In this model, village, gender of the head of household, number of mules or donkeys owned, degree of crop loss due to the last drought, and frequency of extra grain purchases all have significant negative impacts on household BMI. Alternatively, economic ratio, religion, number of sheep owned, and use of irrigation all have significant positive impacts on household BMI. Overall, the model explains roughly 47% of the variation seen in household BMI.
TABLE 39: Linear Regression of Influences on Household Body Mass Index

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-Standard Coefficient</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Constant</td>
<td>16.733</td>
<td>1.058</td>
</tr>
<tr>
<td>Village</td>
<td>-0.440</td>
<td>0.082</td>
</tr>
<tr>
<td>Economic Ratio</td>
<td>2.487</td>
<td>0.675</td>
</tr>
<tr>
<td>Gender of Head of Household</td>
<td>-1.445</td>
<td>0.363</td>
</tr>
<tr>
<td>Mules/Donkeys Owned</td>
<td>-0.812</td>
<td>0.178</td>
</tr>
<tr>
<td>Religion of Household</td>
<td>2.205</td>
<td>0.692</td>
</tr>
<tr>
<td>Crop Loss Due to Drought</td>
<td>-0.165</td>
<td>0.078</td>
</tr>
<tr>
<td>Sheep Owned</td>
<td>0.176</td>
<td>0.054</td>
</tr>
<tr>
<td>Extra Grain Purchases</td>
<td>-0.592</td>
<td>0.218</td>
</tr>
<tr>
<td>Use of Irrigation</td>
<td>0.759</td>
<td>0.300</td>
</tr>
</tbody>
</table>

Notes:  F = 10.747, R² = 0.472; *p <0.05; **p <0.01

Implications of Male and Female Heads of Household

Sex and gender roles are important social factors influencing many of the variables explored in this study. Sex of the head household plays a significant role in household vaccination status, duration of household food stocks, degree of crop loss due to drought, and household BMI. Many organizations, notably the WFP, have long recognized the positive influence that resources controlled by women have on the nutritional status of the household and on children. Of the 120 households interviewed during the study, almost 20% were headed by a woman.
A majority of those female headed households were found in Boru Meda and Bishaniko (Fig. 18). The major differences between male and female heads of household were found in the number of chickens and cows owned, the amount of land dedicated to “other” purposes (khat, fruit, vegetables, grazing), the amount of money spent on livestock each month, and participation in food aid (Table 40). These differences were significant at the 0.05 level, although hectares of land was just barely so.

**TABLE 40: Variation in Responses Between Male and Female-Headed Households**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Chickens</td>
<td>0.027*</td>
</tr>
<tr>
<td>Number of Cows</td>
<td>0.007**</td>
</tr>
<tr>
<td>Hectares of Land Dedicated to “Other” Purposes</td>
<td>0.043*</td>
</tr>
<tr>
<td>Household Livestock Costs</td>
<td>0.038*</td>
</tr>
<tr>
<td>Participation in Food Aid</td>
<td>0.039*</td>
</tr>
</tbody>
</table>

Notes: Test Used-Independent Samples: Mann Whitney U Test; *p < 0.05; ** p < 0.01
For female-headed households, the major significant differences across village were seen in quantity of food stocks, land used for forest, land used for other purposes, percent of land cultivated, and the number of oxen and mules or donkeys owned (Table 41). Previous results have shown that access to livestock is reduced for households headed by women; this may explain the variation seen in livestock holdings for these households. Additionally, the patrilineal inheritance practiced among the Amhara means land typically goes to a son, not the wife, upon the husband’s death. Though some women receive small parcels of their husband’s land, they do not retain ownership of the plot which may be why there is a significant difference in land holdings, particularly when villages such as Bishaniko, where half the households are headed by females, are taken into consideration.

**Table 41: Variation of Responses across Villages for Female-Headed Households**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of Food Stocks</td>
<td>0.030*</td>
</tr>
<tr>
<td>Hectares of Land Used for Forest</td>
<td>0.009**</td>
</tr>
<tr>
<td>Hectares of Land Used for “Other Purposes”</td>
<td>0.030*</td>
</tr>
<tr>
<td>Percent of Land Cultivated</td>
<td>0.017*</td>
</tr>
<tr>
<td>Number of Oxen</td>
<td>0.036*</td>
</tr>
<tr>
<td>Number of Mules/Donkeys</td>
<td>0.004**</td>
</tr>
</tbody>
</table>

Notes: Test Used-Independent Samples: Kruska-Wallis Test; *p < 0.05; ** p < 0.01

For male heads of household, the list of variables with significant differences is longer, and only the quantity of food stocks, hectares of land used for other purposes, and percent of land cultivated were the same as found in female-headed households. BMI, duration of food stocks, cost of using Western medicine, hectares of total farmland and
crop land, years of farming experience, number of different types of crops grown, household cost of fertilizer and irrigation, percentage of crops lost to pests, and livestock owned by the household (cows, sheep, horses, donkeys, mules) were all found to have significant difference in variation across villages for men (Table 42).

TABLE 42: Responses across Villages for Male-Headed Households

<table>
<thead>
<tr>
<th>Variable</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index</td>
<td>0.019*</td>
</tr>
<tr>
<td>Quantity of Food Stocks</td>
<td>0.000**</td>
</tr>
<tr>
<td>Duration of Food Stocks</td>
<td>0.002**</td>
</tr>
<tr>
<td>Cost of Visiting a Western Doctor</td>
<td>0.000**</td>
</tr>
<tr>
<td>Hectares of Farmland</td>
<td>0.003**</td>
</tr>
<tr>
<td>Hectares of Crop Land</td>
<td>0.009**</td>
</tr>
<tr>
<td>Land Used for Other Purposes</td>
<td>0.006**</td>
</tr>
<tr>
<td>Percent of Land Cultivated</td>
<td>0.035*</td>
</tr>
<tr>
<td>Years of Farming Experience</td>
<td>0.007**</td>
</tr>
<tr>
<td>Number of Different Types of Crops Grown</td>
<td>0.002**</td>
</tr>
<tr>
<td>Household Cost of Fertilizer</td>
<td>0.000**</td>
</tr>
<tr>
<td>Household Cost of Irrigation</td>
<td>0.000**</td>
</tr>
<tr>
<td>Percentage of Crop Lost to Pests</td>
<td>0.000**</td>
</tr>
<tr>
<td>Number of Cows</td>
<td>0.003**</td>
</tr>
<tr>
<td>Number of Sheep</td>
<td>0.000**</td>
</tr>
<tr>
<td>Number of Horses</td>
<td>0.000**</td>
</tr>
<tr>
<td>Number of Mules/Donkeys</td>
<td>0.000**</td>
</tr>
</tbody>
</table>

Notes: Test Used-Independent Samples: Kruskal-Wallis Test; *p < 0.05; **p < 0.01
Anthropometrics and Household Demographics

Anthropometrics from the study site reveal that, as an aggregate, females and males in all villages are grossly underweight. WHO (2011) statistics on female nutritional status in Ethiopia show that 68.4% of the population is within a normal weight range (18.5-25) and that only 26.5% are underweight, or have a BMI below 18.5. Just 9% of the population in this study was within a normal range, while the remaining 91% were underweight. This could be due, in part, to the time of year the measurements were taken, but also due to regional differences. The study was conducted during the “starvation” period in Ethiopia when individual BMI may be at its lowest. The starvation period in this particular region of Ethiopia occurs just before the first harvest of short rain crops in mid-June or July. For children under the age of five, the WHO data indicate that being underweight, wasting, and stunting have a prevalence of 34.6%, 12.3%, and 50.7% respectively (WHO 2011). In this study, most children were far below the international standards. In fact the majority of children were below the third percentile for WHO estimates of height-for-age and weight-for-age. WHO classifies measurements below the 5th percentile as being indicative of severe stunting and wasting. However, contrary to WHO data, this study demonstrated that wasting was much more prevalent than stunting among children in South Wollo. Again, this could be related to the time that measurements were taken. Children also show a distinctly different pattern than adults regarding sex and BMI. Males aged twelve and under tended to have noticeably higher BMI values than females. Throughout Ethiopia, male children are actually more likely to be stunted, wasted, and underweight compared to female children (Mekonnen et al.)
In the Amhara region, this may be the result of male babies receiving water at an earlier age (Mekonnen et al. 2005). This practice could expose male children to contaminated water and subsequently cause diarrhea and vomiting, detrimental to health status (Mekonnen et al. 2005). The results in this study did not suggest that male children were more likely to suffer from stunting. Rather female children were more likely to suffer from wasting. This could be due to the prevalence of treated water sources or use of water treatment in the homes of most participants. There is also a substantial amount of evidence both inside Ethiopia, and in other developing nations, that there is a bias toward nutritional investment in male children. It has been suggested that during lean times or during crop failure, parents differentially invest in children, favoring males (Hadley et al. 2008; Akresh et al. 2009; Behrman 1988). A study conducted in Rwanda found that farmers working under conditions (i.e. farm size, highland area, subsistence agriculture) similar to those in South Wollo tended to allocate a larger portion of nutritional resources to boys in the household (Akresh et al. 2009). Girls in Rwanda had a significantly lower height-for-age z-score than males from the same households (Akresh et al. 2009). Some have suggested that this general trend in disparate investment in male children is likely due to the prevalence of patriarchal societies in developing nations (Hadley et al. 2008). Patriarchal societies, such as the Amhara, allow boys more freedom to find subsistence elsewhere or seek out other food resources (Hadley et al. 2008).

Nubé and van den Boom (2003) suggest that males in developing countries within Sub-Saharan Africa typically had a greater likelihood of exhibiting lower BMI values. By contrast, 15% of males in this study could be classified as normal, compared to only 9% of females. Males only had a 45% prevalence of severe thinness, compared to 63% of
females. Males did however, have higher percentages than women in both the mild and moderate thinness categories. Some studies have shown that during drought, a regular phenomenon in South Wollo, women’s health statuses were more negatively affected, which would explain the lower BMI values for women (Hoddinott and Kinsey 2000). This may also be a result of differential workloads between males and females. Men are more often responsible for extended hours of hard manual labor in the fields, and as such may receive a larger portion of household food resources. However, average adult female BMI did show an advantage over men in all villages, with the exception of men in Agala.

Armspan has been used as a proxy for height in previous studies, particularly those focusing on disabled or elderly populations. However, in Ethiopia when considering armspan and height, it is important to consider ethnic group. Ninety-eight percent of individuals in the study region self-identified as Amhara. There are few studies examining the differences in anthropometric measurements by ethnic group. One study of men from the Amhara region revealed an average height of 170 cm, an arm span of 176.6 cm, and a BMI of 19.1 (de Lucia et al. 2002). Results from this study generally agree with those of de Lucia with the exception of BMI. In this study, BMI values were considerably lower, with an average BMI for adult males of 16.14. For Amhara females, de Lucia et al. (2002) calculated an average height of 156.7 cm, an arm span of 161 cm, and a BMI of 19.6. Again, for women in South Wollo, measurements from all villages are in line with de Lucia et al. (2002) with the exception of BMI. Females in this study had an average BMI of 16.48. Again, these discrepancies may be a consequence of the time that measurements were made, a period just before the first harvest. Consequently results
from this study do suggest, as de Lucia (2002) did, that women have a height weight advantage.

Household BMI is a unique value calculated for this study. Previous studies have typically looked at adult BMI or assessed the BMI for children under five. However, this study incorporates the values for both adults and children. Because children have significantly lower BMI values than their parents, combining the values has dramatic effects on household BMI averages. This is the case for all villages with the exception of Boru Meda. Boru Meda has more single member households with no children compared to all other villages and the adult BMI values for males and females are the third and second highest respectively. Interestingly, household BMI for male-headed households, but not female-headed households, had significant variation across villages. This may be due to the particularly small sample size of female-headed households; only 20% of the total sample was headed by a female, and most female-headed households were concentrated in two villages.

A number of other studies have explored the role that household demographics and household composition have on food security and household well being. In this study, two sets of descriptive statistics were calculated, one set for all households and a second set for only multi-person households. The statistics were run for household size, age of household head, and economic ratio—the factors deemed to have the largest effects on household well-being in previous studies. Household size is important, if for nothing else because of the vital role in access to land; larger families have access to more land as a consequence of the land tenure system. However, the economic ratio may be more important in relationship to drought mitigation strategies. Multi-person
households are more effective in their exploitation of economic resources and are therefore better able to cope during drought (Liu and Wu 1998). Having several members in a home also means that households are able to send someone to work off-farm when resources are limited or crops are lost. Generally, migration for daily labor is not a means of securing wealth, but merely a way for households to prevent destitution. This means that the more individuals in a home who are able to migrate to towns for work, the less likely a household is to lose all of its assets during severe drought (Mebru 2005).

Health and Nutrition

Farmers’ perceptions were used to gauge potential gaps between what farmers believe is healthy and what researchers suggest is important for maintaining a high health status. Participants’ self-reported a gap between their perceptions and what medical and healthcare professions deem to be healthy (e.g. a BMI of 18.50 or greater), though it is not a large one. Generally individuals who reported being “okay” had higher BMIs than individuals who reported being unhealthy. However, the two individuals who self-reported as healthy were actually classified as severely thin. The only village where visits from a healthcare worker appear to have a correlation with perceived health status is in Boru Meda. Individuals who reported a poor health status were more likely to have been visited by a healthcare worker in the recent past. This may be due to the presence of a full service hospital located within the village of Bora Meda. Easy access to care may mean that those who need care, but are not receiving services, may be targeted by healthcare workers. This proximity to healthcare facilities may also result in the low costs associated with Western care in Boru Meda. People may be more likely to visit the hospital for minor things before severe conditions, associated with more costly solutions, develop.
Access to care has been listed as a paramount indicator of stunting in children (Blaney et al. 2008). Although traditional healers may play a more significant role in rural communities in other regions of Ethiopia, the presence of a significant number of healthcare facilities in the study area make them of more marginal use. Bishaniko, the farthest village from the larger town, Dessie, is still only a thirty minute drive to the nearest hospital. Hitacha and Agala both have low preference for hospitals as a first place to seek treatment. For Hitacha, the reluctance to seek care in a professional setting may be reflected in the low household and female BMIs. Top health concerns reported in the village of Hitacha included malaria and kidney disease which can be fatal if left untreated. This may also explain why the cost for households to visit a doctor is relatively expensive, roughly $11.50 USD at the time of the study. Considering Ethiopians have been reported to spend an average of $22 USD on healthcare services per year, the cost to visit a Western facility is very expensive (UNICEF 2010). Agala had the lowest preference for visiting hospitals when an individual needs treatment. Perhaps the expense associated with Western healthcare prevents households from seeking this option. Additionally, many of the top-rated health concerns in Agala are not necessarily “doctor worthy”. Conditions such as headaches, general pain, and dental problems are treated with OTC medications or through other less expensive and more easily accessible avenues. However, HIV and TB were also reported as problems for a significant number of individuals. Still these diseases may not necessarily warrant Western care as the medications used to treat them are typically beyond the financial means of rural Ethiopians. This lack of care may also be the reason that 12% of deaths in Ethiopia are HIV/AIDS-related. For Bishaniko and Amumo, where the distance is greater to a
hospital, treatment at a hospital is preferred, regardless of the high costs. Yet, many of the health concerns and problems associated with this village require immediate medical care and include diseases such as malaria, typhoid, and heart and kidney disease.

Educating households on environmental sanitation, of which pit latrines are an integral part, appears to be the primary focus of healthcare workers in the South Wollo region. Environmental sanitation covers a wide range of topics including housekeeping, separating family living quarters from livestock living areas, and the sanitary removal of human waste. Health workers also appear to focus on personal hygiene which includes family health and family planning, particularly the use of condoms to combat the spread of HIV. Several villages, mostly in the low/mid-lands, reported health complications related to female genital cutting (FGC). However, Bishaniko was the only village to report that healthcare workers were educating residents on the potential harm FGC posed to young women, but none reported training about safe procedures to ensure a high health status once a female had undergone FCC. In Ethiopia, CARE International has had some success in changing attitudes toward FGC by incorporating education on the practice and its negative effects on reproductive health into well-established health extension programs (Chegna 2004). This is a subject many observe as taboo and participants may not have been comfortable discussing the practice.

Vaccinations are offered by healthcare workers free of charge to Ethiopian citizens. The United Nations Children’s Fund (UNICEF 2010) estimates that approximately 75-86% of Ethiopians are vaccinated. The vaccinations which are offered at no cost include polio, hepatitis B, DPT, and TB. However, only 64% of the study population reported having members of the family vaccinated. Regression analyses
suggested that older heads of household tended to be less likely to have vaccinated individuals in the home. This could be because older heads of household tend to have older children who may not be targeted for vaccination by healthcare workers.

Access to clean water is important for household well-being, and in particular child health status. UNICEF (2010) estimates that only 26% of the rural population of Ethiopia has access to treated water sources, but Mekonnen et al. (2005) estimate only 54% can easily access clean water. This study found a comparable percentage of households to that of Mekonnen et al. (2005), with approximately 62% of rural households reporting the use of treated water in the home. All households in Boru Meda and Bishaniko reported having access to treated water, but this is due to their location near a hospital (Boru Meda) and a city center (Bishaniko). For areas not using pretreated sources, such as Agala and Alasha who obtain 100% and 60% of their water from a spring or river respectively, there is the risk of waterborne illness. In Agala, 53% of individuals do not treat water used in the home and 40% of households in Alasha fail to treat as well. In these two villages, households reported that waterborne illness, with symptoms of vomiting and diarrhea was common. Hitacha also has a large portion of its population who are unable to access treated water. However, water in Hitacha is obtained from a pipe and the risk of contamination from human and animal fecal matter is not as high compared to open water sources such as springs or rivers.

Food Aid and Food Security Issues

Using the USAID standards for determining food security, this study was only able to designate six households as food secure. Almost all households pronounced a failure to eat as they needed and/or wanted. Households who responded that they did
receive enough to eat were isolated to Boru Meda, which had the highest aggregate BMI. Additionally, with the exception of Agala, few villages have enough food at the household level to last them more than a few months and 50% relied on food aid receipts at some point. This suggests the widespread occurrence of food insecurity. Other research in the region supports these results of this study (Clay et al. 1999; Devereux 2000; Quisumbing 2003; Sharp 2004; Little et al. 2008; UN World Food Program 2011).

Food stocks, both their quantity and duration, are important in determining food security. The largest positive impacts on food quantity were made by large agricultural inputs (i.e. the number of horses, oxen, and household cost of fertilizer). Livestock and oxen in particular, are important for plowing and preparation of the fields, whereas horses are important tools used during threshing. Threshing is the sole source of grain harvesting in all communities, and requires the use of a team of horses. Individuals who own both oxen and horses are saved from the burden of borrowing livestock and do not run the risk of planting or harvesting late. This agrees with Frank (1999) and Little et al. (2004; 2007), who found that households in the Amhara region which are without oxen, female-headed households in particular, tended to be food insecure as a result of late planting or harvesting because they were forced to borrow animals from neighbors or kin. The cost of fertilizer per household is indicative of the amount of fertilizer used by a household. In an area characterized as severely eroded and degraded, fertilizer may be the necessary boost the soil needs to produce greater quantities of food (Dejene 2003).

Crop rotations were also significant in explaining food quantities. Crop rotations provide two improvements to agricultural productivity. Namely, depending on the type of crop, they reintroduce nutrients back into the soil (Bender 1994). For example, many
farmers rotate maize or barley with a nitrogen-fixing crop such as beans or vetch, and this helps maintain soil fertility (Bender 1994). This may also be why farmers in Alasha and Boru Meda are not heavy users of fertilizer. Secondly, crop rotations disturb the habitat enough to make it difficult for weeds and pests to completely infest an area (Bender 1994). Because there are so many factors specific to a particular village (e.g. soil quality, rainfall, and use of inputs) it is difficult to determine which one contributed to the negative impact on food quantities. As for traditional healers, a negative association is most likely due to the demand for in-kind payment, which is typically in the form of small livestock, sheep, chickens, or grain.

Many of the variables influencing the duration of food stocks most likely have an indirect effect through food quantity. However, the influence of gender of head of household is specific to food stock duration and this is likely due to the control women have over food storage and rations in the home. Additionally women are more likely to reserve food resources for household consumption, a fact the World Food Program has embraced, as it now requires a majority of food aid receipts to be controlled by women (Quisumbing 2003) Although there was not a variable in the study to account for kin help, Little et al. (2002; 2004) suggested that kin relations are an important means of recover and contribution in times of need.

Frank (1999) argues that gender, specifically gender of head of household, is one of the most important explanatory variables in food security. The results of this study only partially support gender as a factor in food security. Regarding the quantity of food stocks, gender did not play a significant role. However, the village with the greatest number of female-headed households, on average, stored less than two quintals of grain.
This could be due to small sample size. But gender is significant in explaining how long food stocks last; food of all kinds in female-headed households, or at least controlled by females, are used more successfully and efficiently for household purposes (Quisumbing 2003; Frank 1999). This may be the reason that gender has a negative effect on food duration and overall food security, as males were coded higher than females. Additionally, the differences seen in food duration across villages for male heads of household are significant, whereas there were no significant differences in food stock duration across villages in female-headed households.

Extra grain purchases are another way of measuring household food security and there appears to be a relationship between a household’s frequency of grain purchases and their participation in food aid. Generally speaking, households who purchase grain yearly, with the exception of Amumo, do not receive food aid. However, households who never or rarely purchase grain seem to be more likely to receive food aid, e.g., the villages of Gerado and Hitacha. This could be the result of successful targeting; households who are too poor to purchase grain are receiving it, or it could be that food aid receipts are creating dependency on supplemental foods. Desalegn et al. (2006) warned that food aid receipts, when improperly managed could create vulnerability in the form of household dependence. By contrast it has been argued that often small quantities and irregularity of food aid packages discourage such behavior (Moges and Holden 2007; Little et al. 2008). In this study, one farmer noted that he received approximately 50 kgs of grain every three months, suggesting that there is some regularity of food aid. Still, the amount is small, perhaps only enough to last the family one month.
Household cost of fertilizer and household economic ratio both have negative impacts on frequent grain purchases meaning that the more fertilizer and the more people of “working” age who are available to work the fields, the less likely a household is to purchase grain. Participation in religious organizations also had a positive effect. After speaking with faculty at Wollo University and several community members, it was noted that families active in religious organizations, particularly Muslim organizations, are often responsible for hosting festivals for the community. This is an especially interesting trend given that the Amhara were formally an Orthodox Christian group, and have only recently made the transition to Islam (Messing and Skoddard 1998). These festivals are often an important source of financial and grain stress because of the magnitude of donations required. Years of farming experience were also associated with an increase in frequency of grain purchases. This could be due to age, in that older farmers may be responsible for larger families or are unable to work the fields with the same vigor.

Participation in food aid only had two significant explanatory variables—the degree of crop loss due to drought and head of household’s age. The degree of crop loss due to drought makes sense intuitively. But also the results of this study support those of Bashaasha et al. (2006); the more crop loss a family experiences, the more likely they are to seek grain sources elsewhere or need help from the Government. Older heads of households appear to be less likely to receive food aid. This outcome contradicts Quisumbing’s (2003) finding that aid was specifically targeted to families with elderly heads of household. Also gender, livestock (assets), and irrigation were not significant, which contradicts previous studies conducted throughout Ethiopia (Frank 1999;
Quisumbing 2003; Tesfaye et al. 2008). However, non-parametric analyses did show that there are significant differences in participation in food aid between male and female-headed households. This discrepancy may be because the study site is within the traditional famine area which has been promoted as part of a fairly successful food aid targeting program (Clay et al. 1999). Perhaps this means that only families who truly need aid receive it, rather than simply supporting those households with elderly members and females as heads.

**Agriculture and Economics**

The average hectares of land controlled by farmers in the study area were 0.91, just higher than the 0.82 hectares reported in other studies (Little et al. 2007). However the difference between the amounts of land farmed by males and females as heads of household was significant; males farm 0.95 hectares, whereas females farm 0.70 hectares. The amount of land farmed by females who head a household is nearly 25% less than male headed households and these results agree with previous research results (Frank 1999; Little et al. 2007). Farmers typically designate a certain amount of land for growing grains for household use. The remaining land is then divided up for other activities such as grazing, fruit or *khat* production, and in many cases wood production or areas allowed to grow as forest. Although Alasha has the most land designated for forest production, Boru Meda has the largest percentage of total forest land. This is most likely due to the use of trees in construction. Boru Meda is the closest village to the urban center, Dessie, where a recent economic boom has resulted in a surge of construction. As such, many farmers in Boru Meda have relied heavily on tree products, specifically for construction and firewood, as a means of earning extra income. The Village of Bishaniko, though they
have one of the smallest average plots, dedicates the largest percentage of farmland to crops. This could be due to two factors specific to this village. The first is that almost half of the households surveyed in this village are headed by women and women are more likely to invest resources into household well-being, including more grain and more food. Also, this village is the beneficiary of Government-initiated agricultural development on a much larger scale than the other villages. Many of the farmers in this village are “model” farmers and as such receive improved seed and instruction on farming techniques. This may mean that more of their land is dedicated to crops as a result of stipulation from the government and agriculture office located within the village. Overall, Agala and Amumo have the largest average plots, but this is not surprising as the land tenure system is based upon family size. Agala and Amumo have the largest families hence individual farmers would have received the largest plots (Bigsten et al. 2002).

Just like the uses of land vary by village, crops grown and crop rotations vary drastically by village. Most farmers, with the exception of those in Alasha, incorporate nitrogen-fixing crops into their rotations. Although they may not know of its soil fertility boosting properties, they certainly make note that their production is better when using this type of rotation. Agala is an excellent example. Agala has the most severely degraded soil (interview with Addis Ababa agronomist May 21, 2011) but also has the greatest crop diversity. By contrast Alasha is the only village to grow during one season; however, farmers here derive a significant amount of income from livestock rearing and devote a large portion of land to grazing livestock.

Wheat, teff, and barley have long been an important component in Ethiopian agriculture, dating back to the foundations of plant domestication (Ehret 1979). Teff is a
commonly grown crop both because of its cultural importance and marketability, but also because of its drought resistance. However, wheat is the only consistent crop found in all production schemes, but this too may be the result of marketability and immense household use. Barley may have added importance for those who also engage in maize production. Previous research performed in Hungary suggest that the increases in yield as a result of crop rotation were greatest in systems that incorporated barley and maize together (Berzensy et al. 2000).

Seed acquisition is mostly from the farmers themselves through their own production, at least in Eastern Ethiopia (McGuire 2008). Interviews in the study area agree with this finding; sixty-three percent of farmers obtained the seed to plant new crops using those derived from their own previous crop production. Still, a substantial number of farmers obtain seed from agricultural offices or the market. Also, in Bishaniko, the home of the model farmers, 50% obtain their seed from a local market. Model farmers, because they participate in Ethiopian Government-sanctioned agricultural activities (e.g. cropping systems or improved seed) receive their seed at either a reduced cost or free from the agricultural office. In return for utilizing these government-approved methods, they are rewarded with plots of land and improved building materials.

Irrigation and fertilizer use in any farming system is very much dependent on the types of crops grown and the number of growing seasons in a farmer’s production system (Bender 1994). Irrigation use is very low for Boru Meda and Alasha, as these villages rely mostly on belg rains during the spring months and do not grow crops that require irrigation. Irrigation begins to be common place in the villages of Gerado and Agala. Here there is an almost total reliance on belg and meher rains. But more importantly there
is a switch in production types as far as money-making activities. Agala with its *khat* production, and Gerado with its vegetable production, both require irrigation to grow crops which are sold at market. Other studies have suggested that farmers who use irrigation are able to produce more lucrative cash crops and often grow two crops a year (Tesfaye et al. 2008; Rosell and Homer 2007). Boru Meda may be an exception as farmers routinely produce two crops a year without the benefit of irrigation.

Irrigation is also particularly prevalent in villages where *teff* is grown. Agriculture in South Wollo is characterized by *teff* and grain production, with one in eight farmers living in *teff*-potential areas (Rosell and Holmer 2007). *Teff* is a short season crop, and requires only ninety days to complete its growth cycle. Farmers typically grow *teff* during the *belg* rainy season from March to May (Rosell and Holmer 2007). This short window requires conditions to be fairly consistent from year-to-year as an interruption in rain levels has devastating effects on *teff* crops. Some have insinuated that the amount of rainfall has not necessarily changed; rather there has been an increase in variability over the past century with less consistency in the number of rainy days, in Ethiopia as well as other African counties such as Niger (Shenoda et al. 1999; Seleshi and Camberlin 2006; Rosell and Holmer 2007). The differences in variability for three sites used in this study was previously measured for rainfall through time; Hyke (Tehuledere), Dessie, and Kutaber. Hyke and Dessie experienced a 41% and 26% increase in variability from 1983 to 2003 respectively (Rosell and Holmer 2006). Particularly with regard to the *meher* (longer) rainy season which typically runs from July to October, extended dry periods in the middle of the season have catastrophic effects on crops (Seleshi and Camberlin 2006). This may explain the widespread use of irrigation in *teff*-growing villages.
Although the mid/lowlands do not see a significant increase in irrigation use, they do see a significant increase in the cost to maintain irrigation. Irrigation systems in Gerado and Agala are maintained by the individual farmers and are less technical, such as a borehole or tube-well, than those in the lowlands. Irrigation systems in the lowland have more materials that farmers must pay for out-of-pocket annually such as plastic lining. Bishaniko is a unique case in that the work needed to establish and maintain irrigation systems is almost always contracted out. However farmers in Bishaniko mitigate this cost through a co-operative situation. Often a group of neighboring farmers come together to split the costs associated with hiring someone to build the system. This development of a cooperative as a way to increase income, without incurring all of the costs in a single household, is not new to Ethiopia. Holloway et al. (2000) uses an example of dairy farmers in the highlands of the Oromo region who formed a cooperative in order to establish a stable market and split the costs associated with smallholder dairy production. The case in Bishaniko is similar in that, rather than investing in dairy cows which are very expensive, farmers in this village invest in irrigation as a means to produce larger quantities of teff, khat, fruits, and vegetables, thus securing access to a more stable market (khat and teff mostly). This also has important implications for Bishaniko, as half the households are headed by females and they are disproportionately disadvantaged in their access to livestock (Frank 1999; Little et al. 2004). This limited access to livestock makes dairying or other husbandry activities unrealistic, but women can more easily afford to purchase materials to establish irrigation schemes on their farms, particularly if those costs are shared with neighbors. Household size and the cost to maintain an irrigation system had significant positive effects on the likelihood that
farmers would use irrigation. A larger household size means there are more individuals to help maintain the system, particularly the digging necessary for boreholes and tube-wells. Fertilizer was also found to be an important indicator of irrigation use. The findings in this study did not substantiate those obtained in Eastern Ethiopia, which state that as farm size increases, there is a failure to utilize irrigation as part of a production scheme (Bekele and Tilahun 2006). Farmers in Agala and Amumo have the largest average farm sizes and the second and third highest prevalence of farmers using irrigation. Irrigation, a major component of development initiatives since the 1960s, was not an issue widely requested of development agents or extension officers by respondents in other studies conducted in the Mekele Plateau located in northern Ethiopia (Aberra 2006). But unlike the farmers in Bekele’s (2004) study, many farmers in this study, particularly in the lowlands, did have lined storage ponds. These linings were actually one of the reasons that the cost for irrigation spiked in the lowlands; other than hiring a laborer to dig the irrigation trenches the lining, which needs to be replaced annually, is the only major expense associated with irrigation.

Fertilizer has a much more widespread use than irrigation but fertilizer use and expense are not so easily accounted for. Fifty-nine percent of farmers in this study used fertilizer, considerably more than the 40% Assefa et al. (2008) projected. According to soil scientists and agronomists from Wollo University and Addis Ababa University, the soil found in Agala is severely degraded and farmers often have a hard time growing crops that produce well. This may account for the high average household cost for fertilizer in this particular area. It is acknowledged, however, that fertilizer alone is not the solution to poor soil quality. In the other villages where fertilizer is commonly used, it
could be that extension officers encourage fertilizer use and that they have the extra income that highland villages do not possess to spend on fertilizer. Lowland villages also grow crops such as *khat*, fruits, and vegetables that may need fertilizer. Additionally, fertilizer is closely tied to irrigation, which is common in the lowlands. But the reasons for not using fertilizer are clear; most farmers attributed their lack of its use to expense and lack of need. The latter factor, a lack of need, was found mostly in the villages of Alasha and Boru Meda. In Alasha, farmers reported that because they only grow one crop each year, fertilizer use was not necessary. They explained that “fertilizer was not necessary for *belg* season” or “fertilizer is for *meher* production.” By contrast, farmers in Boru Meda reported most often that there was little need for fertilizer because it burned crops. This could be a result of poor consumer education regarding the appropriate rate and application method for applying fertilizer among farmers in Boru Meda.

Conservation is also an important component of any production scheme. Typically rain-fed agriculturalists are more likely to use contour bunding, terraces, and drought resistant crops (Desalegn et al. 2006). However, results of this study indicate that contour bunding and drought resistant crops were more common among farmers using irrigation. In this study, regardless of circumstances, almost all farmers used terraces. But rain-fed agriculturalists were more likely to utilize contour plowing. According to previous studies, uncertainty and the increase of farm size have the potential to increase the likelihood that conservation mechanisms will be removed (Gebrehedhin and Swinton 2003). But, this was not the case for the population in this study. In fact, almost all farmers reported using conservation mechanisms and utilizing more types than in previous years. Most commonly, those individuals who reported not using conservation
practices were women who lacked farming experience. Conservation agriculture was introduced in Sub-Saharan Africa by the UN Food and Agriculture Organization and incorporates the concept of no till (planting without disrupting or turning the soil), crop residue burning, and semi-permanent ground cover (which in some cases means leaving the crop residue) to reduce erosion and improve water moisture (Rockstrom et al. 2009). This practice, in combination with the use of fertilizers and herbicides has been shown to improve crop yield drastically. The no till practice is beneficial for poor households, particularly those headed by females, as they would no longer need to borrow or beg for the use of oxen to plow their fields. However, conservation agriculture, to reach its full potential, does require the use of herbicides and pesticides and neither of these are commonly used among Ethiopian farmers, particularly highland farmers in South Wollo (Giller et al. 2009). This study revealed that few farmers, even those losing almost 20% of their crop to pests, did not use pesticides. Without the use of pesticides and herbicides, the effectiveness of conservation agriculture is minimized, which would require an increased labor commitment to weed fields. An increased labor commitment would make conservation agriculture practical among households with large economic ratios, but not for others (Giller et al. 2009). Additionally, conservation agriculture requires the development of complex crop rotations which incorporate nitrogen-fixing plants or plants with other beneficial properties (Giller et al. 2009). Although many farmers in this study continue to utilize traditional crop rotations ideal for conservation agriculture, there are several farmers who have dedicated large portions of their farmland to the growth of market crops such as *khat*, fruit, and vegetables.
Even with extensive conservation mechanisms and irrigation systems in place, crop loss due to drought is a regular occurrence for farmers in South Wollo. Although households who experienced a total loss are a small minority, mostly all households experienced some amount of loss. Crop loss is most heavily experienced by households in the highlands. These households are the least likely to use fertilizer or irrigation in their production schemes but they also grow the least drought-resistant crops. The mid/lowlands, villages such as Hitacha, Amumo, and Bishaniko, not only incorporate irrigation more consistently in the agricultural practices, but they grow native crops that are more adapted to drought conditions, specifically teff and sorghum. Crop loss due to pests is also an important agricultural problem and it has been asserted that most farmers rely on native or traditional pest management mechanisms but not on chemical pesticides (Abate et al. 2000; Tefara 2004). Crop loss due to pests is much less severe in the highlands where temperatures tend to be cooler and less suited for maize and teff pests. The fact that few crops are lost due to pests may also be due to intercropping, which is known to reduce the prevalence of certain pests considerably. Intercropping was either reported or observed in Boru Meda, Alasha, and Gerado. However, in the warmer lowland regions, as much as 20% of a farmer’s crop can be lost as a result of infestation. Consequently farmers, particularly in Amumo and Bishaniko, are more likely to utilize chemical pest control methods. Although none of the chemicals farmers use are known to be carcinogenic, their toxicity to aquatic environments could be hazardous if or when run-off enters nearby streams, particularly those which are potential water sources for other households.
Even in years where there is a loss in crop productivity due to pests or drought, farmers must harvest and process their grain. In order to accomplish this, farmers must have access to certain livestock, namely oxen and pack animals. Livestock distributions between the villages reflect not only production needs, but needs associated with money-making activities. For example in Boru Meda and Gerado, where dairy production is a means of earning extra income, the largest concentrations of cattle are present. Also in the village of Alasha, a large portion of households rely on livestock as a means of bringing in additional income; consequently Alasha has the largest concentration of most types of livestock and the greatest associated cost for livestock maintenance. For areas within villages such as Boru Meda, Alasha, and Agala, where trees for construction and firewood are important money-generating activities, there are larger concentrations of pack animals such as mules, donkeys, and horses. Farmers in Bishaniko do not have a significant number of pack animals, but they rely heavily on lumber and firewood production. This may be due to the village’s proximity to the market place. Taxis or horse-carts may be more convenient than the year-round maintenance of a pack animal. This also explains the low monthly cost associated with livestock in Bishaniko. Sheep tend to be more common in the highlands; this is probably due to the availability of grazing land in highland regions. Little et al. (2007) found that 35% of rural residents in South Wollo did not have oxen, a comparable number to that found in this study. Previous studies have suggested that households with no oxen were most at risk of running low on food stockpiles (Frank 1999; Little et al. 2007). The results of this study disagree with this risk assessment. In South Wollo, male-headed households controlled more livestock
in each category, compared to female-headed households, and this is supported by previous studies (Frank 1999; Little et al. 2007).

In their efforts to mitigate drought and crop loss, farmers seek information and education from local extension officers. Most requests of extension agents are related to crop production, such as the use of fertilizer, composting, and improved seed. This was true for all villages, including villages such as Alasha, where fertilizer is not widely used. Other requested extension services usually centered on animal rearing and production, such as veterinary services and fattening programs. In other words, extension services appear to be just another step toward alternative drought mitigation practices. One such practice, migration, is widely studied and a growing phenomenon in Ethiopia. Although many studies focus on the permanent or semi-permanent movement of a family member out of the household for work, this study included many individuals who spend a large portion of their time off farm, working for pay. Though not a particularly common practice in many of the villages, the findings agree with Tefera (2004) that roughly one fourth of farmers in this region migrate for paid labor. Additionally, there was no significant difference in the pursuit of daily labor between rain-fed and agriculturalists and those who use irrigation, a result which supports Makombe et al.’s (2007) findings. Several factors may drive family members to migrate, including the high costs associated with medical care and hosting festivals. But this issue may also fail to acknowledge the full scope of migration occurring in the region. Many individuals reported only younger sons or a daughter working in nearby towns. However, some households acknowledged that there were family members that were gone several times each week selling construction materials and participating in construction work. Other sources of drought
mitigation were usually related to money-making activities that households were already engaged in. For example, in the lowlands where irrigation is utilized by most farmers, many dedicate larger portions of their farm to *khat* and fruit production, another means of income and a method of surviving drought. For others savings, reducing food intake, and receiving food aid were major means of surviving dry periods of low rainfall.

**Significant Influences on Nutritional Status**

The primary focus of this study was on the influences that agriculture and related issues have on household well-being, measured in this case via household BMI. In both models, linear regression and mixed model, multiple factors have a significant impact including gender of the head of household, economic ratio, village, religion, number of sheep, degree of crop loss during the last drought, and irrigation. Irrigation and fertilizer were both associated with positive health outcomes in the mixed model analysis. This is most probably due to a positive correlation with food stocks, which means more food on the household's table. Gender of the head of household revealed that household BMI was negatively affected by having a male head of household and this is supported in many previous studies, e.g. Frank 1999; Carter et al. 2004; Little et al. 2004, and Blaney et al. (2008). Females tend to invest resources into household well-being and this is reflected in the anthropometric data collected for this study. Household assets appear to be a positive predictor of household well-being (Croppenstedt and Muller 2000; Bashaasha et al. 2006; and Little et al. 2007). This study, measuring assets in number of livestock, had partial agreement with earlier studies. Although mules and donkeys were negative predictors, sheep were positively associated with household wellbeing. This may be because sheep are more likely to be an asset used in hard times for food. However, oxen were not found
to be significant predictors of well-being in contrast to earlier studies (Little et al. 2007). Past shocks have been shown to be negative predictors for household well-being, and in this study, using degree of crop loss due to the most recent drought as a proxy for past shocks, confirmed these results (Bashaasha et al. 2006). The amount of land one farms was not a significant predictor of household BMI, though this may be because almost all households controlled over 0.40 hectares, a threshold previously suggested as necessary for positive well-being outcomes (Bashaasha et al. 2006). Household size, age of household head, number of crops grown, access to extension, and seed source were all deemed important in previous studies but were not shown to be significant using either linear regression or mixed model analysis (Bashaasha et al. 2006; Little et al. 2007). Throughout all villages, women tended to be leaner than men, despite the fact that men are typically the head of household and perform the heaviest labor.

Conclusions

Household well-being is a dynamic and varied concept in South Wollo, Ethiopia. Farmers here have had to frequently combat disease, famine, and natural disaster. This study supports many of the factors previous researchers have found to be moderately good predictors of household well-being. However, there are significant differences, many of which arose due to a lack of standard for measuring household well-being and the use of household BMI. Most studies utilize poverty, typically measured in oxen, adult BMI, or child BMI as a measure of household well-being. Household BMI, though not common in the literature, was used to account for the differences between adult and child BMI, as well as differences between male and female BMI. Additionally, the holistic approach used in this study, which incorporates farmers’ perception as well as household
BMI, helped to untangle the relationship between livestock and household well-being. Livestock, particularly oxen, a primary source of household wealth, were not significant in predicting household well-being. Instead their importance was shown to be isolated to their role in production, specifically the amount of grain stored annually. Other social factors, namely gender of the head of household and smaller types of livestock, such as sheep, were found to be better predictors of household well-being. This is important for policy makers, who may use previous studies to encourage livestock building to the exclusion of other forms development, e.g., micro-enterprise for women.

Another finding substantiated by this study focused on gender. Female-headed households were positively associated with household well-being, despite being at a disadvantage in most measures of agricultural productivity. This study highlights the importance of using a holistic approach in the study of food insecurity, poverty, and well-being in Ethiopia. Such findings have value for policy developers at the local, regional, and national levels. In South Wollo, agricultural agents can use information gathered to enhance extension services offered to farmers in the region. Tailoring specific outreach programs to the individual needs of each village is not only a more efficient use of Government and donor funds, but it also allows farmers and extension workers to build on existing knowledge and skills within the community. Many households that grow vegetables do not consume them on farm, but instead send them to market. A focus on vegetable gardens for household use would be an important step toward more nutritious food reaching rural peoples in South Wollo. Regionally, data gathered on food aid receipts and those factors influencing the need for food aid are important. Officials in Amhara, a drought prone region in Ethiopia, can help build programs and policies that
ultimately strike at the core of food insecurity. Focusing on crop rotations that improve overall soil fertility, without the expense of irrigation or fertilizer, and empowering females to control food resources would be important steps toward a food secure region. Nationally, an emphasis on nutrition education is greatly needed. When interviewing households regarding nutrition, most individuals simply relied on the quantity of food to determine “nutrition” rather than quality or variety, suggesting a serious gap in knowledge related to creating and maintaining healthy households.

Limitations of the Study

Although it is acknowledged that health and nutritional status have significant impacts on agricultural productivity, this study focused on factors influencing nutritional status, specifically BMI. Thus the influence of nutritional status on agricultural productivity was not explored thoroughly. Another deficiency in this study was related to timing of anthropometric measurements. Because measurements were taken during the starvation period, just before the harvest, most BMI values were very low, and did not necessarily reflect household well-being throughout the year. Regardless, it is acknowledged that BMI is simply a snapshot of health status at a given time and interpretation of results should be done with this concept in mind. This study also failed to normalize BMI for age, however, even when age is reported, concepts of time are rarely precise for rural families and as such exact dates could not be recorded. Without proper documentation age is a relative number and efforts to normalize the data set may not necessarily reflect actual population ages. Additionally, the WHO recommends the use of mid-upper arm circumference (MUAC) for children and the ponderal index (weight/height³) for adults, rather than BMI, for measuring health and well-being.
This study failed to account for the educational attainment of the head of household which was a prominent predictor of productivity in previous studies of food security. The WHO also emphasizes the importance of educational attainment, especially for children, as an indicator of household well-being. In addition, this study was of short duration, rather than a long-term, in-depth one and consequently, a different picture might emerge for many of the variables assessed in this three-month study.

Although this study failed to account for farmers’ perceptions of rain variability, particularly over time, many have suggested that it is a paramount issue facing agriculturalists (Deressa and Hassan 2009). Increased rain variability combined with rising temperatures will, in time, decrease the ability of farmers to produce crops on their land and has in some regions, most notably East Africa, already caused traditional farming systems to be ineffective (Mutai 2007; Deressa and Hassan 2009). Future studies should incorporate measures of actual rain variability, as well as farmers’ perceptions and subsequent responses to this climate unpredictability.
Appendix A: IRB Approved Informed Consent (Adults)

INFORMED CONSENT FORM

IRB# 20100310613EP

Identification of Project: Effects of Agriculture on the Nutritional Status of Rural Ethiopian Communities

Purpose of the Research: The purpose of the project is to combine the use of measurements of the body such as height and weight and listen to your concerns and perspectives to draw a more holistic picture of nutrition and related agricultural productivity in one or two rural communities of the drought prone Amhara region in Ethiopia. Because Ethiopia is one of the poorest and most densely populated countries in the world, it is the recipient of large quantities of food aid and farming development initiatives. With the introduction of Western farming techniques, there has been a push away from traditional crops and farming practices, resulting in the deterioration of agricultural productivity and health status in rural areas. This research project will examine traditional farming practices, agricultural productivity, and health status from the recipient perspective to provide a better understanding of how development and aid might be better targeted.

Procedures: Participation in this study will require about 90 minutes of your time. I will ask you questions and we will discuss your concerns, ideas, and needs. Additionally, I will collect weight, height and skin fold data. This data will be collected using a portable ruler or stadiometer to measure height, a portable scale to measure weight, a skin fold caliper to measure body fat, and a tape measure to measure upper arm circumference and arm span. All data collection will be performed by a team which includes the UNL primary researcher and a scholar from Wollo University in the region of study who will also act as interpreter.

Risks and/or Discomforts: There are no known risks or discomforts associated with this research. If for any reason you are uncomfortable answering a given question, you may refuse to answer or skip a particular section. Additionally, interviews and measurements will be conducted at a time convenient for you and your family with as little interference in your daily schedule as possible. For example, I would be happy to visit your home at dinner time if that would be helpful to you.

Benefits: You and your family will be provided with immediate feedback about your current nutritional status (BMI, weight comparable to others in and the same age categories in this region). Additionally, a community debriefing will occur where you can ask questions about the study and I will explain how the data are to be used. Additionally information on health, nutrition, and agriculture will be available at the community meeting. Lastly, equipment will be left with the local university to continue anthropometric measurements so long-term data can be collected and provide better insight into health and nutrition in your region. This will allow you and your family to monitor changes in your body health indicators.
Confidentiality: Any information obtained during this study which could identify you will be kept strictly confidential. The data will be stored in at universities in Ethiopia and the U.S. and will only be seen by the investigators during the study. The information obtained in this study may be published in scientific journals or presented at scientific meetings but the data will be grouped and described for the region, not by individual families.

Compensation: There is no compensation for participation in this work; however I will provide a small gift for each family, such as soap or toothbrushes, for speaking with me.

Opportunity to Ask Questions: You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. You may contact the investigator at any time, through the Wollo University Extension Center. Please contact the investigator:

- if you want to voice concerns or complaints about the research
- in the event of a research related injury.
- you wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
- to voice concerns or complaints about the research
- to provide input concerning the research process
- in the event the study staff could not be reached

Faculty at Wollo University will then contact the University of Nebraska on your behalf.

Freedom to Withdraw: Participation in this study is voluntary. You can refuse to participate or withdraw at any time without harming your relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Consent, Right to Receive a Copy: You are voluntarily making a decision about whether or not you wish to participate in this research study. Your signature certifies that you have decided to participate, having read the documents or after someone has read the documents to you. You will be given a copy of this consent form to keep.

Signature of Participant: ____________________________

Name of Participant ____________________________ Date ____________________________

Primary Investigator: Annie Cafer, B.Sc.

Email Address: anniecafer@gmail.com
Appendix B: IRB Approved Parental Informed Consent

PARENTAL INFORMED CONSENT FORM  
(TO BE PRESENTED VERBALLY)

IRB # 20100310613EP  
THE EFFECTS OF AGRICULTURE ON NUTRITIONAL STATUS IN RURAL ETHIOPIAN COMMUNITIES

You are invited to permit your child to participate in this research study. The following information is provided in written form and will be read to you in order to help you to make an informed decision about whether or not to allow your child to participate. If you have any questions please ask at any time.

Your child is eligible to participate in this study because he/she lives in your household and is under the age of 19. Your child will also be asked if he/she is willing to participate.

The purpose of this study is to determine whether children are growing at the same rate as others in this region.

This study will take approximately fifteen minutes of your child’s time. This study will be conducted in or near your home. In order to assess nutritional status we will record measurements using a portable ruler (to measure height), portable scale (to measure weight), skin fold caliper (to estimate body fat), and a tape measure (to measure arm span and upper arm circumference). All measurements are non-invasive and pain free. This information, in turn, will allow us to assess the health and nutrition of your child. All of these measures are considered routine in a health clinic. The data will be given to you so that you can see where your child is compared to others of the same age.

There are no known risks associated with this research.

The information obtained from this study may help us to better understand the impact food resources and agricultural output have on nutrition. Additionally, if your child is small for his/her age, you will be given information on ways to maximize your child’s health.

Any information obtained during this study which could identify your child will be kept strictly confidential. The records will be kept in a locked file at the University of Nebraska and only available for view by the primary investigators (one from the U.S. and one from Wollo University) for five years. The information obtained in this study may be published in scientific journals or presented at scientific meetings, but the data will be reported from the region and as a group. Your child’s identity will be kept strictly confidential.

Your child’s rights as a research participant have been explained to you. You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. You may contact the investigator at any time, through the Wollo University Extension Office.
Please contact the investigator:
• if you want to voice concerns or complaints about the research
• in the event of a research related injury

Contact Wollo University so that they can contact me for the following reasons:
• you wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
• to voice concerns or complaints about the research
• to provide input concerning the research process
• in the event the study staff could not be reached

Participation in this study is voluntary. You are free to decide not to enroll your child in this study. You can refuse to participate or withdraw your child at any time without harming their or your relationship with the researchers at Wollo University or the University of Nebraska-Lincoln, (or other institutions or organizations), or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

DOCUMENTATION OF INFORMED CONSENT
YOU ARE VOLUNTARILY MAKING A DECISION WHETHER OR NOT TO ALLOW YOUR CHILD TO PARTICIPATE IN THE RESEARCH STUDY. YOUR SIGNATURE CERTIFIES THAT YOU HAVE DECIDED TO ALLOW YOUR CHILD TO PARTICIPATE HAVING READ AND UNDERSTOOD THE INFORMATION PRESENTED. YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP.

__________________________________________
Child’s Name

__________________________________________
Signature of Parent

__________________________________________
Date

IN MY JUDGEMENT THE PARENT/LEGAL GUARDIAN IS VOLUNTARILY AND KNOWINGLY GIVING INFORMED CONSENT AND POSSESSES THE LEGAL CAPACITY TO GIVE INFORMED CONSENT TO PARTICIPATE IN THIS RESEARCH STUDY.

__________________________________________
Signature of Investigator

__________________________________________
Date

IDENTIFICATION OF INVESTIGATORS
PRIMARY INVESTIGATOR
Anne M. Cafer, BSc
Email Address:anniecafer@gamil.com
Wollo University
Appendix C: IRB Approved Confidentiality Agreement

RESEARCH CONFIDENTIALITY AGREEMENT

I, ___________________________, agree to protect and keep confidential any information, to which I have access that is obtained during this study and which could identify participants and their families including but not limited to:

- Name
- Age
- Any responses to questionnaires
- Conversations between researchers and participants
- Health information and statistics
- Income and assets
- Any information pertaining to children

Furthermore, it should be noted that confidential information is defined as all information except information accessed via public records.

Signed: ___________________________ Date: __________________

Primary Investigator’s Signature: ___________________________

Secondary Investigator’s Signature: ___________________________
Appendix D: Anthropometric Protocol

Stature/Height:
1. Participants will be barefoot and all hair ornaments will be removed
2. Participants will stand on the stadiometer floorboard with their back to the measuring rod of the stadiometer.
3. Participants will be asked to distribute their weight evenly on both feet, with their arms at the side and palms facing inward
4. The heels of the feet will be placed together with each touching the backboard of the stadiometer at an angle of approximately 60 degrees (medial border).
5. The heels, buttocks, scapulae and posterior cranium will be in contact with the vertical backboard of the stadiometer. If subjects were unable to keep these points in contact with the board while maintaining a normal posture, the buttocks and heels OR cranium will be placed in contact with the board.
6. The subject’s head will be placed in the Frankfurt Horizontal Plane.
7. Subjects will be instructed to take a deep breath and maintain an erect posture.
8. The measurement will be taken on the most superior point of the head with enough pressure to depress the hair on the top of the head.
9. This measurement will be taken to the nearest cm

Upper arm circumference:
1. Participants will be asked to hold their arms perpendicular to the floor
2. An examiner will stand at the participant’s side and place the measuring tape around the upper arm, half way between the shoulder and elbow.
3. The tape will be checked to insure that it was parallel to the elbow and snug to (but not compressing) the skin.
4. This measurement will be taken to the nearest cm

Arm span:
1. The participants arms will be bare
2. Participant will stand with their back against a wall and asked to hold both arms out perpendicular to the floor
3. Researchers will stand on either end of the arm and hold the tape measure from finger tip to finger tip across the chest
4. The measurement will be taken to the nearest cm.

Weight:
1. Participants will be barefoot and remove all heavy jewelry
2. Participants will stand on the scales base
3. Participants will be told to distribute their weight evenly on both feet, with their arms at the side and palms facing inward
4. The heels of the feet will be placed together at an angle of approximately 60 degrees (medial border).
5. The subject’s head will be placed in the Frankfurt Horizontal Plane.
6. The measurement will be taken to the nearest 1lb mark.
Skin Fold:

1. The participant will be sitting and asked to relax their muscles
2. The examiner will select skin folds at the medial calf, the front of the thigh (depending on modesty of individual), and over the triceps and biceps.
3. The examiner will pinch the skin at the appropriate site to raise a double layer of skin and the underlying adipose tissue.
4. The calipers will then be applied 1 cm below and at right angles to the pinch
5. Measurements will be taken to the nearest mm

*All measurements will be taken by the same researchers using the same equipment to minimize variability.

*Frankfurt Horizontal Plane: a horizontal plane on which the upper part of the ear canal and the lower part of the orbit of the eye are parallel with the floor.
Appendix E: Questionnaire

* Indicates contributions from Wollo University Faculty and Development Agents

Demographics:

1. Household size
2. Number of adults
3. Ages of individuals
4. Age of household head
5. Religion
6. Participation and active membership in governance and administrative institutions
7. Participation and active membership in social and/or religious institutions
8. Number of females v. number of males in household
9. Number of economically active individuals (≥ 15 and ≤65)
10. Number of economically dependent individuals (≤15 and ≥65)

Nutritional Component.

1. Do you think your body is healthy

   (healthy: no sickness)  (okay: not good/not bad)  (not healthy: sick/needing care)

2. How did you learn about health?
3. Have you ever been visited by a community health worker?
   a. If yes:
      i. When was the last visit?
      ii. How often do they visit?
      iii. Other times in your life you remember them visiting?
      iv. What did they teach you? What did you learn?
4. What are the biggest health concerns for you?
5. What have been the biggest health concerns for you in the past?
6. What are the biggest health concerns for your family?
   a. In the past?
7. What is your first place to seek treatment?
   a. Has this resource always been available
   b. What types of services (home remedies, traditional healers, etc)*
8. Do you use a traditional healer for treatment?
   a. If yes:
      i. What type of traditional healer (ask about gender)*
      ii. For what kinds of treatment?
      iii. When do you seek their help?
      iv. Why do you seek their help?
      v. What do they tell you?
      vi. How much do you pay them for treatment?
      vii. Ask about maintaining balance between supernatural and the people*

9. Do you use western doctors/facilities for treatment?
   a. If yes:
      i. For what kinds of treatment?
      ii. When do you seek their help?
      iii. Why do you seek their help?
      iv. How much do you pay them for treatment?

10. What do you eat?

11. How much of each food do you eat?

12. What time(s) of day do you eat?

13. Are you eating as often as you need to?

14. Are you eating as often as you want to?

15. Are you eating enough of the types of foods you think of as good, healthy?

16. Have your eating patterns changed over time?
   a. If so, how?

17. If you could add something to your meals, what would it be?

18. Are there foods that you cannot eat because of tradition?*
   a. If yes: What are these foods?*

19. Are there foods that you cannot eat because of religion?*
   a. If yes: What are these foods?*

20. How do you store your food for future use?*
    a. Where?*
    b. What type of structure?*

21. Are there problems with how you store the food or grain?*
    a. Pests (such as weavils)?*
    b. Food/grain rotting?*

22. How much food do you usually store each growing season?*
    a. How long does it last?*

23. Do you practice other food preservation methods, such as drying?*
a. If Yes: What methods?*

24. Where do you get your water from?*
   a. Is it a treated source?*
   b. Do you treat the water at home?*
      i. If yes: How?*

25. What diseases are common in your community?
   a. Are these diseases seasonal?*
   b. Have they always been common?
   c. If not: What other diseases were common?

26. If you or a family member gets this disease, where would you go?

27. Are vaccines available in your community?
   a. If yes:
      i. How much do they cost?
      ii. Which members (if any) of your family have received them?
      iii. From who are they available?
      iv. When did they become available?

**Agricultural Component**

1. How much land do you farm?
2. Have you always farmed this much land?
3. What percentage of this land is cultivated at any given time? (i.e. do you leave part of it fallow)
4. Have you always done this?
5. How many years have you farmed this land?
6. How did you learn to farm?
7. Have you farmed the same pattern the whole time you have farmed this land?
8. Do you do any of the following?
   a. Protection of steep slopes
   b. Tree planting
   c. Residue left on field
   d. intercropping
   e. Terracing
   f. Contour bunding
   g. Contour plowing
   h. Deforestation
9. Have you done any of the above in past years?
   a. If yes, which ones?
10. Do you practice traditional methods of conservation?*
    a. If yes: What methods?*
11. What crops do you grow? (check for traditional, nitrogen fixing, or drought resistant crops)
12. Where do you get your seed from?
13. Do you change these crops during the year?
    a. If yes: By Season?
14. Have you always grown those crops?
    a. Why/why not?
15. Do you use fertilizer?
    a. If yes: What types? What is the cost
    b. If not: Why?
    c. Ask about composting
16. Do you use irrigation?
    a. If yes:
       i. Have you always used it?
       ii. How is the system designed?
       iii. Where do you get the water from?
       iv. What is the cost each year to use it or maintain the system?
17. How much of your crop is lost annually to pests?
18. What kind of pests are the biggest problems for you crops?
19. What practices do you have for farmland after harvest (post-harvest care)?*
    a. Tillage, grazing, other? *
20. How do you process grain after harvesting?*
    a. Ask about threshing or other traditional methods.*
    b. Do you lose much of your crop using this process?*
21. Do you use pest control on your farm?
    a. If yes: what kinds?
22. Do you have livestock?
    a. If yes
       i. What types
       ii. How many heads of each
23. What portion of your income is spent on livestock (veterinary costs, medicines, food, maintaining barns)?
24. How much of your crop is consumed on farm (for both family and livestock)?
Economic Component

1. How much of your crop each year is sent to market?
2. What is the typical price at market for your crop?
3. How far is the market from your farm?
4. How do you transport your farm products?
5. Do you participate in other money making activities (please list all)*:
   a. Fruit production
   b. Firewood
   c. Charcoal
   d. Chat production
   e. Other: ___________________
6. Do you have to purchase additional grain?
   a. If so: Every year or rarely?
7. Is your family responsible for providing food or money for festivals or celebrations*?
   a. If Yes:
      i. How often (in a year)?*
      ii. How much food/money should you provide?*
      iii. What types of festivals or celebrations?*
      iv. Are these contributions very demanding on your food supply?*
8. What are the biggest problems facing your farm?
   a. Drought
   b. Input/output markets
   c. Soil/water conservation
   d. Development of irrigation
   e. Resettlement of potential cultivatable areas
   f. Labor shortages (off-farm activities)
   g. Increase in population
   h. Land redistribution
   i. Land granted to large foreign farming companies
   j. Other: ___________________
9. Have these always been the biggest problems?
   a. If no, what has changed?
10. How has drought affected your farm?
   a. Have you had crop loss during drought years?
      i. If so how much?
   b. Have you had livestock losses during drought years?
   c. If yes to either a/b:
      i. How did you handle these losses?
      ii. Did you have help from outside sources?
         1. If yes: Who?

11. Do members of your family work away from the household or off-farm to make money?
   a. If so:
      i. Number of individuals from home participating
      ii. Sex
      iii. Age
      iv. Amount of income/percentage of total income
      v. What do they do?
      vi. Only during drought or every year
      vii. How long do they work away from the home

12. Have you or members of your family participated in farm based or community development initiatives?
   a. If so:
      i. Why?
      ii. What did they help you with?
   b. If not: would you if you had the opportunity

13. What, if any, areas help would you like community development workers to help you with (i.e. planting methods; sustainable farming practices; irrigation)?

14. Would you like community health workers to give you information about ways to improve health through farming practices?
   a. Why/Why not?
Appendix F: Supplemental Graphs and Statistical Information

HEIGHT FOR AGE: MALES AND FEMALES UNDER .......................................147
WEIGHT FOR AGE: MALES AND FEMALES UNDER .......................................148
FARMING PROBLEMS BY VILLAGE ..............................................................149
DROUGHT MITIGATION ACTIVITIES BY VILLAGE .........................................152
MONEY MAKING ACTIVITIES BY VILLAGE ...................................................155
Farm Problem: Bishaniko

Number of Respondents

- Drought
- Frost
- Heat
- Pests
- Plant Disease
- Untimely Rain
- Weeds
- Worms
Drought Mitigation: Bishaniko

Number of Respondents

- Borrowing
- Daily Labor
- Food Aid
- Government Aid
- Irrigation
- None/NA
- Sale of Livestock/Assets
- Savings
Note: *Gesho* is a type of plant grown to make beer.
Money Making Activity: Amemo

Money Making Activity: Bishaniko
Appendix G: Glossary

Belg: short rainy season, from March to May
Boru: equivalent to village
Borehole: type of well
Contour bunding: soil conservation mechanism where stones are strategically placed around contour slopes
Contour plowing: soil conservation mechanism where plowing is done perpendicular to land following elevation slopes
Dabo: Ethiopian bread similar to a French roll
DAP: diammonium phosphate; a type of fertilizer common in South Wollo
Dazinon: type of chemical pest control used in South Wollo
Economic ratio: number of economically active individuals (aged 15-65) in a household divided by the number of individuals in that household
Gesho: plant grown in South Wollo used to make local beer
Intercropping: practice of planting two crops very close together in the same plot; aids in pest and weed reduction
Injera: traditional Ethiopian pancake like bread typcially made from teff, or in some cases wheat or barley
Kebede: administrative region within the woreda; similar to counties in the US
Khat: stimulant grown in Ethiopia as a cash crop
Kollo: roast barley
Malathion: chemical form of pest control used in South Wollo
Meher: long rainy season, typically runs from July to September/October
Rogor: chemical form of pest control used in South Wollo
Shiro: bean paste eaten with injera
Sorghum: native Ethiopian crop; occasionally used to make teff
Teff: native Ethiopian grain; historically used to make injera
Threshing: traditional harvesting method where horses are rotated over a pile of grain; separates the kernel from the stalk
Tubewell: type of well; similar to borehole
Wat: stewed meat eating with injera
Wodaja: form of prayer which incorporates khat; typically used in traditional healing
WuhaAgar: form of water sterilization used by Ethiopians
Appendix H: List of Wollo University Academic Colleges, Related Departments, and Collaborating NGOs in South Wollo

Wollo University Academic Collages and Related Departments:

- College of Agriculture and Veterinary Medicine
  - Animal Science (focus on Veterinary Medicine)
  - Plant Science (focus on Soil and Water Resource Management)
- College of Business and Economics
- College of Health Science and Medicine
  - Environmental Health
  - Medical laboratory
  - Nursing
  - Pharmacy
- College of Natural Science
- College of Social Science and Humanities
  - Geography and Environmental Studies
  - History
  - Law
- Institute of Teacher Education and Pedagogical Science
- Institute of Technology

NGOs Collaborating with Wollo University

- Agri-Service Ethiopia (ASE): Capacity building
- Carter Center Ethiopia (CCE): Health
- Ethiopia Evangelical Church Mekane Yesus (EECMY): Agriculture and natural resource, HIV/AIDS, social welfare
- Ethiopia Organic Seed Agency (EOSA): Agriculture and natural resource
- Ethiopian Kale Hyewot Church (EKHC): Water and sanitation, social welfare
- Family Guidance Association of Ethiopia (FGAE): Health
- HELVETAS – Ethiopia: Capacity building
- Hope Enterprise (HE): Education, emergency & food security response, social welfare, women and girls
- Organization for Rehabilitation & Development in Amhara (ORDA): Water and sanitation
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