ASSESSING SEASONAL DIETARY VARIABILITY AND VULNERABILITY IN THE KILOMBERO VALLEY

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ABSTRACT

Food security is one of the most important considerations in assessing sustainable livelihoods, whereby enough safe, nutritious, and culturally appropriate food is a necessary condition for improving overall wellbeing. Yet, small-scale subsistence agriculturalists are particularly vulnerable to environmental, economic, and social issues across a globalizing world, and food security is increasingly difficult to achieve. Seasonal variability of harvest yields, unpredictability of climate patterns, and poor access to external markets pose substantial obstacles for these populations to achieve a sustainable way of living. This research project focuses on household food security and seasonal resource variability among small-scale agricultural villages adjacent to Udzungwa Mountains National Park (UMNP), Tanzania. The study will analyze Income and Expenditure Diary data on produced and purchased items for 119 households in the village of Mang’ula B over a 12-month period, review Household Survey Questionnaire data, take a closer look at the experience of individual households, assess the nutritional status of local dietary and consumption patterns, and use supplementary data from key informants. Food security is gleaned through the domains of dietary quantity and quality from season to season for subsistence households in the village of Mang’ula B in the Kilombero Valley. The aim of this analysis is to identify household-level seasonal vulnerability in livelihood strategies and assess overall community nutritional status, considering implications for the protection of UMNP. More specifically, it examines (1) what people are eating from season to season, and (2) what nutritional patterns, if any, exist in times of extreme shortage and vulnerability. These questions seek to explain how and to what extent the community members’ dietary needs are being met in order to maintain or increase their quality of life without ultimately compromising the protection of biological diversity in UMNP.
# TABLE OF CONTENTS

LIST OF FIGURES ........................................................................................................ iii

LIST OF TABLES ........................................................................................................ iv

ACKNOWLEDGEMENTS ................................................................................................. v

Chapter 1: Research Design and Objectives .............................................................. 1

  Statement of Purpose ................................................................................................ 1
  Methodological Approach ......................................................................................... 2
    Quantitative research methods ........................................................................... 2
    Qualitative research methods ........................................................................... 5
  Project Outline ......................................................................................................... 5

Chapter 2: Food Security and Subsistence Livelihoods .............................................. 7

  What is Food Security? ............................................................................................ 7
    Domains of Food Security .................................................................................... 8
    Food Security vs. Food Sovereignty .................................................................... 10
  Vulnerability and Subsistence Livelihoods ............................................................ 12
    What is Vulnerability? ......................................................................................... 12
    Vulnerability in a Changing Climate ................................................................ 14
    Subsistence Agricultural Livelihoods ................................................................ 16

Chapter 3: Study Area and Context ........................................................................... 18

  The Geographic Setting ......................................................................................... 18
  The Local Economy ............................................................................................... 21
  Context of Food Security ........................................................................................ 22

Chapter 4: Assessment of Seasonal Dietary Variability and Vulnerability in Mang’ula B: The Results ................................................................. 25

  Restatement of Purpose ....................................................................................... 25
  Household Survey Questionnaire .......................................................................... 25
  Household Income and Expenditure Diary: Purchasing patterns ......................... 27
    Long Rains ......................................................................................................... 28
    Dry after Long Rains ....................................................................................... 30
    Short Rains ........................................................................................................ 30
    Dry after Short Rains ....................................................................................... 31
    Summary ............................................................................................................ 32
  Household Income and Expenditure Diary: Production patterns .......................... 34
    Long Rains ......................................................................................................... 35
    Dry after Long Rains ....................................................................................... 35
    Short Rains ........................................................................................................ 36
LIST OF FIGURES

Figure 1: Core household food insecurity experiential domains and subdomains. Reprinted from Coates et al 2006. .................................................................9

Figure 2: Explanation of the three components of the vulnerability framework. From Turner et al. 2003 .................................................................14

Figure 3: Current rainfall and temperature profiles for Tanzania versus the predictions of HadCM3 for 2080 under A2a (4–5°C increase in temperature) and B2a (2.5–3.5°C increase in temperature) emission scenarios (data from WorldClim 2009). Reprinted from Parham & Michael 2010 .................................................................15

Figure 4: A view of UMNP. Photo by: Andrew Vargo. Reprinted from: Schumacher 2015 .19

Figure 5: Map of the study area: Mang'ula B, UMNP, and other areas mentioned in the text. Data source: Larry Gorenflo .................................................................21

Figure 6: Amount of rice of purchased per household across all seasons ......................33

Figure 7: Amount of maize flour purchased per household across all seasons ..................33

Figure 8: Amount of rice produced per household, Dry after Long Rains .........................36

Figure 9: Tea and yams (i.e. Taro) for breakfast. Taken by Mohamed Kambi .................48

Figure 10: Ugali, Matembele (sweet potato leaves), and sardines for lunch. Taken by Mohamed Kambi .....................................................................................48
LIST OF TABLES

Table 1: Twelve core purchased products analyzed across seasons .........................................3
Table 2: Eleven core produced products analyzed across seasons...........................................3
Table 3: Summary of main food products and other items purchased in all seasons ............28
Table 4: Summary of main food products and other items produced across seasons ..........34
Table 5: Nutrients per food for commonly consumed quantities..........................................46
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Finally, I must express my appreciation to my wonderful mother and father, Jennifer and Ross Spangler, and sister, Kendall. All too often I take for granted the support system that I have had behind me since day one. Thank you for grounding me, loving me, and always reminding to not take life too seriously.
Chapter 1: Research Design and Objectives

Statement of Purpose

This thesis involves a culmination of interests, questions, concerns, and research objectives that have flourished over time, beginning with the ongoing research within the surrounding villages of the Udzungwa Mountain National Park (UMNP) located in the Kilombero Valley of south-central Tanzania. My supervisor, Professor Larry Gorenflo, and his team of researchers seek to identify the most appropriate methods to conserve the ecological biodiversity of UMNP, and, in doing so, must understand better the livelihood strategies enacted by the communities that surround it. This is an essential step in elucidating the demand for natural resources within UMNP for the communities that depend on them, as well as identifying times of increased or decreased demand or need. Variability in this context of access to resources into and out of households in a village near UMNP, namely Mang’ula B, is the main focus of this research project.

Using data that were collected with the intention to understand how resource access varies between seasons, this thesis applies the concept of food security and vulnerability to analyze and illustrate the experience of households within Mang’ula B throughout the year. Thus, the purpose of this thesis is to consider how variability of access to and availability of food crops, energy sources, and nonfood items contributes to the dietary quality and quantity of each household. Additionally, a main objective is to explore how this variability contributes to the economic and nutritional vulnerability of households. These considerations aim to understand how this vulnerability may affect the utilization of or dependency on natural resources within UMNP for the current and future livelihoods of Mang’ula B.
Methodological Approach

Quantitative research methods

This project employed a series of quantitative research methods using primary data from the existing and ongoing research of Dr. Larry Gorenflo. In his research, 119 households were randomly sampled from the village of Mang’ula B in south-central Tanzania during the year of 2014 to 2015. The selected households were given both a Household Survey Questionnaire (see Appendix A) and a Household Income and Expenditure Diary (see Appendix B). The Household Survey Questionnaire served to collect data about the demographics of individual household members, including age, place of residence, and earning potential, as well as the general characteristics, including size, structure, and amenities, of the household itself. The Household Income and Expenditure Diary was administered for two-week periods during all four seasons in Mang’ula B: Short Rains (November to December), Dry after Short Rains (January to February), Long Rains (March to May), Dry after Long Rains (June to October). During each two-week period, all 119 randomly sampled households recorded purchased and home-produced items for each day, indicating price, value, quantity, and use of each product.

The Household Income and Expenditure data were the primary focus of this quantitative research approach. All surveys were entered and consolidated into a Microsoft Excel document by the Tanzanian key informant, Mohamed Kambi, allowing for comparison of purchased and produced items within and across all households for each season. Therefore, nine categories were used to distinguish and group purchased items together based on nutritional content and utilization: Staple crops/Grains, Protein-rich foods, Prepared foods, Vegetables and Fruits, Leafy greens, Tubers/Starches, Cooking Fuel/Oil, and Non-food items. Using these nine categories, each food product was assigned to a category. The total quantity and cost of each product within their assigned category were referenced and recorded for all four seasons, creating a spreadsheet for each season of all 119 households. Twelve core products were chosen to
illustrate the purchasing patterns of all four season by identifying the product purchased in the largest quantity overall for each nutritional category and considering cultural knowledge of local diet and consumption patterns from Mohamed, a key informant. These 12 products are outlined in Table 1. All twelve products were displayed graphically to show how much each household purchased in each season.

<table>
<thead>
<tr>
<th>Product Group</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staple Crops/Grains</td>
<td>Rice</td>
</tr>
<tr>
<td></td>
<td>Maize Flour</td>
</tr>
<tr>
<td>Protein-rich foods</td>
<td>Beans</td>
</tr>
<tr>
<td></td>
<td>Beef</td>
</tr>
<tr>
<td></td>
<td>Sardines</td>
</tr>
<tr>
<td>Prepared foods</td>
<td>Andazi (baked donut)</td>
</tr>
<tr>
<td>Fruits/Vegetables</td>
<td>Coconuts</td>
</tr>
<tr>
<td></td>
<td>Tomatoes</td>
</tr>
<tr>
<td>Leafy greens</td>
<td>Amaranth greens</td>
</tr>
<tr>
<td>Tubers/Starches</td>
<td>Irish potatoes</td>
</tr>
<tr>
<td>Cooking Fuel/Oil</td>
<td>Firewood</td>
</tr>
<tr>
<td>Nonfood items</td>
<td>Telephone vouchers</td>
</tr>
</tbody>
</table>

**Table 1: Twelve core purchased products analyzed across seasons**

The same process was used to identify 11 key items produced by each household. These distributions were compared across seasons, illustrating: 1) household access to each product, 2) seasonal variability in recorded household consumption, and 3) seasonal variability in ratio of purchased to produced items.

<table>
<thead>
<tr>
<th>Product Group</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staple Crops/Grains</td>
<td>Rice</td>
</tr>
<tr>
<td></td>
<td>Maize (For flour)</td>
</tr>
<tr>
<td>Protein-rich foods</td>
<td>Pigeon peas</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Eggplant</td>
</tr>
<tr>
<td></td>
<td>Okra</td>
</tr>
<tr>
<td>Fruits</td>
<td>Oranges</td>
</tr>
<tr>
<td></td>
<td>Coconuts</td>
</tr>
<tr>
<td>Leafy greens</td>
<td>Matembele (sweet potato leaves)</td>
</tr>
<tr>
<td>Tubers/Starches</td>
<td>Cassava</td>
</tr>
<tr>
<td></td>
<td>Sweet potatoes</td>
</tr>
<tr>
<td>Cooking Fuel</td>
<td>Firewood</td>
</tr>
</tbody>
</table>

**Table 2: Eleven core produced products analyzed across seasons**
Furthermore, 20 households were chosen using the spreadsheet distributions of household purchasing patterns in each season as a secondary sample within Mang’ula B. This sample was purposefully chosen to investigate households that reflected consistently high, low, and varied purchasing patterns across the four seasons. Thus, four households were identified as lower purchasing, four households as higher purchasing, and 12 households as varied purchasing. These distinctions were made by the following criteria: 1) how much did the household purchase during the season of greatest overall purchasing (Long Rains), 2) how much did the household purchase during the season of lowest overall purchasing (Dry after Short Rains), and 3) how much did the quantity, quality, and value of all purchased products vary between seasons?

Using this sample of 20 households (16.8% of original sample), supplementary data collection concerning the situation of food security is still ongoing. Mohamed Kambi, the key informant from Mang’ula B, is administering a supplementary questionnaire of five questions to better understand each household’s situation beyond the household demographic survey (Appendix D). This questionnaire serves to illustrate more appropriately and explain the situation of food security within these households of interest. Furthermore, a group of community assistants identified by Mohamed is overseeing that all 119 households acquire a metric scale for a span of five days. This scale is being used to measure the individual components for each prepared meal of each household member over the age of 18 over the five-day span. These data are recorded using a food weight log (Appendix C) that will be used to understand how food is 1) utilized, 2) prepared, and 3) distributed within each household, better illustrating essential components of dietary quality and quantity in assessing food security of Mang’ula B. This data collection is projected to end by June 30, 2016.

Additionally, the nutritional quality of the household diet in Mang’ula B is investigated by using Nutrition Data System for Research (NDSR) to analyze the micro- and macronutrient content of commonly consumed foods, as identified by key informants and results from the household resource diary. These nutritional analyses were calculated using dietary quantity estimates from existing literature
(Beegle et al., 2012; Sanusi & Olurin, 2012), and will be applied to the results of food weight logs once data collection has finished. However, these nutritional analyses are used to paint a more complete picture of the situation of food security in Mang’ula B, as it relates to the health and wellbeing of its community members.

Qualitative research methods

The nature of this research project is qualitative, whereby all quantitative research methods are interpreted using a qualitative ethnographic approach to understand the complex condition of food security in Mang’ula B. More specifically, the use of the primary key informant Mohamed Kambi was essential to the progress and appropriateness of this research. E-mail, Skype, and several face-to-face interactions with Dr. Larry Gorenflo were used to ask clarifying questions about cultural knowledge and beliefs around certain types of food, agricultural practices, and livelihood strategies. This insight served as a guiding force in the interpretation of collected data, as well as any suggested conclusions.

Project Outline

The rest of this project is outlined as follows:

Chapter 2 will review the existing literature of the discourses of food security and food sovereignty. Additionally, I will discuss how these concepts relate to subsistence livelihoods and the vulnerability framework that serves as the analytic foundation for this study.

Chapter 3 will discuss the study area of the Kilombero Valley and more specifically Mang’ula B as it geographically and culturally relates to the Udzungwa Mountain National Park., The local mixed economy in Mang’ula B is further described as it relates to seasonality in resources and economic activities. Furthermore, the context of food security of Mang’ula B is illustrated briefly here.
Chapter 4 will present the data analysis from this study to address the guiding questions of this project. Namely, these questions are: 1) how are the demographics and economic activities in Mang’ula B understood overall; 2) what food and nonfood products are households purchasing and producing in Mang’ula B; 3) what does a closer look at an individual household illustrate about intra- and inter-seasonal variability; and 4) what can we glean about the nutritional dietary patterns in Mang’ula B? These questions are confronted through the exploratory nature of this analysis, in which I attempt to tell a story about the livelihoods of Mang’ula B as the data support.

Chapter 5 will discuss and summarize the findings of the data and relate these to the issues presented in Chapters 2 and 3. It will also further discuss the limitations of this study, as well as the implications this study holds for the present and future livelihoods of the people of Mang’ula B and the surrounding area.
Chapter 2: Food Security and Subsistence Livelihoods

What is Food Security?

The World Conference Report of 1975 first defined food security as: “Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices” (FAO, 2013; Jarosz, 2014). This definition emphasized the supply of food, focusing on caloric availability. However, during the next few pivotal decades of development, this definition was further analyzed and critiqued. By 1983, the Food and Agriculture Organization (FAO) incorporated access to food into this concept, redefining it as: “Ensuring that all people at all times have both physical and economic access to the basic food that they need,” (FAO, 1983; FAO, 2013).

By the mid-1990s, food security discourses were not limited to sufficient caloric energy or access to economic markets. The conversation had expanded to include quality of food, nutrient composition, food safety, and cultural or social context of food preference. The World Food Summit of 1996 in Rome, Italy, merged these multidimensional concerns in the most widely accepted definition of food security as: “Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 2013).

This definition is used in the majority of modern developmental discourses, and it is seen to most comprehensively address the domains by which food security is measured and achieved. Therefore, the concept of food security changed over the course of dynamic international political agendas. It began as a priority of international agribusiness to increase agricultural production for the world market, but it is now more recently understood as a multidimensional and interdisciplinary outcome of sustainable livelihoods (Jarosz, 2014).
Domains of Food Security

Common domains of food security are defined by international development organizations and modern research objectives in order to ensure the universality and adaptability of this concept. Smith and Subandoro (2007) in their report from the International Food Policy Research Institute (IFPRI) attempt to inform the construction and use of Household Expenditure Surveys to measure most effectively the various elements of food security. They define the core domains of food security as: 1) diet quantity, 2) diet quality, and 3) economic vulnerability. These three broad indicators are used commonly in the measurement and analysis of food security. This report uses household-level measurements of each indicator to attempt to measure prevalence. Diet quantity is measured by daily energy consumption per capita and the percentage of households that are energy-deficient, whereby the basal metabolic function of each household is calculated and compared to intake of food over a reference period. Diet quality is measured by diet diversity of a household, the percentage of household food coming from staple crops, and the amount of specific foods consumed each day per capita. Finally, economic vulnerability is simply measured by the percentage of total household income that is spent on food. These measurements paint a picture of each aspect of food security defined by the World Food Summit (1996), but they compromise accuracy of food-energy availability estimates and intra-household distribution by using the household as a unit of analysis. Therefore, the specific measurement indicators used by researchers, project managers, government or development agency officials, or other practitioners may vary across geographical locations and by context-based objectives.

In an exploratory research study across 22 ethnographies in 15 countries, Coates et al. (2006) identified cross-cultural commonalities of the experience of food insecurity to address the complexity of this concept. They argue that the U.S. Household Food Security Survey Measure (HFSSM) that is often
adopted and translated cross-culturally is an insufficient measure of the entire, multifaceted food insecurity experience. Thus, their analysis of international ethnographies reveals four commonalities of the experience of food insecurity to more appropriately inform the metrics by which it is measured: 1) uncertainty and worry, 2) inadequate quality, 3) inadequate quantity, 4) social unacceptability. These domains are further explained and outlined in Figure 1.

| Core household food insecurity experiential domains, subdomains, and sample items from cross-country analysis |
|---|---|---|---|
| **Uncertainty and worry** | **Inadequate quality** | **Insufficient quantity** | **Socially unacceptability** |
| **Subdomain** | **Sample item** | **Subdomain** | **Sample item** | **Subdomain** | **Sample item** | **Subdomain** | **Sample item** |
| Worry about food in near term. | I worry about where the next day’s food is going to come from. | Not eating balanced meal/ Not eating healthy and nutritious food/ Not eating properly. | Did you feel you could not afford to eat properly? | Reports of running out of food. | Did the food you bought not last, and you didn’t have money to buy more? | Socially unacceptable means of acquiring food. | Did you ever have to work in the fields with men? |
| Long-term uncertainty | When you have some money, do you spend the money for more food or save it for the lean period? | Limited within-or between-meal variety. | Did you cook the same food day after day? | Perception that quantity of food consumed was not enough. | Do you eat less than you think you should because you don’t have enough money for food? | Eating socially unacceptable foods that cause shame or embarrassment. | Did you have to eat wheat gruel because there was no money for other food? |
| | | | | | | | |
| Eating less preferred foods/less expensive, luxurious, or socially preferred foods. | Did you have to eat less (or another grain) although you wanted to eat rice? | Did you have to eat rice because you lacked money for food? | Had to eat less or nothing at all | Did you personally eat less food so that there would be more for the rest of the family? | Since the last harvest, did you or any other adults in your household reduce the number of their daily meals? |
| Eating socially unacceptable foods that cause shame or embarrassment. | Did you have to eat rice because you lacked money for food? | Had to disrupt typical meal patterns. | | | |
| Unsafe or not fresh food | Were you not able to cook hot rice? | | | | | |

**Figure 1: Core household food insecurity experiential domains and subdomains. Reprinted from Coates et al 2006.**

These findings suggest that across cultural contexts, similarities exist in food insecurity at the household level, and these similarities can serve as the basis for measuring levels of food insecurity. Similar conclusions have been found over the course of food security research, suggesting that food access, availability, and utilization can and should serve as the foundation of food security assessment.
(Bashir & Schilizzi, 2013; L. C. Smith & Subandoro, 2007; Swindale & Bilinsky, 2006). However, this current literature discusses a need for contextual adaptability of measurement tools and procedures. A common mistake of recent and ongoing food security assessment is to generalize the complex experience of this issue by only using the core domains and overlooking the subdomains. Thus, the detail and variability across each household is lost in the aggregation of data, and priorities of development programs are often oversimplified, inefficient, and unsustainable (Bashir & Schilizzi, 2013; Beegle et al., 2012; Coates et al., 2006; Jarosz, 2014; L. C. Smith & Subandoro, 2007).

This thesis project is primarily concerned with the domains of dietary quantity and quality. More specifically, the specific domains of quality that this project focuses on are variety within and between meals, nutritional content of diet, and consumption of less luxurious or socially preferred foods. The domains of dietary quantity are having enough food, the perception of having enough food, reduction in amount of food eaten during specific meals or times of year, and any disruptions of meal patterns. Although these domains cannot illustrate the entire picture of food security in the study area, along with subdomains they provide crucial insight into priority setting for further research and intervention.

**Food Security vs. Food Sovereignty**

Food security and food sovereignty are two concepts often used interchangeably, but their distinctive political histories and use in modern development demand clarification. Food security, as discussed in the evolution of its internationally accepted definition, has been linked to the development of the world agricultural market. Jarosz (2014) illustrates how food security was initially defined with a focus on stabilizing the world market prices to increase the production of foodstuffs. Therefore, it had a heavy focus on agribusiness development and trade networks of international agricultural products. The concept of food security was constructed within a global context, necessitating a universal definition of its goals, measurements, and outcomes. Conversely, as discussed by Jarosz (2014), food sovereignty is
defined, realized, implemented at an individual level. When food sovereignty serves as the objective of measurement, the local economy and governing structures of a community serve as the primary focus in the assessment of poverty and hunger. Building on these considerations, the People’s Food Sovereignty Forum officially defines food sovereignty as:

*Transforming the current food system to ensure that those who produce food have equitable access to, and control over, land, water, seeds, fisheries and agricultural biodiversity.*

*All people have a right and responsibility to participate in deciding how food is produced and distributed. Governments must respect, protect and fulfill the right to food as the right to adequate, available, accessible, culturally acceptable and nutritious food* (Jarosz, 2014).

This definition illustrates how, in comparison, food security and food sovereignty differ in the principles on which they operate. While food security is more recently concerned with the purchasing power of an individual or household unit, food sovereignty stresses the need for greater realization of the fundamental human right to be free of hunger (Jarosz, 2014). Therefore, food sovereignty is not a prerequisite or outcome of food security assessment or development initiatives, whereby increasing access to nutritious food and agricultural markets may not address governmental inefficiencies that limited access in the first place. This distinction helps to clarify the scope of research projects and development programs, as well as identify needs to be addressed through other means.

Food security is the primary focus of this research project, but the importance of food sovereignty as a separate political objective should not be overlooked. Assessing the status of food security provides an insight into the vulnerability of households and individuals within a geographical context, and it is an important indicator of sustainable livelihoods. If a household experiences greater food insecurity, the need for greater coping and survival strategies, as well as vulnerability to disease may increase. Reduced physical and cognitive ability due to inadequate dietary quality and quantity will increase the likelihood of agricultural productivity losses, and even higher morbidity rates can occur (Coates et al., 2006).
Therefore, this study uses primary data to provide insight into these concerns. However, as Rosset (2011) argues, the need for food sovereignty to have a greater presence in modern discourse is undeniable. Food security does not address where food comes from and how it is produced, but food sovereignty aims to identify sources and decision-making that underlies food production and, ultimately, put power in the hands of small-scale peasant agriculturalists. This emphasis on economic and social rights provides the affected community members the ability to decide how land is used, what is produced, and where the food goes (Rosset, 2011). Furthermore, as emphasized by Jarosz (2014), a universal method of measurement and intervention is not appropriate in the pursuit of food sovereignty because it is contingent upon what the population needs and depends on for a sustainable livelihood. This research project does not address or analyze the role of such factors in food sovereignty, but the relevance of long-term solutions to inadequate, unavailable, or misused food supplies cannot be understated. Food security is used in this project as an informative tool to understand the assets, priorities, and existing needs of Mang’ula B. However, in an increasingly liberal world market system that threatens the rights of small-scale agricultural communities, the principles of food sovereignty comprise the longstanding objectives of this project’s implications.

Vulnerability and Subsistence Livelihoods

What is Vulnerability?

As initially defined by White (1974, p. 2), vulnerability is “the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or a stressor.” This concept has been tested in ongoing research, particularly in the field of climate change, to better understand how increasing stressors to the environment may affect the system that is connected to it (Turner et al., 2003; Thorlakson, 2011). These studies have illustrated a need for an
analytical framework for assessing vulnerability as it relates to increasing changes to the world climate and specific geographical locations. Figure 2 shows an expanded vulnerability framework by Turner et al. (2003), whereby vulnerability is assessed in a human-environment system. The human-environment system is defined as a mutualism between humans and their environment that have typically been understood and assessed as separate hierarchical systems but, in fact, operate on a dependent and reciprocal relationship. This dependency is characterized by the assumptions that the human and environmental systems are separate but complementary, involving interrelated feedback loops of human action on the environment and environmental changes on the human experience (Scholz & Binder, 2003).

Turner et al. (2003) further explains the components of vulnerability: exposure, sensitivity, and resilience. Exposures refer to the biophysical and social capital that affects the existing condition of the human-environment system. Coping mechanism are, in turn, the responses to such events that may be enacted from the human system to make the environmental system more or less able to adapt effectively, and vice versa. Such coping mechanisms may be implemented at several different levels: individual or institutional, public or private, strategic or autonomous action, preventative or reactionary, and short- or long-term. Regardless, the outcomes of the coping strategy will affect the resilience of the human-environment system through a series of feedback loops. Therefore, resilience is the ability of the affected system to bounce back from a disturbance, or maintain existing structures despite the stressor itself.
In the symbiotic relationship of human-environment systems as discussed above, vulnerability is of particular concern in an increasingly unstable and changing climate. As stated and explained in Cardona et al. (2012), vulnerability in the human-environment system is most concerning and apparent in areas most affected by climate change. The likelihood of an increase in extreme weather events, in addition to the unequal distribution of large-scale global impacts and threats to the biodiversity of ecosystems are cause for concern as the global mean temperature rises. Geographical areas that are predicted to be most affected by these extreme weather and climate changes are the areas that are least protected from hazards through economic and financial security, appropriate infrastructure, and access to adequate natural and social resources.
For example, subsistence, agricultural communities are particularly vulnerable to changes in rainfall patterns, wherein a decrease in rainfall and greater variability of precipitation patterns between seasons may endanger a livelihood already at the edge of subsistence. Therefore, areas that are impoverished, geographically isolated, marginalized, technologically undeveloped, disempowered, and/or poorly governed are least capable of adapting to increased exposure of environmental risks and hazards (Smith et al., 2001). Figure 3 shows projected changes for 2080 in rainfall patterns and temperature profiles for Tanzania, illustrating considerable concerns for the fate of climate change in Tanzania. This necessitates a comprehensive research approach to understand how populations rely on the current and predictable conditions of their natural environment, and how this may be affect the vulnerability of their livelihoods over time.

Figure 3: Current rainfall and temperature profiles for Tanzania versus the predictions of HadCM3 for 2080 under A2a (4–5°C increase in temperature) and B2a (2.5–3.5°C increase in temperature) emission scenarios (data from WorldClim 2009). Reprinted from Parham & Michael 2010.

Ahmed et al. (2011) illustrates how this concern is specifically relevant to the population of Tanzania, wherein food production and food prices are sensitive to the changing volatility in climate. In
Tanzania, agriculture accounts for over 50% of the gross national product and employs over 80% of the population (Thurlow and Wobst, 2003; Ahmed et al., 2011). Furthermore, the majority of agriculture in Tanzania and most agricultural-dependent developing countries is fed by rainfall because irrigation infrastructure is generally unavailable. Thus, droughts and floods pose a serious threat to agricultural productivity and poverty vulnerability. Additionally, rainfall patterns affect the timing of planting crops, as well as their subsequent harvesting. Such factors may strongly influence agricultural yields through affecting the timing of planting and harvesting. The interface between environmental hazards and the affected human system is a vital consideration in addressing and developing appropriate action.

**Subsistence Agricultural Livelihoods**

To contextualize the concern over increasing vulnerability, subsistence agricultural livelihoods must be clearly defined. A livelihood is described as “people, their capabilities and their means of living, including food, income, and assets” (Chambers & Conway, 1991, p. 1). Furthermore, the self-sufficiency of these actions is an integral part in establishing a livelihood, wherein a subsistence livelihood will be effectively resilient to stresses and shocks, manage or augment their capabilities, and beneficially contribute to the livelihoods of future generations. The concern for subsistence and, thus, sustainability is both environmentally, or externally, driven and socially, or internally, driven for a given population or community (Chambers & Conway, 1991). Small-scale, or smallholder agriculture is understood as farming, mostly done in the Global South, that is conducted by mainly family labor and defines the primary income source for the family unit (Morton, 2007).

Furthermore, as Chambers and Conway (1991) demonstrate, convenient methods of measurement for employment, income, and consumption often underappreciate and misdiagnose small-scale subsistence livelihoods. Manifestations like formal job markets, wage labor, or household consumption surveys provide quick access to statistical analysis of a narrowly defined livelihood. However,
sustainable livelihoods are composed of various and diverse factors, and small-scale, rural livelihoods are often reduced to simplified methods of measurement that overlook the complexity of these dynamics. Therefore, conventional measures of subsistence agricultural livelihoods have focused on simple factors to value the productivity of the land, such as agricultural output, that have resulted in efforts to intensify output of singular cash crops; these factors are often measured within just one growing season, not allotting enough time to see the entire picture of seasonal variability. However, the diversification and increased heterogeneity of agricultural output, as well as sources of income is a vital consideration in the management of risk and vulnerability for subsistence livelihoods; this consideration is often misrepresented in simplified measures of wealth and economic growth of the Global South.
Chapter 3: Study Area and Context

The Geographic Setting

The Eastern Arc Mountains are a range of biologically diverse mountains stretching from the Taita Hills of southern Kenya to the Udzungwa region of south-central Tanzania. Separated into 13 separate blocks, these mountains are identified as one of the most important areas of biodiversity conservation due to the high prevalence of endemic animal and plant species within each block. One of the most important blocks to conserve and protect the diversity of vertebrates and trees are the Udzungwa Mountains, covering 1353 km$^2$ of forest area according to standardized analysis of satellite imagery and covering a range of 300 to 2580 meters in altitude (Burgess et al., 2007). This block includes Udzungwa Mountain National Park (hereafter referred to as UMNP) and several distinct forest reserves, namely the Udzungwa Scarp, Iyondo, Matundu, Nyanganje, Ihanga, and Iwonde reserves. UMNP is located in the Kilolo (80%) and Kilombero (20%) districts of southern Tanzania, spanning about 1,900 km$^2$. It is composed primarily of dense mountain forest, in which the bulk of the rainfall is from November to May (UMNP pictured in Figure 4). Additionally, until 2011, it was the only national park in Tanzania where local peoples were permitted to practice traditional worshipping and collect dead wood, medicinal plants, and grass for thatching (Nyundo, 2006); these practices have since been stopped in the interest of maintaining park ecology.

UMNP and its bountiful resources has been the subject of several studies and conservation efforts. To understand how the communities surrounding UMNP rely on the resources within the park, Harrison (2006) used questionnaires, interviews, and Sustainable Livelihoods assessments of household members and key stakeholders to study 15 villages surrounding UMNP. This project illustrates that the livelihoods of these communities adjacent to the park are not sustainable enough to not rely on the
resources within the park boundaries for income-generating activities, as well as for basic needs in vulnerable periods. These resources and practices include timber, charcoal burning, firewood, hunting of small animals, wild fruits and vegetables, medicines, and mining (Harrison, 2006b; Tango, 2007).

![Figure 4: A view of UMNP. Photo by: Andrew Vargo. Reprinted from: Schumacher 2015](image)

Furthermore, 63% of UMNP’s habitats have been degraded, of which the biggest threat to these habitats is the cutting of poles for tool handles and construction. Annual bushfires threaten the understory regeneration, and until 2011 firewood collection was widespread throughout the park (Marshall, 2008). The dead wood collected serves as the primary source of energy (73%) in the surrounding villages of UMNP, for cooking food, firing bricks, and brewing local beer; this consumption of dead wood is increasing, though collecting fuel wood in the park (allowed for one day per week) became prohibited on 1 July 2011 (Larry Gorenflo, personal communication). Similarly, park resources are used for brick making, medicinal plants, and supporting small businesses. Thus, the reliance on these resources holds socioeconomic implications for the villages, including an immediate decline in health services and energy supply, and must be considered in the conservation efforts of UMNP (Harrison, 2006b; Marshall, 2008; Nyundo, 2006; Tango, 2007).
The Kilombero District is the area of study for this research project, specifically the ward of Mang’ula B. The Kilombero District lies within the Morogoro Region of Tanzania, covering 14,918 km² that is primarily residential areas and arable land. It is split into five administrative units: Ifakara, Kidatu, Mang’ula, Mngeta, and Mlimba (Affa, n.d.). Mang’ula B is one of 35 wards within the district, within the Mang’ula unit. Man’gula B, one of the two main villages in the Mang’ula Ward, is a community similar to most in the area—scattered houses connected by narrow dirt paths and roads and often next to a small kitchen garden or two. The location of Mang’ula B within UMNP, as well as the scatter of houses is shown in Figure 5 below. Each housing unit, corresponding to a single household, usually consists of a house, an outdoor kitchen, and possibly a storage shed and latrine (except for the few houses that have indoor plumbing). A small commercial district, consisting of a market, a few shops, and a handful of simple restaurants, provides one of the few sources of wage employment and an area where residents can spend small amounts of cash. Most agriculture in Mang’ula B, as with other villages in the area, occur on the eastern edge of the village where high water and wet conditions for most of the year are conducive to rice cultivation and a detriment to settlement (though some do live in these less desirable localities) (Larry Gorenflo, personal communication).

Although the Tanzanian government conducted a census of population and housing in 2012, village-level data have yet to be released. As presented by Schumacher (2015), the population of Mang’ula B is estimated from the population growth rate for the Mang’ula Ward as recorded by Harrison (2006), which is 2.31%. With a population of 3,992 people in 2002, it is estimated that the population in 2012, at the time of data collection, was 5,026, and the population for 2015 is estimated at 6,187 people (Schumacher, 2015). Harrison (2006) also presents that 96% of residents in this area rely on subsistence agriculture as their primary livelihood strategy. Therefore, with a steadily increasing population size and heavy reliance on the land for agricultural production, the natural resources of the local land and, consequently, UMNP are under increasing pressure.
Figure 5: Map of the study area: Mang'ula B, UMNP, and other areas mentioned in the text. Data source: Larry Gorenflo

The Local Economy

Mang’ula B is characterized by a mixed wage-subsistence economy (Harrison, 2006c). A subsistence economy involves production based on the available cycle of seasonal resources and complementary participation in other activities, i.e., short-term wage labor, that provide income and resources for the family unit. Reliance on subsistence does not necessarily imply a community on the fringe of existence, in which sustainable survival is of utmost concern. Rather, it reinforces a sense of community self-reliance coupled with a social system based on communalism and reciprocity, valuing the contributions of each person and household to the greater whole (Kuokkanen, 2011). This understanding argues for the need to embrace the household as a primary unit of analysis, in which the household is the nexus of economic production, decision-making, and coping mechanisms in times of vulnerability.
Understanding the situation of one individual, or rather the community as a whole, says little about the daily life in Mang’ula B; instead, understanding how the household as a dependent and interrelated economic unit, embodying cultural values and traditional practices of the local context is essential to the appropriateness of research such as this.

Inherent to the mixed wage-subsistence economy of Mang’ula B is the notion of seasonality, as found in Alaskan mixed economies studied by Sumida (1988) and Wolfe & Walker (1987). Moreover, the economic activities, risks, and livelihood strategies vary between and within seasons, and this variability plays a crucial role in elucidating what residents have access to, how resources are utilized, when resources are more abundant or scarce, and how time is allocated to certain activities. In times of harvest, household members use their time in gathering produce, and processing, selling, or storing the yield. Often, the household takes what it needs and sells the rest for income. In seasons of rain or crop growth, time is often spent earning extra income through other small-scale means, collecting other natural resources to keep or to sell, and stored food supplies are relied upon more heavily (Harrison, 2006b; Kuokkanen, 2011). Such seasonal differences indicate a reliance on predictability of climate patterns, stable food prices for consistent income, and ability to store adequate quantities of surplus between seasons for times of shortage. This seasonality and how it relates to increasing or mitigating vulnerabilities serves as an underlying concern and motivation for research in Mang’ula B on the flow of resources within subsistence livelihoods.

**Context of Food Security**

Several studies have been conducted to understand better the situation of nutrition and food security in the Kilombero Valley. Kinabo et al. (2006) discusses how most undernutrition efforts in Tanzania focus on how lack of adequate food correlates with disease prevalence; however, little is known about foods to help fight malnutrition. Thus, Kinabo and colleagues identified the nutrient contents of
commonly consumed foods in the Iringa and Morogoro regions, as well as determine the frequency of their consumption. This study examined six villages in the Morogoro and Iringa regions, and conducted focus group discussions with key informants from each village. Additionally, food samples were collected from the local markets for lab analysis. Through this endeavor, Kinabo and colleagues illustrated how locally produced varieties of crops, such as millet, cassava, sweet potatoes, maize, groundnuts, and other fruits and vegetables are naturally high in micronutrients.

A study conducted in two communities in the Kilombero Valley by Nyangile (2013) identified and compared livelihood strategies and food security outcomes. By using food security questionnaires at the household level and anthropometric data from each village clinic, this study concluded that there is a significant difference between the two competing livelihood strategies of migrant agropastoralists and indigenous peasant households. More specifically, agropastoralists have more acquired land and sell their food crops as a main income source. Contrastingly, peasant households own and cultivate less land, mainly grow rice, are characterized by low production, and have a lower Dietary Diversity Score (DDS) compared to agro-pastoralists. However, agropastoralists have a higher proportion of chronically malnourished children (indicated by stunting), and peasant agriculturalists have a higher proportion of acutely malnourished children (indicated by wasting). This indicates that peasant households are more sustainably nutritious than agro-pastoralists, in which availability of food does not necessarily ensure food security within households.

In Mang’ula B and the surrounding villages, a primary concern for food security is the variability and vulnerability that differs across seasons for households (Harrison, 2006a; Schumacher, 2015). As previously stated, the access, availability, and utilization of different resources changes at different times of year; consequently, assessing the quality of the household diet elucidates to what extent this variability has an effect on the health and wellbeing of household members and sustainability of their livelihood strategies. If climate patterns, crop yields, or barriers to natural resources were to become increasing more unpredictable or less accessible due to political, economic, and environmental changes, how would
the food security within and across households be affected throughout the year? Such concerns guide this research project, whereby telling the story of Mang’ula B and the factors that affect access to basic needs provide a basis for more informed, appropriate, and long-term solutions.
Chapter 4: Assessment of Seasonal Dietary Variability and Vulnerability in Mang’ula B: The Results

Restatement of Purpose

To reiterate and contextualize the review of the data analysis, the purpose of this thesis is to consider how variability of access to and availability of food crops, energy sources, and nonfood items contributes to the dietary quality and quantity of each household. Additionally, a main objective is to explore how this variability contributes to the economic and nutritional vulnerability of households. These considerations aim to understand how this vulnerability may affect the utilization of or dependency on natural resources within UMNP for the current and future livelihoods of Mang’ula B.

Household Survey Questionnaire

Data collection for this research in Mang’ula B consisted of two components. A survey A collection of four two-week diaries, in turn, administered in each of the four major climatic seasons in Mang’ula B, provides detailed income and expenditure data, though only for two-week periods.

The Household Survey Questionnaire is a tool used to illustrate a broad overview of each household’s income and major expenditures over the preceding year, along with basic demographic and housing characteristics. It is a record of all persons in each household as their usual place of residence, indicating the type and amount of work each resident contributes. Furthermore, the characteristics of the house structure are described, and a 12-month recall of purchased consumer durables was recorded for the calendar year of 2012 to 2013 (see Appendix A).

The data collected through this questionnaire paint a general picture of life in Mang’ula B. A total of 295 people live across the 119 households surveyed: 247 people lived in their current residence as of five years ago, and 37 residents were less than five years old. Some 109 housing units were single-
family detached homes, and the remaining 10 were single-family attached, with an overall average of 4.4 rooms per household. Piped water was accessible within five individual housing units, 62 houses had piped water to the building, and 45 houses had no piped water to that unit (normally relying on standpipes in the village). Furthermore, 14 households had a toilet connected to a septic tank, 103 households had a latrine, and two households did not indicate their type of toilet. The majority of households (61 households) used the village water system as their main water source, 44 households used a public standpipe, seven households use a public pump, four used the nearby stream or river, and only one household solely relied on the public system. Only two households were buying their drinking water.

The primary source of cooking fuel is wood, in that 106 households relied on it as their main energy supply. The remaining households either rely on charcoal or kerosene. These preferences are dependent mainly upon cost and availability of each resource. For transportation means and other amenities, 13 households owned a television, 101 households had an average of 1.1 mobile phones, and 120 households owned a bicycle.

When asked to recall what type of work each household member participated in over the past week, mixed results were found. In total, 23 members participated in full/part-time work only, 79 members participated in full/part-time work with subsistence activities, 47 members worked only in subsistence activities, and 140 members had no work in the past week. Thus, 50.2% of members did not participate in work during the last week, although this includes members that are under the age of 5 as well as students falling in school ages. The subsistence activities that were fulfilled in the week preceding the survey included mostly farming (170 household members participated), firewood collection (89 household members), and collecting other resources (63 household members). Three residents indicated that they participated in trapping, and two residents had made handicrafts. Wage labor in business or agriculture involved 89 residents over the previous year, averaging 5.5 hours worked per household when completing the wage labor task. In total, the economic activity that earned the most overall earnings (in Tsh) was selling agricultural products with a raw total of 29,695,000 Tsh, followed by wage labor earning
a sum of 6,462,500 Tsh from 2012 to 2013. Individual non-farm businesses earned 1,745,000 Tsh, 188,000 Tsh was earned from remittances, and 135,000 Tsh was earned from another unspecified economic activity. For reference purposes, in January 2013 $1.00 US equaled 1,583 Tsh, so income was fairly modest.

Therefore, it appears that most households relied on subsistence farming as their main economic activity, accounting for 77.7% of the total earnings for the 119 households surveyed. The greatest number of households participated in subsistence farming, and other small-scale economic ventures generally supplemented the reliance on this occupation. Furthermore, the data indicate that the estimated quantity of each product sold from subsistence farming is greatest compared to the estimated amounts sold from other subsistence activities.

**Household Income and Expenditure Diary: Purchasing patterns**

The Household Income and Expenditure Diary serves as the primary lens to gain deeper insight into the seasonal variability of what each household purchases, when these purchases are made, in what quantities, and at what cost (Appendix B). Compared to the Survey Questionnaire, this data collection method produces a more refined and detailed dataset. More specifically, each household recorded all purchased and produced products for two weeks during each of the four seasons. This provides further information concerning the patterns of harvesting crops and how these patterns shape the consumption needs of individual households, as well as the need for supplementary wage labor. The livelihood strategies illustrated by the data are dynamic, changing not only between seasons but also week to week and day by day, as shown in Table 3. Such time-sensitive variability is evident through a closer comparative look at the Household Diaries from the 119 households in Mang’ula B.
Interpretation and analysis of this data indicates complex and variable patterns of consumption in Mang’ula B. For a village defined by small-scale agriculturalists and a mixed economy, it would be expected that households produce and rely mostly on subsistence crops through small plots of farmland and bustanis, or home gardens (Mohamed Kambi, personal communication, February 10, 2016). However, the data collected over two-week periods during the Short Rains, Dry after Short Rains, Long Rains, and Dry after Short Rains tell a different story. Table 3 summarizes the total amount of each major product purchased for each season. More detailed examinations of the patterns of each season appear below.

### Long Rains

This season, normally lasting from March to May, is characterized by heavy rainfall and a period of waiting for crops to be ready to harvest (Mohamed Kambi, personal communication, February 10, 2016). Therefore, in Mang’ula B, purchasing was at its highest for nearly all food products during this time. In particular, buying rice and maize flour, the two main staple crops for this area, was much higher.
than in any other season. Notably, the purchase of supplementary fruits and vegetables, indicated by coconuts, tomatoes, and amaranth greens, was also greater overall. The primary protein-rich foods, namely beef, beans, and sardines, were highest by a smaller margin than the staple and supplementary crops, but andazi (baked donut) is purchased nearly three times as much as the next highest season of the Dry after Short Rains. Telephone vouchers purchases, indicating non-food items, were 64% higher in the Long Rains than the next highest purchasing period in the Dry after Long Rains.

The distribution of purchases of staple crops was more evenly spread across all households and is higher overall in amount. Seasonal comparison of purchases for rice and maize flour can be seen in Figures 3 and 4 respectively, whereby the Long Rains distributions are most visibly linear. More specifically, 106 households purchased rice during the two-week diary period, with an average of 4.78 kg; 118 households purchased maize flour, with an average of 5.23 kg. Furthermore, the distribution of purchases for the remaining 11 food and nonfood products are skewed to left at a comparatively greater degree than at any other time in the year, indicating that a greater number of households purchased each product in small amounts. For example, 96 households purchased tomatoes with an average of 2.96 piles (piles include approximately four to five tomatoes), and 60 households purchased beans with an average of 0.81 kg within the two-week snapshot of this season. Tomatoes represent a commonly consumed vegetable for most traditional meals, and beans are a less costly source of protein as compared to types of meat (Mohamed Kambi, personal communication, February 10, 2016). Thus, the variation of their purchase is demonstrative of trade-offs between seasonal livelihood strategies. Fuel wood, as the primary source of energy for Mang’ula B, was bought in the greatest quantity during the Long Rains, with 103 bundles purchased across 46 households.
Dry after Long Rains

The Dry after Long Rains season typically lasts from June to mid-October, characterized by the lowest average annual rainfall and moderate temperatures. Throughout these months, the majority of the crop harvests occur. During this season, purchasing decreased from the Long Rains, especially for rice, tomatoes, prepared foods like andazi, and beans. Maize flour purchases remained relatively high compared to other times in the years, as well as telephone vouchers. Beans are purchased in nearly half the amount as the Long Rains.

Overall purchasing patterns during this two-week period were more concentrated in a smaller number of households as compared to the Long Rains, specifically for supplementary fruits and vegetables. Thus, their graphic distributions are more exponential rather than linear, demonstrating fewer households that purchased relatively higher quantities of each product than the other households across the distribution. For example, 67 households purchased tomatoes with an average of 2.16 piles, and 30 households purchased beans during the collection period, averaging 0.8 kg. Staple crops are purchased more evenly across households, but in varying degrees to the other seasons. Explicitly, in the Dry after Long Rains, 74 households purchased rice with an average of 2.96 kg, and 100 households purchased maize flour during the two-week period, with an average of 4.31 kg. For fuel wood, 28 households purchased a total of 51 bundles.

Short Rains

The Short Rains usually last from mid-October to December. During the Short Rains, purchasing was generally lower than the Long Rains and Dry after Long Rains for most food products. Beans, sardines, and andazi, and amaranth greens were purchased in the lowest overall quantity compared to quantities purchased across all four seasons. Sequentially, there was a decrease in overall purchase of
maize flour, from 435.25 kg in the Dry after Long Rains season to 279 kg in the Short Rains. However, rice purchasing increased by a small margin through the same seasonal transition, from 222 kg in the Dry after Long Rains to 267 kg in the Short Rains.

Total purchasing was not at its overall lowest during the Short Rains, but purchasing patterns were highly variable across households. For staple crops, 94 households purchased rice with an average of 2.81 kg, while 99 households purchased maize flour with an average of 2.79 kg. Therefore, more households are purchasing lesser amounts of these products compared to the Dry after Long Rains, but fewer households are purchasing these products as compared to the Long Rains in lesser amounts as well. In consideration of other food products, 73 households purchased an average of 2.3 piles of tomatoes, and 27 households purchased an average of 0.87 kg of beans during the two-week collection period. Fuel wood purchases are concentrated in 28 households, with a total of 44 bundles; this is the smallest total quantity of bundles purchased across all seasons. In general, compared to the data collected during Dry after Long Rains season, the purchases during the Short Rains are relatively similar in quantity and variety.

**Dry after Short Rains**

The Dry after Short Rains normally last from January to February in between the Short and Long Rains, making it the shortest season in duration. Purchasing increases following the Short Rains for sardines, beans, coconuts, *andazi*, and amaranth greens. Most notable, purchasing of beans from the Short Rains to the Dry after Short rains increased from 24.5 kg to 45.75 kg, a 46.4% increase. However, average purchasing of staple crops declined from the Short Rains; in fact, these averages were the lowest during the Dry after Short Rains than in any other season. A similar observation can be made for luxury items such as beef and Irish potatoes, as well as telephone vouchers. These goods were purchased the least, on average, during this data-collection period.
Overall, the Dry after Short Rains season is characterized by fewer households purchasing the majority of each product, wherein the distributions of household purchasing are more concentrated to the right side of the graph. This is particularly true for staple crops. For example, only 77 households purchased rice with an average of 2.29 kg, and 92 households purchased an overall average of 2.63 kg of maize flour. Therefore, fewer households purchased fewer amounts of these two products. In contrast, fewer households are purchasing a greater average amount of beans, whereby 48 households purchased an average of 0.93 kg. Some 78 households purchased an average of 2.02 piles of tomatoes during this season. Furthermore, 63 bundles of fuel wood were purchased across 39 households.

Summary

The data illustrate general purchasing patterns of households in Mang’ula B. Overall, a greater proportion of products, both food and nonfood, are purchased during both rainy seasons, in considering the length of each season. Purchasing patterns of rice and maize flour can be seen in Figures 3 and 4 respectively. Thus, in both the Short and Long Rains, more households are purchasing the reviewed products, resulting in a more even distribution across all households. However, this is most true for the staple crops of rice and maize flour, while the purchases of beef, beans, vegetables, fruits, and tubers are consistently concentrated in a small number of households for each season, as discussed above. Out of the three protein-rich foods (sardines, beans, and beef), sardines are purchased most evenly and consistently across households and across seasons, followed by beans. The fewest number of households purchase beef in each season, marking a densely concentrated distribution of households.
Figure 6: Amount of rice purchased per household across all seasons

Figure 7: Amount of maize flour purchased per household across all seasons
These disparities in household purchases of supplementary goods like fruits, vegetables, and protein-source are exacerbated and more evident during both the Dry after Short Rains and Dry after Long Rains. Finally, in consideration of purchasing fuel wood bundles as the primary source of cooking fuel and an energy source, the largest quantity of fuel wood is purchased during the Long Rains, followed by the Dry after the Short Rains. The Short Rains is the season with the lowest quantity of fuel wood purchased. Note that wood most often is purchased in bundles, so in many cases it will last for many days, or even multiple weeks, (depending, obviously, on intensity of use)

**Household Income and Expenditure Diary: Production patterns**

As indicated by the diary data, production of staple and other food crops is generally concentrated in a small number of households for all seasons. It is important to note that the two-week data collection periods provide a glimpse into the activities of each season. Therefore, during each data collection period, production across households and across seasons is both unequal and highly variable. Indeed, the survey data, many reflecting activities over a year, reveal broader engagement of production. Table 4 summarizes the total production across households for each seasonal data collection period.

<table>
<thead>
<tr>
<th>Product (unit)</th>
<th>Short Rains</th>
<th>Dry after Short</th>
<th>Long Rains</th>
<th>Dry after Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava (kg)</td>
<td>4.9</td>
<td>24.3</td>
<td>6.4</td>
<td>13</td>
</tr>
<tr>
<td>Coconuts (1 coconut)</td>
<td>18</td>
<td>18</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Eggplant, small (pile)</td>
<td>22</td>
<td>24</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Fuel wood (bundle)</td>
<td>20</td>
<td>42</td>
<td>47</td>
<td>51</td>
</tr>
<tr>
<td>Maize (kg)</td>
<td>0</td>
<td>3</td>
<td>10.5</td>
<td>0</td>
</tr>
<tr>
<td>Matembele/Sweet Potato leaves (pile)</td>
<td>33</td>
<td>47</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td>Okra (pile)</td>
<td>24</td>
<td>49</td>
<td>45</td>
<td>49</td>
</tr>
<tr>
<td>Oranges (1 orange)</td>
<td>17</td>
<td>24</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Pigeon peas (kg)</td>
<td>8.5</td>
<td>6</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Rice (kg)</td>
<td>0</td>
<td>0</td>
<td>6.5</td>
<td>10651.5</td>
</tr>
<tr>
<td>Sweet potatoes (pile)</td>
<td>24</td>
<td>38</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Extra Wage Labor Income (Tsh)</td>
<td>49,000</td>
<td>57,500</td>
<td>51,500</td>
<td>116,500</td>
</tr>
</tbody>
</table>

Table 4: Summary of main food products and other items produced across seasons
**Long Rains**

During this season, the data shows that household production was very limited. For the staple crops of rice and maize flour, production was particularly low. Four households (3.4% of households) harvested rice, with an average yield of 1.63 kg, and 3 households (2.5%) harvested maize, with an average yield of 3.5 kg. A greater number of households produced supplementary crops in relatively small quantities. Pigeon peas are the main source of leguminous protein grown in Mang’ula B, and 5 households (4.2%) harvested pigeon peas, with an average yield of 2.6 kg. Thirteen households (10.92%) harvested okra, with an average yield of 3.46 piles, and 8 households (6.7%) are harvested small eggplants, with an average yield of 2.88 piles. For leafy greens, 17 households (14.3%) harvested *Matembele* (sweet potato leaves), with an average yield of 2.94 piles. Tuber production is concentrated in 12 households (10.1%), harvesting an average yield of 2.33 piles of sweet potatoes. Finally, 18 households (15.1%) produced a total of 47 bundles of firewood for energy.

**Dry after Long Rains**

The Dry after Long Rains is the season characterized by harvesting, after crops have been hydrated by the Long Rains. The data collected from the two-week period during these months indicate an increase in the diversity of crops harvested, as well as a significant increase in the amount of rice produced. A total of 23 households (19.3%) harvested rice over the two-week diary period, with an average yield of 443.8 kg. Furthermore, the maximum produced by one household is 950 kg, and the minimum of producing households of 100kg. Thus, production is high, but it is still concentrated in a small proportion of households. Figure 7 displays this production distribution of rice for this season (this is the only season where a graphic distribution of a staple crop is applicable). The production of supplementary crops similarly involves a small number of households for the two-week collection period.
For vegetables and greens, 19 households (16.0%) harvested okra, with an average yield of 2.45 piles, 15 households (12.6%) harvested Matembele (sweet potato leaves), with an average yield of 2.81 piles. Households producing tubers like cassava and sweet potatoes were few. Four households (3.4%) harvested cassava, with an average yield of 3.25 cassavas, and nine households (7.6%) harvested sweet potatoes, with an average yield of two piles. An average yield of 3.75 coconuts was harvested across four households (3.4%). The largest quantity of bundles of fuel wood was produced during the Dry after Long Rains, constituting 51 bundles across 19 (16.0%) households.

![Figure 8: Amount of rice produced per household, Dry after Long Rains](image)

**Figure 8: Amount of rice produced per household, Dry after Long Rains**

**Short Rains**

Household production was very low and seemingly insignificant during the Short Rains, as these two months typically involve sowing rather than harvesting (Mohamed Kambi, personal communication, February 10, 2016). Therefore, no rice or maize was harvested during the data collection period. However, two households (1.7%) harvested pigeon peas, with an average yield of 4.25 kg. Furthermore, 10 households (8.4%) harvested okra, with an average yield of 2.18 piles. For fruit production, two households (1.7%) harvested oranges, with an average of 8.5 oranges, and two households (1.7%)
harvested coconuts, with an average of 9 coconuts. The production of fuel wood was concentrated in eight households (6.7%), producing 20 bundles total, which was the lowest amount across all seasons.

**Dry after Short Rains**

During the Dry after short Rains, production was low, but it was higher than the Short Rains. Sowing is also typically done during this season, rather than harvesting (Mohamed Kambi, personal communication, February 10, 2016). The diversity of crops harvested was greater during this season; however, yields were concentrated in a small percentage of households. Only one household (0.8%) harvested maize, with a yield of 3 kg, and one household (0.8%) harvested pigeon peas, with a yield of 6 kg. Vegetables produced included okra and small eggplants. 17 households (14.3%) harvested okra, with an average yield of 2.72 piles, and 7 households (5.9%) produced small eggplants, with an average of 3 piles. A greater number of households produced leafy greens, whereby an average yield of 2.94 piles of *Matembele* (sweet potato leaves) was harvested across 15 households (12.6%). Tuber production was relatively high: 11 households (9.2%) are producing sweet potatoes, with an average of 3.17 piles. Yet, fruit production was relatively low, whereby four households (3.4%) are harvesting oranges, with an average of 6 oranges, and 3 households (2.5%) are harvesting coconuts, with an average of 6 coconuts. Finally, 17 households (14.3%) produced fuel wood, representing a total of 42 bundles.

**Summary**

Overall, household production in Mang’ula B across the rainy and dry seasons is illustrated in greater detail through the Household Income and Expenditure Surveys. The two-week collection periods during each seasons help to tell the story of this subsistence agricultural community. According to the data, the Long Rains and Dry after Long Rains are the only seasons that rice is recorded to be harvested.
Maize was only harvested during the Long Rains and the Dry after Short Rains by, at most, 3 households. Thus, this presents a perplexing story about the production of the staple crops for Mang’ula B.

Furthermore, the data do not indicate that the purchased and produced food items are easily or equally substitutable. For example, the production of protein-rich foods such as pigeon peas does not clearly supplement or replace the purchase of beans, sardines, or beef. The same can be said of vegetables, fruits, and tubers, whereby okra, oranges, coconuts, and sweet potatoes are produced in small, highly concentrated amounts during each season. Therefore, production may realistically substitute the purchases of merely staple crops, leafy greens, and tubers for a small number of households who produce the greatest amount. Greater reliance appears to be placed on purchasing the bulk of food products from season to season, rather than solely household production. In fact, based on diary data, production may be more supplementary than primary, though again data reflect only two-week periods, as discussed further below.

**Household Case Studies**

Aggregated data concerning the production and purchasing of food and non-food products may compromise the unique and individual experience of food security for each household. A closer look at specific households across all four seasons, namely what they purchase and produce and how these patterns vary by data-collection period, helps to illustrate a more complete picture of the livelihood strategies enacted by household units of Mang’ula B in differing times of vulnerability.
Household 14: Low Purchasing and Production

Survey Questionnaire

The Survey Questionnaire provides useful insights into the livelihood of Household 14. The housing unit is a single family detached with 6 rooms and a flush toilet that is connected to a septic tank. A television and 1 bicycle are both present in this household. The number of occupants is five, none of whom is under the age of 5 years. As the data indicates, subsistence is not their sole form of income, being supplemented by collecting, farming, firewood production, and handicrafts. With a total of 28 weeks worked for the household during the year prior to the survey, both a non-farm business and selling agricultural products provided the majority of their annual household income. This income was 75,000 Tsh and 150,000 Tsh, respectively, for these activities.

Income and Expenditure Diary

During the Long Rains, the only recorded purchases include 1 kg of beans, 1 pile of tomatoes, and 1 coconut, as well as small amounts of cooking oil and personal items, such as mobile phone charging services and toothpaste. Household production did not occur.

The Dry after Long Rains season is indicated by purchases of 1 kg of maize flour, 1 kg of wheat flour, and 1 loaf of bread. Proteins purchased include 0.25 kg of beans and 2 cups of sardines. Furthermore, comparatively low amounts of fruits, vegetables, greens, and nonfood items are recorded as purchases, and no household production occurred.

The Short Rains was the highest purchasing period for Household 14. Some 3.25 kg of rice and 4 kg of maize flour were purchased, as well as 1 kg of beans and 1 cup of sardines for protein. Vegetable and fruit purchases were in small amounts with little diversity, but 2 piles of sweet potatoes were
purchased. Only 1 pile of charcoal was purchased for cooking fuel. Otherwise, no food products were produced, and no wage labor earned.

During the Dry after Short Rains, this household purchased a limited variety of goods in small amounts. The largest purchase was 2.6 kg of maize flour. However, only 2 cups of sardines and 7 andazi were recorded as purchases, in addition to 3 kg of sugar and small amounts of nonfood items. Household production occurred in small amounts: 2 piles of pumpkin leaves, 2 bundles of fuel wood, and 5 piles of Matembele were recorded. No extra wage labor income was earned.

In general, within and across seasons, consumption and production is consistently and comparatively low or at zero. The highest number of purchased products falls within the in Short Rains season. However, little to no purchasing of grains, protein sources, vegetables, and fruits occurred during the Long Rains when overall purchasing was highest across Mang’ula B.

**Household 2: Varied Purchasing and Production**

**Survey Questionnaire**

The Survey Questionnaire provides details on Household 2. The housing unit is a single family detached unit with three rooms, piped water, and a latrine toilet. The household owns one motorcycle and one bicycle. The population of the household is four people, all over five years of age. During the year prior to the survey data collection, the subsistence activities by household members included collecting, farming, and firewood production, in which farming is the most prevalent. A total of 78 weeks worked during the previous year was reported for all four members of the household, with a total of 90,000 Tsh earned from wage labor and 220,000 Tsh earned from selling agricultural products. Therefore the data indicates that Household 2 produced enough agricultural crops to sell as their primary source of income.
Income and Expenditure Diary

During the Long Rains, 1 kg of both rice and maize flour were purchased. The sources of protein purchased were 0.75 kg of beans, 2 cups of sardines, and 2 dried fish. Beyond that, small, supplementary amounts of prepared foods, fruits, and vegetables were recorded as purchases. Production was limited to two piles of small eggplants. However, 16,500 Tsh of extra wage income was earned for this collection period.

In Dry after Long Rains, Household 2 is consistently one of the highest purchasers of rice (13 kg), maize flour (14.5 kg), sardines (8 cups), andazi (baked donut) (26 andazi), tomatoes (5 piles), and telephone vouchers (50 100-Tsh vouchers). This household produced 3 piles of Matembele (sweet potato leaves) and 1 pile of okra. For extra wage labor income, 9,000 Tsh was recorded.

The Short Rains is characterized by less variety and less quantity of supplementary foods. Rice and maize flour were purchased in above average amounts, namely 2.5 kg and 3.5 kg respectively. Only 1 cup of sardines, 2 dried fish, and 1 egg were purchased as protein-rich foods, and no vegetables and fruits were purchased. Similarly, nothing was produced at the household level, and no extra wage labor income was recorded.

For Household 2 during the Dry after Short Rains, purchasing is at its lowest. The only recorded purchases include two eggs, one lemon, one coconut, one cabbage, and small amounts of cooking fuel and spices. Household produced items included 4 bundles of firewood, 6.5 kg of cassava, and 2 piles of sweet potatoes. No extra income was earned.
Household 65: Higher Purchasing and Production

Survey Questionnaire

This household lives in a single detached family unit with 3 rooms and no water that is supplied directly to this structure. Thus, a flush toilet is not present, and their main water source is from the village water system. For forms of transportation, no motorcycle, bicycle, or motorized vehicle is owned. The household members include two adults and one child less than 5 years of age. The major subsistence activities indicated were farming and firewood collection, but the survey respondent indicated that during the week prior to the survey, they had no work. With a total of 17 hours worked across the household during the previous year to the survey, 80,000 Tsh were earned selling agricultural products, and 15,000 Tsh were earned through remittances.

Income and Expenditure Diary

During the Long Rains, this household purchased 7.5 kg of rice and 10 kg of maize flour, far exceeding the season averages of 4.3 kg and 5.2 kg respectively. Two cups of sardines and one dried fish were purchased, serving as recorded protein sources. Furthermore, 15 andazi were purchased, as well as a few vegetables and fruits in small amounts. For nonfood items, 15 telephone vouchers of 100 Tsh were purchased, as well as an electricity bill of 16,000 Tsh. No extra wage income or household-produced items were recorded.

In the Dry after Long Rains, Household 65 purchased 5.5 kg of maize flour, 2 kg of maize flour, and one loaf of bread. A diversity of protein-rice foods were purchased, including four cups of sardines, three dried fish, and 0.5 kg of beef. In this season, a considerable diversity of supplementary fruits, vegetables, and leafy greens were purchased, and 7,500 Tsh of extra wage labor income was earned.
The Short Rains for Household 65 indicates highly varied purchases in large quantities. For staple crops, 2 kg of maize flour was purchased, and 5.5 kg of rice was purchased which is 2.76 kg above the average for all households in this season. Furthermore, 1.5 kg of beef and 3 cups of sardines were purchased, in addition to a variety of prepared foods. Vegetables and fruits including onions, tomatoes, eggplant, okra, lemon and coconut were purchased in above average quantities. Three types of leafy greens, and three types of tubers were purchased, as well as a variety of cooking fuel sources including cooking oil, charcoal, and fuel wood. Household production was limited to four small piles of eggplant, and no extra wage labor income was earned.

For the Dry after Short Rains, purchases remain varied and in higher quantities compared to most other households. A total of 1.5 kg of rice was purchased, along with 3 kg of maize flour and 1 kg of wheat flour. Protein sources are not as varied as the Short Rains, whereby 0.5 kg of beans and 1 dried fish were purchased. However, small amounts of prepared foods were purchased, and a wide variety of vegetables and fruits were purchased in small amounts. This includes onions, tomatoes, eggplant, okra, banana, cabbage and amaranth greens. For tubers/starches, sweet potatoes, cassava, and yams were purchased in small amounts. A total of 620 mL of cooking oil was recorded as purchased, as well as four piles of charcoal and 40 mL of kerosene. Household production was limited to 5 piles of okra, and no extra wage labor was pursued.

Overall, Household 65 indicates less vulnerability during both the Dry after Short Rains and Dry after Long Rains when purchasing decreases overall for Mang’ula B. This household purchases a consistent variety of grains and proteins in quantities that are slightly higher than average. Additionally, specifically during the Short Rains, high quantities of culturally luxurious products like beef and fruits like coconut were purchased.
Nutritional Assessment

Nutrient Content of Commonly Consumed Foods

A list of commonly consumed foods was gathered through the highest purchased and produced products from the Income and Expenditure Survey data, as well as through exchanges with our key informant, Mohamed. Furthermore, methods of meal preparation, feeding times, proportions of meal components, and cultural perceptions and preferences of food were better understood through the local insight of Mohamed (Mohamed Kambi, personal communication, October 1, 2015). The ongoing data collection (project to conclude by June 30, 2016) of food weight logs to indicate the weight of each component of each household member’s meal will inform this research about the utilization of food products, distribution of food within a household, and individual access to quantities and quality of daily calories. For the purpose of this research project, quantities (in grams) of each food product analyzed were estimated through information from Mohamed and through existing literature on estimates of portion sizes (Beegle et al., 2012; Sanusi & Olurin, 2012). Thus, estimated quantities of each food product were entered into NDSR, the Nutritional Data System for Research. The results of this analysis are presented below in Table 5. This table reviews the nutrient content of commonly consumed foods in Mang’ula B, including both macronutrient and micronutrient analysis. The caloric content provides an initial look at the energy availability of foods commonly consumed in these quantities in this village, and the macronutrient analysis serves to understand the proportion of fats, carbohydrates, and protein within food product that are eaten most often. Assessment of dietary fiber content is justified by acknowledging that this nutrient hosts a suite of benefits to overall health, including the prevention of heart disease and intestinal disorders, and may indicate the satiating ability of a food to satisfy one’s hunger (Burton-freeman, n.d.). Furthermore, the micronutrient analysis aims to provide a deeper look into the availability of essential micronutrients in locally produced and/or locally consumed food as it may relate to potential
or existing deficiencies. Vitamin A, iron, zinc, and folate were chosen to assess because they stand as the most prevalent micronutrient deficiencies in developing countries across the world (Alderman et al., 2003). Vitamin B12 provides an important insight into the sources of dietary iron that the diet provides, an essential consideration for a diet traditionally low in animal protein.
Table 5: Nutrients per food for commonly consumed quantities

Preparation and Consumption of Food in Mang’ula B

Throughout the day of any individual in Mang’ula B, one’s diet may drastically differ. However, residents of this village follow what can be classified as a traditional diet, wherein the type and proportion
of staple foods serves as the primary consideration in determining what the components of the meal will be. Meals may be centered around staple foods such as rice, *ugali*, or starchy tubers like sweet potatoes, in which the side dishes are generally expected and understood amongst residents. The following is an overview of key informant information, as well as field observations from Dr. Larry Gorenflo and his student researchers.

Breakfast typically involves black tea with several spoonfuls of sugar, considering that milk to add is both expensive and rare for households to consume consistently. Often, foods consumed at breakfast time may include prepared foods such as *andazi*, *chapatti* (unleavened flatbread), or *vitambua* (thin, fried rice pancakes), as well as tubers such as yams, sweet potatoes, or arrowroot. Figure 5 below displays a picture of a typical breakfast that may vary by quantity and proportion.

Lunch and dinner, or the remaining meals for the day, often involve the same types of foods in similar proportions and varying quantities depending on age, gender, and availability of food. Staple crops, mainly rice and maize flour are cooked as the primary part of the meal, supplemented with a small amount of an oil-fried leafy green and a protein source including beans, beef or chicken stew, dried fish, or sardines. These protein-rich stews as well as the leafy greens are cooked traditionally with tomatoes and onions, often garnished with flavors from lemons or other spices. Maize flour is boiled with water into a thick, sticky porridge called *ugali* that serves as the primary starch for a meal if rice is not served. The cultural perceptions of these staple foods – rice and *ugali* – vary by tribal identity and background, as well as individual preference. Additionally, the prices of these products may vary greatly between seasons, affecting the quantities that households purchase (Mohamed Kambi, personal communication, October 31, 2015). Figure 6 below shows a typical meal for either lunch or dinner of *ugali*, *Matembele* (sweet potato leaves), and sardines.
Supplementary foods like fruits and vegetables are eaten in less of a predictable pattern or quantity. In general, fruits and vegetables are more expensive per unit and are often eaten in addition to a meal or as a snack throughout the day. Typically purchased fruits at the market include bananas, oranges, mangoes, papayas, watermelon, and pineapple. For vegetables, leafy greens are consistently purchased at
the market, in varieties such as Chinese (a type of spinach), amaranth greens, spinach, Matembele (sweet potato leaves), and cassava leaves. As stated, tomatoes and onions almost always are included in the leafy greens and often in the base of a beef or bean stew. Culturally, fruits are eaten while working in the field or as a supplement to lunch or dinner. The nutritional content of these foods is not as strongly emphasized as the energy and strength that staple foods like rice and ugali provide (Mohamed Kambi, personal communication, February 8, 2016).

The protein source that is most commonly purchased and consumed is sardines, but eggs are affordable and accessible to those who own chickens. The sardines in Mang’ula B are small fish dried in the sun, understood to be rich in iron and protein, and are not preserved in salt and oil. Thus, most people rely on purchasing small amounts of this fish frequently. Beans and legumes are the most common source of protein aside from sardines, considering that legumes such as pigeon peas and mung beans are household-produced and/or are more affordable at the market. Finally, meat sources like beef, chicken, and pork (although pork is rare due to high prevalence of Muslim culture) are viewed as “luxurious” and expensive; therefore, they are eaten in small, infrequent amounts for the village as a whole, mostly by the households with higher income or for celebratory occasions. The cultural emphasis on protein as significant part of every meal is not very strong, in which the perception tends to reflect the mantra “whatever I get, I get,” (Mohamed Kambi, personal communication, February 8, 2016)
Chapter 5: Discussion, Limitations, and Implications

Discussion

The issues of food security and cycles of vulnerability in Mang’ula B are much more complicated and varied than expected prior to this analysis. By comparing data from the community to the household level within and across the four main seasons in south central Tanzania, the livelihoods and livelihood strategies of this small-scale agricultural community are better understood. The data and how it relates to the broader context of this research is discussed below.

Household Survey Questionnaire

The results from the survey questionnaire support the assumptions of a small-scale agricultural community engaging in a mixed wage-labor economy: the majority of households partake in subsistence farming that comprises the bulk of their household earnings and economic activities. The general household characteristics indicate that the most families live in single-family homes where equitable and consistent access to basic needs for each household is an initial concern. Factors such as piped water or flush toilets are variable across households and are present in a large number of households. However, the variability in this access is great and illustrates the economic conditions of residents of Man’gula B.

Household Income and Expenditure Diary

Reviewing and analyzing the responses from the Household Income and Expenditure Diary complicates this initial understanding of Mang’ula B from the Household Survey Questionnaire. The data indicates that production patterns do not reflect that most households are producing small amounts of staple and non-staple crops. In fact, during the two-week data collection periods during harvest periods of
the Dry after Long Rains and Dry after Short rains, only a small number of households are harvesting crops. This harvesting is consistently in small, concentrated quantities that do not comprehensively substitute the purchasing needs of any one household. Instead, it appears that a household may harvest a small amount and purchase an additional amount of that same crop or a related crop of the same nutritional category. For example, during the Dry after Long Rains, the largest number of households (23 households) harvested the greatest quantity of rice (443.8 kg on average), but these producers are still purchasing supplemental amount of maize flour and must purchase protein-rich foods, vegetables, and fruits. Recognition of this pattern seemingly reflects the logic that defines the mixed wage-subsistence economy, whereby the majority of income is earned through production and sale of subsistence agricultural products and the supplemental goods are purchased as needed. Therefore, in this vein, the context of the household unit, rather than aggregated community statistics, may be the most relevant unit to analyze in understanding true vulnerability as it is experienced day by day.

Moreover, overall purchases of food products and cooking fuel – namely, firewood – are consistently greater in quantity and distribution than any product harvested in any given season. For the majority of households, the bulk of resources are purchased in the two-week data collection periods; this includes staple crops, as well as protein-rich foods, fruits, and vegetables. Food products like leafy greens – namely matembele—and vegetables such as okra, are produced in more consistent amounts than other food products, with only 6% to 19% of households participating in this production. This differs drastically from the participation in staple crop production, in which the season of greatest yields (Dry after Long Rains) indicates that 19% of households are harvesting; during the other times of year, the data indicates that nearly no households are growing rice.

The high concentration of staple crop production in a low percentage of households during a narrow timeframe of the harvest season proposes several questions of sustainable agriculture and food security. Such results may indicate that in Mang’ula B, larger-scale farming practices are controlled by a small percentage of households. These households may have access to more land for farming, and they
may be the primary producers of rice or maize for this village, as seen in the study by Nyangile (2013) (discussed in Chapter 2). Furthermore, the households that do not seemingly produce any staple crops or supplementary foods may actually not be participating much in the small-scale agricultural activities, whereby they are purchasing the bulk of their food and earning income through other means. However, it must be considered that the smaller-scale farming practices enacted by the majority of households in Mang’ula B (as shown by the Household Survey Questionnaire) are not holistically reflected in this data analysis, considering the timing of the two-week data collection periods or the long-term storage capabilities of their harvests. This situation would critically question the methods used for assessment and evaluation of these communities, as well as similar modern methods of food security evaluations discussed in Chapter 2.

Moreover, the results of these purchasing and production patterns in Mang’ula B may contrastingly indicate that the results from the Household Survey Questionnaire do reflect the situation of the community as a whole. This situation is presented as 170 total members (out of 295 total residents, including those under the age of five) participate in subsistence farming activities weekly, constituting 57.6% of all household members surveyed at the time of data collection. It could be argued that this gap in participation between the Survey Questionnaire and the Income and Expenditure Diary arises from the process of the two-week data collection periods for the latter. Although subsistence farming may be understood as a consistent influx of small yields of basic foodstuffs, the nature of production in Mang’ula B appears to be less predictable and widely varied. Thus, if the households participated in the Income and Expenditure Survey merely one day after harvesting the bulk of their rice, then the records of purchased and produced products would be misleading in understanding the economic situation and daily living experience of that specific household.

This observation is not necessarily a critique on this method of data collection, but rather it highlights the exacerbated vulnerabilities of households that rely on subsistence farming as their primary source of income. The flow of resources can differ drastically from week to the next, in which one week
the harvest of rice may amount to 950 kg (as indicated by Household 35), but thereafter, the processing, storage, and sale of this large harvest may negatively or positively affect their wealth and wellbeing until the next harvest season one year later. This highlights the need for effective storage facilities to store grains for later use or sale, and it necessitates an economic mindset of long-term saving. If a household earns the majority of its income during one week of the entire year, certain livelihood strategies must be enacted to avoid further vulnerability before substantial income is earned again. This may include compromising immediate needs or desires for the preparation of hardship to come. In times of real temporary shortage, household members may reduce the quantity and quality of the diet for all or certain members of the household until other means can be obtained. Furthermore, the emphasis on the size of the yield for these staple crops becomes more evident through this analysis. If the yield of rice or maize is lesser than expected due to unpredicted environmental conditions, the production of other food crops such as pigeon peas, leafy greens, vegetables, fruits, and tubers cannot serve as the primary source of income; the yields do not seem to extend beyond subsistence and diet supplementation. Therefore, income must be earned by other means, enacting coping mechanisms such as seeking out more wage labor income, support (either directly or through remittances) from family or other community members. This insight into the experience of the mixed wage-subsistence economy helps to identify areas of particular concern and the need for further research.

** Household Case Studies **

A closer look into the specific experience of certain households within the selected sample of 119 households in Mang’ula B provides an ethnographic approach to illustrating the complexity of measuring livelihoods, identifying vulnerabilities, and assessing food security. It shows how the experience of each season can be drastically different between months, weeks, and even days. The three households discussed in this research project indicate distinctive situations and strategies for mitigating the
vulnerabilities between and within seasons. Thus, the most surprising finding is that there is no clear indicator or factor to predict the economic condition of any given household based on the available purchasing or production patterns. The household suspected to be characterized by low economic means (Household 14) as assumed by low purchasing and production across all four seasons indicated earning a higher total income over the previous year than the household assumed to be of higher economic means (Household 65). Furthermore, greater variability in purchasing and production patterns across seasons is not necessarily an indicator for overall economic vulnerability, wherein Household 2 indicated earning the greatest income from selling agricultural products out of all household case studies. Therefore, the most beneficial outcome of this analysis is illustrating a greater need in identifying more predictive and reliable measures of economic conditions through assessing resource flows into and out of the household. The purchase of “luxury” goods such as beef or large quantities of fruit does not necessarily indicate a higher economic status, nor does low purchasing or production indicate a lower economic status. Conversely, factors such as means to save money that is earned in at one time during the year for times of shortage, access to or reliance on extended familial support through remittances or direct transfer of resources, and appropriate storage facilities for large harvests of staple crops must be considered in the assessment of individual household experiences. Overlooking these key factors may result in the individuality of each household’s livelihood strategies being lost in aggregation of data and assumptions.

**Nutritional Assessment**

The first conclusion to discuss from the cursory nutritional assessment of Mang’ula B is that, as indicated by the Income and Expenditure Diary and key informant interviews, in times of resource shortages, staple crops are more heavily relied upon as the main source of calories. This is used as a coping mechanism to get energy-dense calories while cutting costs and compromising the diversity and
quality of the diet. Furthermore, in times of shortage, the number of meals per day may be reduced for some or all members of the household. These strategies hold serious nutritional concerns for the present and future of the health status of Mang’ula B. A research measure to further purse with this concern is the Household Dietary Diversity Score (HDDS) for households within Mang’ula B, as used by Nyangile (2013). This measurement tools assesses the number of unique foods a household consumes over a given period, providing insight into the nutritional quality of the household’s diet at different times of year. This research project seeks to address this same issue, and the ethnographic methods used would be complemented by empirical evidence on changes in HDDS across seasons.

Culturally, the staple foods of maize flour (for ugali) and rice comprise the largest majority of the meal components, as shown in the previous chapter. As shown by Table 5, the rice and maize flour (in the form of ugali) that are most commonly consumed by households in Mang’ula B contain notable amounts of carbohydrates and dietary fiber (ugali as the highest source of dietary fiber). These nutritional qualities serve a necessary role in providing long-term energy and digestive health for residents of Mang’ula B. Furthermore, these staple foods are comparatively high in micronutrients such as iron, zinc, and folate when compared to the other foods available. However, these foods are comparatively low in protein, and they provide no Vitamin A or Vitamin B12.

The fried vegetables and greens as well as the protein source serve as side dishes to the primary grain consumed. Ideally, the fried leafy green, such as matembele, will provide a source of Vitamin A, small amounts of iron, and healthy fat from the oil it is cooked in. The protein source, such as beans, sardines, or beef, would provide the essential addition of protein and Vitamin B12, as well as notable milligrams of zinc. However, as seen through the purchasing and production patterns of Mang’ula B, these products are supplementary in the local food culture. Therefore, in times of shortage, the side dishes typically providing the protein, fiber, or essential nutrients like Vitamin A to the traditional diet are compromised for consumption of staple grains. Therefore, the intake of necessary levels of macro- and micronutrients, such as Vitamin B12 and Vitamin A for all households members must be considered.
These considerations must include studies of gender equality within household cultural practices, age differences, and working capabilities/disabilities of all residents.

For pregnant mothers and newborn babies, these times of shortage and compromise are of particular unease. The purchases and production of beans and legumes in Mang’ula B follow the similar trajectory for most other products analyzed: a small number of households purchased and produced small amounts. Sardines are the most commonly purchased protein source across all households, but the folate content of sardines is negligible. Therefore, a greater reliance on staple foods like rice and *ugali* during times of year of extreme seasonal vulnerability may deprive the developmental process for the mother and child of the adequate amounts nutrients the body needs: folate, iron, and vitamin B12. The WHO recommends that a pregnant mother requires nearly 600 micrograms of folate for healthy development of her child. The highest source of folate from the foods analyzed in Table 5 is beans, at 430 mcg per serving, and the second highest source is rice, providing 195 mcg per serving. Recognizing the tendency to rely more heavily on staple grains in times of shortage necessitates further health research. Folate supplementation during pregnancy is a widespread practice across all areas of the world, illustrating the need for this micronutrient during the critical developmental stages of a child’s life. Thus, without folate supplementation and/or with the exacerbation of existing vulnerabilities within Mang’ula B, this health concern requires further attention.

Similarly other dietary practices are cause for further nutritional consideration. For example, the practice of drinking tea with breakfast, and often several times throughout the day, causes concern for iron absorption in a diet already low in heme iron (from animal sources) as compared to non-heme iron (plant sources). Tea and coffee contain a compound called polyphenols that have been proven to inhibit the absorption of heme iron if consumed around the same time (Ma et al., 2011). Therefore, the purchase and consumption of animal protein sources may be less biologically beneficially than perceived by sociocultural standards. Thus, consumption of adequate heme iron is a strong consideration for further studies.
Furthermore, as indicated by Mohamed and local insights through field researchers, it is not always the case that if households have more money, they buy more of the staple crops or foods part of a traditional diet to increase the number of calories available. Instead, since individuals may not always act as perfectly rational beings, extra income may be spent on more culturally “luxurious” foods such as beef, chicken, or prepared foods like chips (French fries) or mishkaki (fried beef kebabs) (Mohamed Kambi, personal communication, February 10, 2016). Therefore, the nutritional status of an individual or household is not always a determinant in what kinds of food products are purchased, how they are utilized within the household, and if it was the most nutritionally rational choice. This phenomenon is discussed in great length by Banerjee & Duflo (2011). Their argument for context-based capacity building and cultural preferences as essential aspects in assessing and addressing global poverty or vulnerability is particularly applicable to the current and ongoing research in Mang’ula B. Access to adequate calories is only part of the picture; utilization, sharing, preparation, and preferences of food products provide the complementary consideration in understanding the nutritional quality of subsistence agricultural households.

Health clinic statistics that indicate prevalence of nutritional deficiencies such as protein-energy malnutrition, iron-deficiency anemia, Vitamin A deficiency, rickets (caused by Vitamin D deficiency), goiter (caused by iodine deficiency), or Vitamin B12 deficiency are a key resource in painting a more comprehensive picture of the nutritional status of residents in Mang’ula B. In order to understand if the current food system is meeting the cultural and biological needs of its people, these statistics, as well as other nutritional health concerns including diarrheal diseases or water-borne illnesses, must be identified and related to the traditional dietary habits. Furthermore, malnutrition may affect the rate of other more common diseases, such as malaria or dengue fever, in which the body is ill equipped to fight off any viral infections as effectively as it would with proper nutrition. Any periods in the year that indicate greater incidence rates of infectious diseases may provide a lens into times of greater concern for food security and nutrition within households. Such analysis must also be joined with an understanding of local health-
seeking behaviors, whereby the practice of going to the health clinic is determined by several factors including severity of symptoms, socioeconomic status of the head of household, or economic capital (Olasunbo & Ayo, 2013). Knowledge of these behaviors in Mang’ula B is a justified component in the multidimensional assessment of food security in this village, as well as surrounding areas.

The ongoing data collection in Mang’ula B will inform us about the distribution of food within households, considering gender, age, and working capability as potential factors affecting the quantity and quality of the meals consumed. Illustrating the types and amounts of foods eaten by each member of a household, partnered with the Household Survey Questionnaire characteristics and Income and Expenditure Survey data, a more comprehensive story of residents in Mang’ula B can be gleaned. This will inform future research projects within the area of UMNP to more holistically understand the vulnerabilities of resource access faced by residents within and across seasons, and how this may inform the protection and conservation of previous resources within UMNP.

**Limitations**

This project faced several limitations, in large part because data collection was not designed specifically to support a study of nutrition. Some of the more notable limitations include the following: 1) the timing of the data collection periods; 2) lack of appropriate statistical analysis to strengthen findings; 3) ability to complete Household Food Weight Log data collection; 4) availability of local and up-to-date health clinic statistics; and 5) access to key informants and field site. The two-week data collection periods for the Household Income and Expenditure Surveys, as well as the collection of the Household Survey Questionnaires have to come to be a strong consideration in the analysis of the data collected. In understanding the timeliness of harvesting crops during specific times of the year, as well as how weather and climate affect the perceptions and experience of a household’s economic situation, these factors will play a key role in the validity and application of these results in understanding the livelihoods of
households in Mang’ula B. To analyze the data collected by Larry Gorenflo and his field researchers, I primarily used qualitative evaluations based on quantitative summaries data. Given more time and appropriate resources to collect more specific data, conducting statistical analyses such as correlative functions or finding statistical significance in seasonal variation would strongly support the conclusion made in this paper. This project serves as a guideline for these further, more detailed analyses, however it lacks a level of specificity and mathematical support in its conclusions. The collection of the household measurements of food weights and meal components was expected to have commenced before the publication of this project; however, local government difficulties and logistical barriers have prevented the completion of this additional data collection in time for this study. Therefore, the nutritional assessment requires a more specified application the village of Man’gula B that will be possible with the collection of this data in the coming months. In an effort to validate and inform the initial nutritional assessment, I hoped to obtain local health clinic statistics from Mang’ula B clinicians. However, due to bureaucratic formalities of confidentiality and time-sensitivity of the conclusion of this project, this was not possible. Again, in the coming months, these data will inform the ongoing nutritional assessment of this village. Finally, it was not logistically possible for me to visit the actual field site, and thus all local knowledge was understood through key informants and secondary observations.

Implications

This research project holds several, multifaceted implications for the continuing research and conservation efforts in Mang’ula B and the surrounding villages around UMNP in the Kilombero Valley. First and foremost, the emphasis placed on the experience of the individual household within this village is a guiding principle for effective forest management efforts. The dynamic and diverse needs of household members within household units that constitute this village are critical in understanding what resources within UMNP are in most need at differing times of the year. By illustrating a comprehensive
and multidimensional picture of the experience of food security, access to resources, and coping strategies in times of vulnerability, the human-nature dependency may not be dismantled or unknowingly affected by conservation efforts of this highly biodiverse protected area. Thus, this research project lays the groundwork for such comprehensive knowledge by identifying methods of understanding the experience of households within these surrounding villages, as well as pinpointing areas in need of specific further research. Further research in areas such as context-based indicators of household resilience to seasonal variability or distribution of high quality and low quality foods within and across households can inform development and conservation efforts such as this one in the surrounding villages of UMNP. By providing a basis for more informed and appropriate interventions in this area and villages similar to Mang’ula B, the potential of increasing the quality of life and concurrent protection of precious, natural biodiversity such as that of UMNP is possible and within reach.
Appendix A: Household Survey Questionnaire

Survey Questionnaire: Udzungwa Mountains National Park, 2012-2013

Region: ___________________________ District: ___________________________

Village, Sub-village: ___________________________ Household Number: ____________

Respondent Number: ___________________________

Enumerator: ___________________________ Date: ___________________________

This survey is conducted in accordance with guidelines of the Pennsylvania State University Institutional Review Board. All responses are strictly confidential and will only be released in aggregated form.

Introductory Statement: Hello, my name is [your name], and I am an enumerator for a household income and expenditure survey being led by researchers from Pennsylvania State University in the United States. The intention of this survey is to help understand economic conditions in villages near Udzungwa Mountains National Park, in part to guide steps to improve those conditions. All responses will be strictly confidential and will not be shared with anyone (except as total numbers for the entire village). The survey should take less than 1 hour. If possible, I would like to speak to the person who owns or rents this house, apartment, or room.

<table>
<thead>
<tr>
<th>Who to Include and Who Not to Include</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 2012-2013 Household Income and Expenditures Survey counts each individual in his or her usual residence, the place where the person lives and sleeps most of the time.</td>
</tr>
</tbody>
</table>

Please include:
- Everyone who usually lives here, including family members, housemates and roommates, foster children, roomers, boarders, and live-in employees
- Persons temporarily away on a trip, on vacation, or in a hospital
- Newborn babies in the hospital or clinic
- Children in boarding schools below the college level
- Persons who stay here most of the week while working, even if they have a home somewhere else
- Persons with no other home who were staying here on 1/1/2012

Please do not include:
- Persons who live somewhere else
- Persons away in an institution, such as prison or a mental hospital
- College students who live somewhere else while attending college
- Persons in the armed forces who live somewhere else
- Persons who stay somewhere else most of the week while working

1. Please give me the name of each person living here on 1/1/2012, including all persons staying here who have no other home. If everyone is staying here temporarily and usually lives somewhere else, still give me the name of each person. Begin with the household member in whose name the home is owned, being bought, or rented. If there is no such person, start with any adult household member. Please print last name, first name, and middle initial of each person, date of birth and place of birth on the separate sheet provided, and use “Household Member 1,” “Household Member 2,” etc. here.

1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________
6. ___________________________
7. ___________________________
8. ___________________________
9. ___________________________
10. ___________________________

1b. If everyone listed above is staying here only temporarily and usually lives somewhere else, ask where do these people usually live. Write where they usually live next to their names above.

Remarks:

<table>
<thead>
<tr>
<th>Initial, date</th>
<th>Reviewing</th>
<th>Coding</th>
<th>Keying</th>
<th>Keying Verification</th>
</tr>
</thead>
</table>
### Section 1—General Housing Characteristics

<table>
<thead>
<tr>
<th>H1. Which best describes this building? Include all apartments, flats, etc., even if vacant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. One-family house, detached from other houses</td>
</tr>
<tr>
<td>b. One-family house, attached to other houses</td>
</tr>
<tr>
<td>A building with:</td>
</tr>
<tr>
<td>c. 2-4 apartments/rooms for rent</td>
</tr>
<tr>
<td>d. 5-9 apartments/rooms for rent</td>
</tr>
<tr>
<td>e. Other (specify)</td>
</tr>
<tr>
<td>If this is a one-family house, is there a business (shop, medical office, etc.) on the property? 1-yes, 2-no</td>
</tr>
<tr>
<td>H11. What fuel is used most for cooking in this unit; where do you get it?</td>
</tr>
<tr>
<td>a. Wood</td>
</tr>
<tr>
<td>b. Charcoal</td>
</tr>
<tr>
<td>c. Kerosene</td>
</tr>
<tr>
<td>d. Gas</td>
</tr>
<tr>
<td>e. Electricity</td>
</tr>
<tr>
<td>f. Other (specify)</td>
</tr>
<tr>
<td>Source:</td>
</tr>
<tr>
<td>H12. Reason you use the fuel you use.</td>
</tr>
<tr>
<td>a. Cost</td>
</tr>
<tr>
<td>b. Quality of heat</td>
</tr>
<tr>
<td>c. Availability</td>
</tr>
<tr>
<td>d. Quality of cooking</td>
</tr>
<tr>
<td>e. Lack of smoke</td>
</tr>
<tr>
<td>f. Other (specify)</td>
</tr>
<tr>
<td>H13. Do you get water from:</td>
</tr>
<tr>
<td>a. Public system only?</td>
</tr>
<tr>
<td>b. Public system and tank?</td>
</tr>
<tr>
<td>c. Village water system?</td>
</tr>
<tr>
<td>d. Public pump (well)?</td>
</tr>
<tr>
<td>H14. Do you purchase drinking water (Y/N)?</td>
</tr>
<tr>
<td>H15. What type of toilet does this unit have?</td>
</tr>
<tr>
<td>a. Toilet connected to septic system</td>
</tr>
<tr>
<td>b. Latrine</td>
</tr>
<tr>
<td>c. Other</td>
</tr>
<tr>
<td>H16. Does this unit have a television (Y/N)?</td>
</tr>
<tr>
<td>H17. Does this unit have a cell phone (Y/N)?</td>
</tr>
<tr>
<td>(If yes, number of phones, last week's cost)</td>
</tr>
<tr>
<td>Number of phones:</td>
</tr>
<tr>
<td>Last week cost:</td>
</tr>
<tr>
<td>H18. How many motorized vehicles do residents in this unit own?</td>
</tr>
<tr>
<td>(If greater than 0, list number of each type; note if available for use but not owned)</td>
</tr>
<tr>
<td>H19. How many bicycles do residents in this unit own?</td>
</tr>
<tr>
<td>H20. In the past 12 months, did you construct any additions on this unit, or make any repairs (Y/N)?</td>
</tr>
<tr>
<td>(If yes, list type of construction and cost, or amount of time and number of people involved in construction or making repairs)</td>
</tr>
</tbody>
</table>

### Section 2—Detailed Housing Information

<table>
<thead>
<tr>
<th>H2. Is this (house/apartment/room)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Owned by someone in this household who bought it with a loan?</td>
</tr>
<tr>
<td>b. Owned by someone in this household without a loan?</td>
</tr>
<tr>
<td>c. Rented for cash rent?</td>
</tr>
<tr>
<td>d. Occupied without payment of cash rent?</td>
</tr>
<tr>
<td>If answer is a, b, or d, skip to H4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H3. If this house is rented:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is the total monthly rent? Tsh</td>
</tr>
<tr>
<td>2. If someone else pays part of the rent, who does this and how much do they pay? Tsh</td>
</tr>
<tr>
<td>Who pays?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H4. About what year was this building built?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 2010-2012</td>
</tr>
<tr>
<td>b. 2005-2009</td>
</tr>
<tr>
<td>c. 2000-2004</td>
</tr>
<tr>
<td>d. 1995-1999</td>
</tr>
<tr>
<td>e. 1990-1994</td>
</tr>
<tr>
<td>f. 1985-1989</td>
</tr>
<tr>
<td>g. 1970-1984</td>
</tr>
<tr>
<td>h. 1969 or earlier</td>
</tr>
<tr>
<td>i. Don't know</td>
</tr>
</tbody>
</table>

| H5. What year did you move to this housing unit? |

<table>
<thead>
<tr>
<th>H6. What is the main type of material used for outside walls of this building?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Concrete blocks</td>
</tr>
<tr>
<td>b. Fired bricks</td>
</tr>
<tr>
<td>c. Unfired mud bricks</td>
</tr>
<tr>
<td>d. Wattle and daub</td>
</tr>
<tr>
<td>e. Metal</td>
</tr>
<tr>
<td>f. Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H7. What is the main material used for the roof of this building?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Metal</td>
</tr>
<tr>
<td>b. Thatch</td>
</tr>
<tr>
<td>c. Wood</td>
</tr>
<tr>
<td>d. Tile</td>
</tr>
<tr>
<td>e. Other</td>
</tr>
</tbody>
</table>

| H8. How many rooms does this house have (please count living rooms, dining room, kitchen, and bedrooms; do not count bathrooms, balconies, foyers, or hall)? |

<table>
<thead>
<tr>
<th>H9. Does this unit have piped water?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Yes, to this unit</td>
</tr>
<tr>
<td>b. Yes, to this building</td>
</tr>
<tr>
<td>c. No piped water to this structure</td>
</tr>
</tbody>
</table>

| H10. Does this unit have a flush toilet (Y/N)? |
### Section 2—Selected Characteristics of Individual Residents (using household member numbers from page 1)

#### Household Member 1.

**P1. Residence**
- a. Lived in this house 5 years ago, on 1/1/2007 (Y/N)?
- b. If less than 5 years old, write NA.
- c. If No, write where they lived (Village, district)

**P2. Language usually spoken at home:**

**P3. Work in the last week, either full- or part-time. Please do not include housework, school work, or volunteer work.**
- a. Full-time or part-time, no subsistence.
- b. Full-time or part-time, with subsistence.
- c. Subsistence only.
- d. No work last week.

**P4. Where worked last week (main employment; if wage labor, name company and list location)?**

**P5. Occupation:**

**P6. Which of the following subsistence activities done last week (Y/N, amount harvested, and amount sold [Tsh])?**
- a. Fish
- b. Hunt
- c. Trap
- d. Collect
- e. Farm
- f. Firewood
- g. Construction material
- h. Handicrafts
- i. Other (specify)

**P7a. Last year (2011), worked for wages in business or agriculture (Y/N)? If N, go to 8**

**P7b. Number of weeks worked last year?**

**P7c. Number of hours usually worked when working?**

**P8. Which of the following subsistence activities done last year (2011) (Y/N, amount harvested [volume], and amount sold [Tsh])?**
- a. Fish
- b. Hunt
- c. Trap
- d. Collect
- e. Farming
- f. Firewood
- g. Construction material
- h. Handicrafts
- i. Other (specify)

**P9. How much earned last year (2011) [Tsh]?**
- a. Wage labor
- b. His/her own non-farm business
- c. Selling agricultural products
- d. Renting/leasing land or houses
- e. Remittances
- f. Other

#### Household Member 2.

**P1. Residence**
- a. Lived in this house 5 years ago, on 1/1/2007 (Y/N)?
- b. If less than 5 years old, write NA.
- c. If No, write where they lived (Village, district)

**P2. Language usually spoken at home:**

**P3. Work in the last week, either full- or part-time. Please do not include housework, school work, or volunteer work.**
- a. Full-time or part-time, no subsistence.
- b. Full-time or part-time, with subsistence.
- c. Subsistence only.
- d. No work last week.

**P4. Where worked last week (main employment; if wage labor, name company and list location)?**

**P5. Occupation:**

**P6. Which of the following subsistence activities done last week (Y/N, amount harvested, and amount sold [Tsh])?**
- a. Fish
- b. Hunt
- c. Trap
- d. Collect
- e. Farming
- f. Firewood
- g. Construction material
- h. Handicrafts
- i. Other (specify)

**P7a. Last year (2011), worked for wages in business or agriculture (Y/N)? If N, go to 8**

**P7b. Number of weeks worked last year?**

**P7c. Number of hours usually worked when working?**

**P8. Which of the following subsistence activities done last year (2011) (Y/N, amount harvested [volume], and amount sold [Tsh])?**
- a. Fish
- b. Hunt
- c. Trap
- d. Collect
- e. Farming
- f. Firewood
- g. Construction material
- h. Handicrafts
- i. Other (specify)

**P9. How much earned last year (2011) [Tsh]?**
- a. Wage labor
- b. His/her own non-farm business
- c. Selling agricultural products
- d. Renting/leasing land or houses
- e. Remittances
- f. Other
### Appendix B: Household Income and Expenditure Diary

#### 2012-2013 Household Income and Expenditure Survey, Udzungwa Mountains National Park Region

**Purchased Items**

<table>
<thead>
<tr>
<th>DAY 1 – MONDAY</th>
<th>ITEMS BOUGHT</th>
<th>Mark “x” if you did not buy anything on this day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity</td>
<td>Cash (Tsh)</td>
</tr>
<tr>
<td></td>
<td>Number</td>
<td>Unit</td>
</tr>
</tbody>
</table>

If you purchased more items on this day than you have room to record above, please record on overflow sheet on p. 18

Home-produced items, including fruit, vegetables, and animals harvested; firewood or other fuel (e.g., rice husks, charcoal) grown, collected, or produced; food from nature hunted, collected, or otherwise harvested; other resources (e.g., building materials, medicinal plants) obtained from nature. REMEMBER to list units (bags, bundles, adult or juvenile animals, etc.).

<table>
<thead>
<tr>
<th>Office Use Only</th>
<th>Item Description</th>
<th>Quantity</th>
<th>1-Used</th>
<th>2-Sold</th>
<th>3-Traded</th>
<th>Estimated local value (Tsh) and time spent (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you used more items on this day than you have room to record above, please record on overflow sheet on p. 18

**Wages earned from activity outside the home**

<table>
<thead>
<tr>
<th>Office Use Only</th>
<th>Activity/Employer</th>
<th>Rate paid (Tsh/hr or day)</th>
<th>Time worked</th>
<th>Total earned (Tsh)</th>
<th>Household member (no.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If household had more sources of wage labor than you have room to record above, please record on overflow sheet on p. 19
Appendix C: Household Food Weight Log

### Day 1

<table>
<thead>
<tr>
<th></th>
<th>Person 1</th>
<th></th>
<th>Person 2</th>
<th></th>
<th>Person 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal 1</td>
<td></td>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Type</td>
<td></td>
<td>Weight (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal 2</td>
<td></td>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Type</td>
<td></td>
<td>Weight (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal 3</td>
<td></td>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Type</td>
<td></td>
<td>Weight (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix D: Supplementary Questionnaire for Households of Interest

Questions to Ask Households of Interest, Mang’ula B
Number of Households: 20

These follow-up questions are meant to help understand what the specific situation is of each of these households. Based on the data provided, their consumption patterns were consistently high, low, or notably varied. Thus, we’d like to follow up with this sample to help identify variables of particular interest and clarify any data that might be misleading. These questions can be adjusted or added to depending upon the situation of each household.

1. In which season (Short Rains, Dry after Short Rains, Long Rains, Dry after Long Rains) do you typically have the most food to eat? Least food to eat?

2. Is there anything particularly unique about your situation that might help or hurt your financial and food security?
   a. i.e. Receiving remittances from abroad, supporting extended family, disabilities?

3. Where does the majority of your income come from – wage labor, selling crops, etc.?

4. Do you grow or purchase the majority of your food?

5. What is your biggest concern between each season?
   a. i.e. Buying enough food, crop yields, having enough money, paying bills, etc.?
BIBLIOGRAPHY


Jarosz, L. (2014). Comparing food security and food sovereignty discourses. Dialogues in Human Geography, 4(2), 168–181. Retrieved from http://psu.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwY2AwNtIz0EUrEyxTjM2MDZJS TEHn1aUmpZmYGKeZpaWaGCVZAIt3pmmw3WPg5VBIIBybEANTap4og46ba4izhy5orVV8Ae QYhnhD6EnVRuDjLFDPxtQY2Po3NBRj4E0ELQ_PKwFvI0uRYFBISk1MNDY3MDdKBrb_U0 yBRTBQl3myaWKaeaqBSXIKAKOxLWU


ACADEMIC VITA

Kaitlyn A. Spangler
Email: Kaitlyn.Spangler@gmail.com

Education

The Pennsylvania State University (PSU), Schreyer Honors College | May 2016
   Bachelor of Arts in Anthropology
   Bachelor of Science in Community, Environment, and Development
      (International Development Option)
   Minor in Global Health
   Honors in Anthropology and Landscape Architecture

Fields of Interest

   Food security, rural development, asset-based development, global health, rural
   sociology, nutritional assessment, cultural ecology, natural resource management

Travel Experience

Semester Abroad: Minnesota Studies of International Development, Kenya | Spring 2014
   • Studied East African cultural, economic, and environmental development with 10
     Kenyan professionals for 2 months
   • Interned for the GMCR Livelihoods Project with Caritas Nyeri to increase food
     security in Mukurweini District: conducted 300 interviews with farmers; distributed
     project materials; aided in office records for 2 months

Global Health Minor Fieldwork Experience: Tanzania | May - July 2015
   • Shadowed 15 global health professionals in at national hospital and health clinics
   • Worked hands-on with Tanzanian nursing students from Muhimbili University to
     conduct community health assessments of mental health, access to healthcare, and
     general wellbeing in Haneti village
   • Conducted a needs assessment of access to and quality of water in Haneti over 10
     days and presented our findings to Muhimbili University administration

Global Environmental Brigades Volunteer: Panama; Honduras | May 2013; March 2015
   • Worked alongside community members and Global Brigade staff to assist in
     sustainable development projects over 7 days
   • Planted over 300 plantain and coffee seedlings on a demonstration farm in Panama
   • Built 1 eco-stove, 2 latrines, and 3 concrete floors with a team of Honduran masons

Work Experience

Research Assistant: PSU College of Health and Human Development | July 2014 – Present
• Assist in food and protein drink preparation for a controlled feeding study isolating the anti-aging effects of a low-methionine diet


• Wrote compelling content for groundswellinternational.org, organize fundraising activities, edit program reports, and compose content for social media accounts
• Coordinated with their office in Washington, D.C. through phone calls and e-mails

**Extracurricular Activities**

**Club Cross Country Team Competing Member: PSU | Fall 2012 – Present**

• Compete against Division II and III college teams and National Intercollegiate Running Club Association (NIRCA) teams nationwide
• Served as women’s captain during fall season of 2014
• Fundraise for PSU’s 46-hour dance marathon (THON), a campus-wide philanthropic event to raise money and awareness for pediatric cancer

**Global Environmental Brigades Co-President: PSU | Fall 2013 – Spring 2015**

• Plan and lead 7-day brigades of about 20 students to Piriati Embera, Panama
• Work on sustainability projects of permaculture and greenhouse use in small villages
• Involve the campus community with awareness events and farming for the food bank

**Awards**

Schreyer Honors College Scholar | Fall 2012 - Present
Dean’s List | 7 semesters: Fall 2012 – Present
Paterno Fellows Program, College of Liberal Arts | Fall 2012 – Present
Phi Kappa Phi Honors Society Member | April 2015 – April 2016
Africana Research Center Grant Recipient | Fall 2015

**Presentations**

**Society for Applied Anthropology 76th Annual Meeting: Oral presentation | April 2016**

Title: “Water Access and Quality in a Village near Dodoma, Tanzania”
Co-Presenters: Francisco Alejandro Montiel-Ishino, Grant Schneider, and Mason Strawser

**Publications**

Title: “L’Oreal: Beauty for Everyone?”
Co-Authors: Emma Fivek, Ciara Hovis, and Madison Miller
Publication: *CED Undergraduate Research Journal*.
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**Languages**

English: Native fluency
KiSwahili: Professional working proficiency
French: Basic proficiency