Monitoring, Evaluation and Technical Support Services (METSS)

Baseline Feed the Future Indicators for Northern Ghana 2012

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Additional information about the survey and the electronic version of the report may be obtained from the METSS' website at **http://www.metss-ghana.k-state.edu**.

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Foreword

Poverty is a major development indicator, influencing health and nutrition status as well as empowerment. For this reason, it has become the focal point for policy interventions in many development projects. To monitor performance of its intervention investments in Ghana and provide a foundation for evaluating outcomes emanating from these activities in relation to the Feed the Future Initiative, the Economic Growth Office of USAID|Ghana sponsored this population-based survey research project. The results provide benchmarks for the identified Feed the Future indicators.

The study was conducted by the Monitoring, Evaluation and Technical Support Services (METSS) staff in Ghana and the U.S. The survey data collection was performed by the Institute of Statistical, Social and Economic Research, and the original survey instrument was provided by the Bureau of Food Security. The Ghana Statistical Service facilitated the sampling process and helped with gaining community support in the selected enumeration areas. The Ghana Ministry of Health provided children anthropometric equipment that made the collection of that data possible. This report, therefore, shows the results of the analyses of data that was made possible by numerous people. To all of the individuals in these organizations who went beyond their job descriptions and pay scales to help us complete this assignment we owe a debt of gratitude.

One person who should be acknowledged because of her tireless support at all stages of this project is Anne Swindale, Bureau of Food Security. She was always available for conversation and advice. Hazel Malapit of International Food Policy Research Institute (IFPRI) also provided invaluable help with the construction and estimation of the Women's Empowerment in Agriculture Index (WEAI). We are also grateful to the numerous reviewers in our collaborating institutions and agencies, including USAID and USDA, who, with their observations, comments, and suggestions, made this report a more user-friendly resource. In the end, however, the authors are responsible for any errors that may be in this report.

As the Principal Investigator, I am especially grateful to all the researchers who supported this work as well as the administrative staff at METSS who understood the project's importance and went the extra mile to make it happen. Saaka Adams, Patrick Fosu-Siaw, James Asafo-Adjei, Catherine Ayettey and our Chief of Party, Dr. Adeline Ofori-Bah, provided both logistical and moral support during the data collection process. Harold Tarver and Jim Suits of USDA/FAS have been wonderful partners on this project, providing much needed program management support. I would be remiss if I do not recognize the leadership provided by Peter Trenchard, the Economic Growth Office Director, and his USAID|Ghana staff for their support. My biggest and most heartfelt gratitude, however, goes to the members of the over 4,400 households who agreed to participate in this study and patiently endured our intrusion in their lives. I hope these results contribute to the development of policies and programs that make it all worthwhile.

Vincent Amanor-Boadu, PhD
Principal Investigator

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Abbreviations and Acronyms

ADVANCE	Agricultural Development and Value Chain Enhancement
ACDEP	Association of Church-based Development NGOs
BECE	Basic Education Certificate Examination
BMI	Body Mass Index
BUSAC II	Business Sector Advocacy Challenge Fund
CAPI	Computer-Assisted Personal Interview
CPI	Consumer Price Index
DANIDA	Danish Ministry of Foreign Affairs
DFID	UK's Department for International Development
EA	Enumeration Area
5DE	Five Domains of Empowerment
GCE	General Certificate of Education
GIZ	German Organization for International Development
GPI	Gender Parity Index
GCAP	Ghana Commercial Agriculture Project
GDHS	Ghana Demographic and Health Survey
GLSS V	Ghana Living Standards Survey Rounds 3 through 5
GSS	Ghana Statistical Service
GPS	Global Positioning System
GNI	Gross National Income
GDP	Gross Domestic Product
HH	Household
HHS	Household Hunger Scale
HDI	Human Development Index
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
IR	Intermediate Results
ISSER	Institute of Statistical, Social and Economic Research
JICA	Japan International Cooperation Agency
MSLC	Middle School Leaving Certificate
MAD	Minimum Acceptable Diet
MMF	Minimum Meal Frequency
MCAR	Missing Complete At Random
MAR	Missing at Random
MNAR	Missing Not At Random
METSS	Monitoring, Evaluation and Technical Support Services
NRCC	Northern Region Coordinating Council
OPHI	Oxford Poverty and Human Development Initiative
PPP	Purchasing Power Parity
PPPs	Private-Public Partnerships
PPS	Probability Proportional to Size
RING	Resiliency in Northern Ghana
UNICEF	United Nations Children's Fund

NCHS	U.S. National Center for Health Statistics
USAID	U.S. Agency for International Development
USG	U.S. Government
WEAI	Women's Empowerment in Agriculture Index
WDDS	Women's Dietary Diversity Score
WHO	World Health Organization
ZOI	Zone of Influence

Introduction

Reporting on the state of the Human Development Index (HDI) for various countries in 2012, the United Nations' *Human Development Report* 2013 (p. 1) notes that:

> "Although most developing countries have done well, a large number of countries have done particularly well – . . . such as Bangladesh, Chile, Ghana, Mauritius, Rwanda and Tunisia".

Ghana's progress was among those considered "particularly rapid" because of significantly larger than predicted growth in its HDI between 1990 and 2012. While the causes of this rapid growth are complex, a number of factors stand out, two of which are worth mentioning. One, Ghana has enjoyed a healthy and stable political and social environment during the past two decades, attributable to good governance and international support. Ghana has also maintained a relatively high level of safety and security, unlike the conditions prevailing in Nigeria and other surrounding nations. The second factor worth mentioning is the substantial improvement in Ghana's trade to output ratio between 1990 and 2012. Its share of global exports of goods and services increased from its average of about 0.03 percent in 1985-1990 to 0.04 percent in 2005-2010 period. This 41 percent increase in Ghana's share of global exports made it the only African country to be in the "High Achievers of HDI" category, as reported by the World Bank (2012a).

Ghana has emerged as a middle-income country (World Bank, 2012b) with average Gross National Income (GNI) per capita of $1,810 in 2011 (measured by the Purchasing Power Parity). Provisional annual estimate of its Gross Domestic Product (GDP) growth in 2012 was 7.1 percent (Ghana Statistical Service, 2012). This compares with 14.4 percent and 8.0 percent in 2011 and 2010, respectively. The strong economic growth is a result of public policies that have encouraged private sector development and the export of crude oil since production officially started in the offshore Jubilee Field in late 2010.

Ghana's political and socio-economic achievements have, thus far, benefited from significant support from the international community. The U.S. Government, through the U.S. Agency for International Development (USAID), has been one of the principal supporters in this effort. The Agency's support activities are outlined in its Country Strategic Plan (2004-2010) under the four-point rubric of: (1) Democratic governance; (2) Private sector competitiveness; (3) Health; and (4) Education. This rubric is also mirrored in the Agency's Country Development Cooperation Strategy 2013-2017. In 2009, the U.S. Government launched its Feed the Future Initiative in response to pressing global hunger and food security challenges. This has engendered a higher level of commitment to Ghana's political and socio-economic development and created a higher level of partnership between Ghana and the U.S. Government through its implementing agencies.

The Feed the Future Initiative aims to help developing countries address root causes of hunger and poverty specific to their individual and unique circumstances through the transformation of agricultural production and improvement in health and nutrition. The initiative operates on the foundation of country-owned plans created through a consultative process with stakeholders and executed in collaboration with the country's political and civil leaders, donor organizations and the private sector. USAID leads the execution of the Feed the Future Initiative. The Agency is charged with leveraging the resources and capabilities of other U.S. Government agencies to achieve the Initiative's objectives. Some of the U.S. Government agencies involved in the Feed the Future initiative are the State Department, Peace Corps, Millennium Challenge Corporation, Treasury Department, U.S. Trade Representative, Overseas Private Investment Corporation, U.S. African Development Foundation, and the U.S. Department of Agriculture. USAID|Ghana is also working closely with the Government of Ghana, local non-governmental organizations, private sector organizations, and international development partners to efficiently achieve the objectives of the Feed the Future Initiatives by avoiding duplications. Some of the international development partners are the World Bank, World Health Organization (WHO), the International Monetary Fund (IMF), the German Organization for International Development (GIZ), the Danish Ministry of Foreign Affairs (DANIDA), EU Micro Project, and the Japan International Cooperation Agency (JICA).

Ghana's Country Strategy

Ghana is one of the 20 focus-countries identified in the Feed the Future Initiative. USAID Missions in each of these focus-countries is required to develop a country strategy, in collaboration with local stakeholders, to guide the unique initiatives that should stimulate progress towards the desired outcomes underscoring the Feed the Future Initiative.

Ghana's strategy, conceived to be executed between 2011 and 2015, was approved in February 2011. The strategy identifies three Intermediate Results (IR) that are in line with those defined within the Feed the Future framework:[1]

IR 1: Increased Competitiveness of Major Food Value Chains (rice, maize, soya, fisheries), achieved through:
   a. Increased agricultural productivity; and
   b. Increased market access.

IR 2: Improved Resiliency of Vulnerable Households and Communities, and Reduction in Under-Nutrition, achieved through:
   a. Improved access to diverse quality food;
   b. Improved nutrition-related behaviors in vulnerable households;
   c. Community-developed mechanisms to identify and address their nutrition problems; and
   d. Strengthening coordination of government and others.

IR 3: Improved Nutritional Status of Women and Children, achieved through:
   a. Improved nutrition-related behaviors and community norms;
   b. Expanded community-based treatment of acute malnourished children;
   c. Expanded accessibility of quality foods for child weaning; and
   d. Identification and addressing of causes of severe anemia among children.

It is important to note that average national metrics on economic growth, human development index, poverty reduction and food security are all "averages" and present large variabilities when checked against reality. For example, while only 5 percent of Ghana's population is considered food insecure, the proportion of residents in the northern part of the country with food insecurity has been estimated to be anywhere from double to seven times the national average (USAID|Ghana, 2012). Similarly, the World Bank reports that while the number of the poor in southern Ghana declined by 2.5 million, it increased by nearly 1 million in northern Ghana. A major factor driving these differences between the northern and southern regions of the country may be the northern region's low population and vast land mass, and the relatively poor roads and infrastructure. The average population density for the three northern regions is approximately 43 people per square kilometer, estimated using 2010 Ghana Census data (Ghana Statistical Service, 2012a). This contrasts with population density of about 145 people per square kilometer for the remaining seven regions. The low population density and poor infrastructure contribute to the isolation of households and communities, decrease individuals' accessibility to markets and exacerbate risks of food insecurity and poverty even as the country's average development indicators show significant growth.

Ghana's Feed the Future country strategy aims to support and engage Ghanaians and their public and private leadership to achieve the Government of Ghana's vision of increasing agricultural growth, expanding food supply and improving nutrition. Achieving these goals is expected to transform the economic achievements from mere "average metrics," that do not define the lives of ordinary people, into an economy that "registers in the lives, livelihoods and incomes of ordinary people by the year 2020 . . . accomplished by the adoption of prudent policies defined by ordinary people, better policy co-ordination and better management of the national economy" (USAID|Ghana, 2012, p. 7).

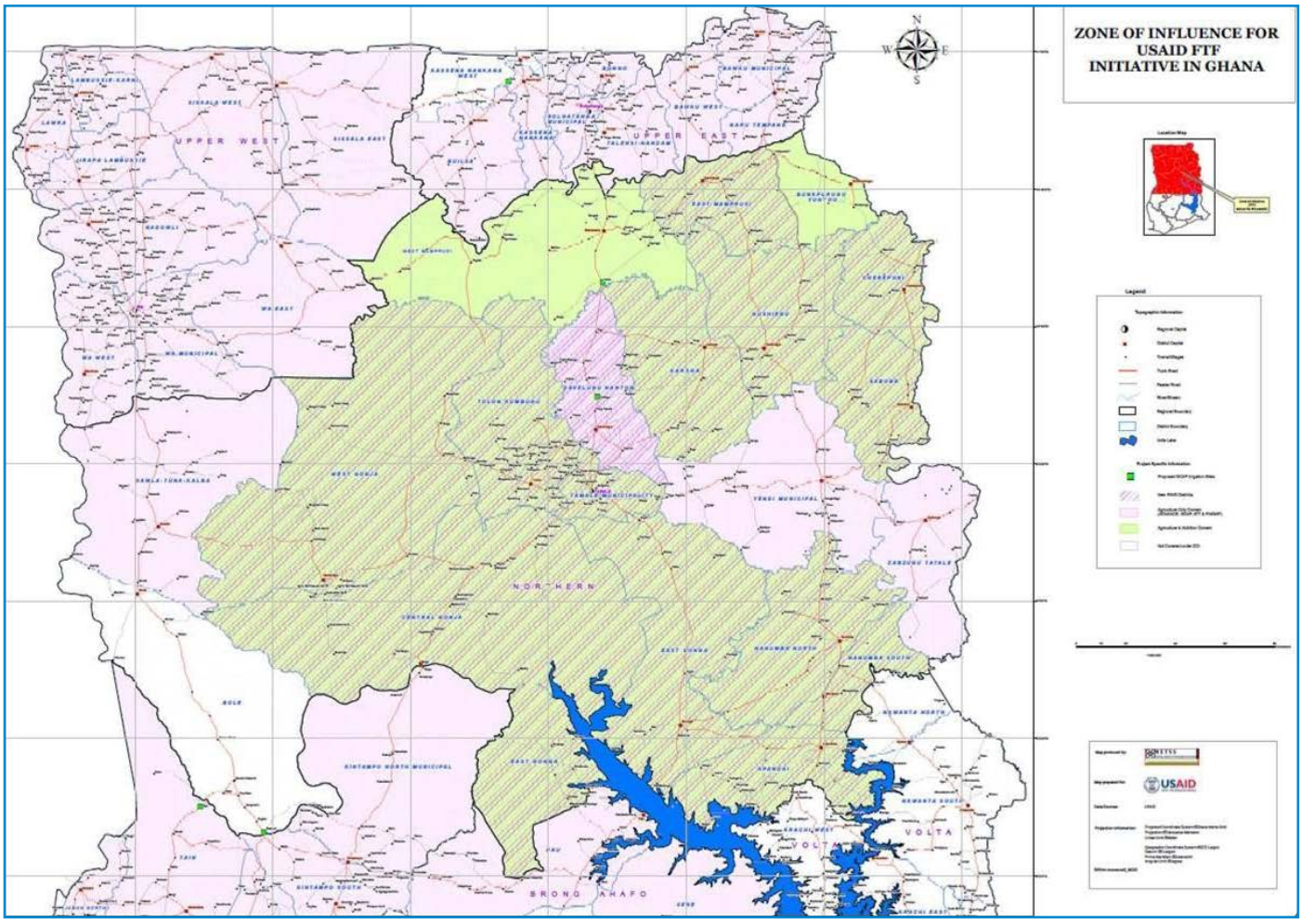
1 See Appendix A for a description of the Feed the Future Framework.

Defining the Zone of Influence

As a result of the foregoing stark differences between the northern and southern regions of Ghana, the principal Feed the Future Intervention activities are being focused in the northern part of the country.[2] The Zone of Influence (ZOI) for these activities has been defined to encompass the area of the country above the 8th Parallel (Figure 1). It covers 45 administrative districts that lie above Latitude 8°N, and in four regions: Brong Ahafo; Northern; Upper East; and Upper West. The total population of these districts in 2010 was about 4.93 million, accounting for about 20 percent of Ghana's population that year (Ghana Statistical Service, 2012a). While the ZOI covers all of the districts in the other three regions, only seven of the 22 districts of Brong Ahafo Region are included.

To provide an idea of the potential impact for the intervention activities in the ZOI, the 2010 populations of the covered districts are presented in Table 1. The seven districts in Brong Ahafo had a total population of 705,722, accounting for approximately 14.3 percent of the ZOI population in 2010. The nine districts, each in Upper East and Upper West Regions, accounted for 21.2 percent and 14.2 percent, respectively, of the ZOI population while the 20 districts in Northern Region accounted for 50.3 percent of the ZOI population. The regional distribution of population contextualizes their relative contribution to the various indicators in this report.

Figure 1: ZOI of Ghana's Feed the Future Strategy



Source: Monitoring, Evaluation and Technical Support Services, Ghana, 2012

2 There is a focus on marine fisheries and nutrition in a small segment of coastal Western Region.

Table 1: Population of the 45 Districts in the ZOI by Region Based on 2010 Census

Brong Ahafo Districts	Population
Jaman North	83,059
Kintampo North	95,480
Kintampo South	81,000
Pru	129,248
Sene	118,810
Tain	108,386
Wenchi	89,739
Subtotal Brong Ahafo	***705,722***
Upper East Districts	**Population**
Bawku Municipal	217,791
Bawku West	94,034
Bolgatanga	131,550
Bongo	84,545
Builsa	92,991
Garu Tempane	130,003
Kasena Nankana East	109,944
Kasena Nankana West	70,667
Talensi Nabdam	115,020
Subtotal Upper East	***1,046,545***
Upper West Districts	**Population**
Jirapa	88,402
Lambussie Karni	51,654
Lawra	100,929
Nadowli	94,388
Sissala East	56,528
Sissala West	49,573
Wa East	72,074
Wa Municipal	107,214
Wa West	81,348
Subtotal Upper West	***702,110***

Northern Districts	Population
Bole	61,593
Bunkpurugu/Yonyoo	122,591
Chereponi	53,394
East Gonja	135,450
Gonja Central	87,877
Gushiegu	111,259
Karaga	77,706
Kpandai	108,816
Mamprusi East	121,009
Mamprusi West	168,011
Nanumba North	141,584
Nanumba South	93,464
Saboba	65,706
Savelugu Nanton	139,283
Sawla/Tuna/Kalba	99,863
Tamale	371,351
Tolon Kumbugu	112,331
West Gonja	84,727
Yendi	199,592
Zabzugu Tatali	123,854
Subtotal Northern	***2,479,461***
Total	**4,933,838**

Source: Ghana: Administrative Division. Available at http://www.citypopulation.de/php/ghana-admin.php. Accessed April 4, 2013.

A Need for Baseline Indicators

In order to ascertain the impact of interventions targeted within the zone of intervention, there is a need to establish a baseline of the principal indicators used to measure progress towards the intermediate results. The baseline of key indicators is measured through a population-representative survey in the ZOI. These baseline indicators provide a reference for monitoring and evaluating the impacts emanating from structured interventions in the ZOI. The baseline indicators and the results of the ensuing monitoring and evaluation activities provide a mechanism for evaluating change towards desired outcomes and impacts. The data also provides input for testing specific hypotheses that can help frame and support the development of research-

driven and evidence-based policymaking to improve the efficiency of intervention strategies and activities. For example, the following projects, supported by USAID|Ghana, are already under way or have been completed in the ZOI:

- Agricultural Development and Value Chain Enhancement (ADVANCE): 2009-2013
  - Project contract awarded to ACDI/VOCA in July 2009. The project is being implemented by two international partners (TechnoServe and Winrock International) and two local partners (Association of Church-based Development NGOs (ACDEP) and PAB Development Consultants).
- Business Sector Advocacy Challenge Fund (BUSAC II): 2010-2014
  - Project objectives include engaging the private sector in policy development and implementation at national, regional, district and local levels. It also seeks to strengthen the advocacy capacity of private sector business organizations to support poverty reduction and improve administrative capacity of private sector leadership. Phase I was from 2004-2010 and was funded by DANIDA, Department for International Development (DFID), and USAID. BUSAC II started in March 2010 with funding from USAID and the European Union, with DANIDA as the lead donor.
- Resiliency in Northern Ghana (RING): 2012-2017
  - Given the disparity between northern Ghana and the rest of the country in terms of poverty and food security, the principal goal of the RING project is to improve livelihoods and nutritional status in Northern Region. Intervention initiatives will focus in 15 of the region's districts, working intimately with and through the District Assemblies and the Northern Region Coordinating Council (NRCC). For the districts not included in the direct intervention activities, the implementing partner will contribute to building capacity of the district assembly through technical assistance.
- Ghana Commercial Agriculture Project (GCAP): 2012-2017
  - A collaborative initiative with the Government of Ghana, the World Bank and USAID aimed at improving the agri-business investment climate and developing inclusive Private-Public Partnerships (PPPs) and smallholder linkages to increase on-farm productivity and value addition in selected value chains. Project objectives include increased access to land, private sector financing and markets for smallholder farmers.

Population-Based Survey Objectives

The Feed the Future indicators of interest are presented in Table 2 and the framework supporting them are also presented in Appendix A. These indicators defined the survey objectives and provided the structure for this report.

There are 11 baseline indicators of economic and health conditions in the ZOI. They are organized into four groups: (1) Economic well being; (2) Women and Children Anthropometry; (3) Hunger and Diet Diversity; and (4) Women's Empowerment. The economic wellbeing group encompass two indicators – the prevalence of poverty and the per capita daily expenditure. The prevalence of poverty is measured by the proportion of people living on less than US$1.25 per day, an indicator provide by the World Bank. The women and children anthropometry group covers four indicators, three of them are focused on children. The three focused on children measure the prevalence of underweight, stunted and wasted children. The one focused on women measures the prevalence of underweight women, limiting the measure to only women of child-bearing age. There are four indicators in the third group: (i) the household hunger scale; (ii) the consumption of a minimally acceptable diet by children; (iii) the dietary diversity of women and; (iv) the prevalence of exclusive breastfeeding of children under the age of six months. The eleventh indicator is the "Women's Empowerment in Agriculture Index," a multidimensional indicator used to measure gender differentiation in control over social, economic, and cultural decisions that affect agency and well-being. Given the critical role of women in smallholder agricultural, understanding the status of empowerment could help frame intervention policies to have far-reaching economic outcomes for women, their children, families, and communities.

Table 2: Feed the Future Indicators and Expected Impact

No.	Feed the Future Indicators	Expected Impact
1	Prevalence of Poverty: Percent of people living on less than $1.25/day	Sustainably reduce global poverty and hunger
2	Prevalence of underweight children under five years of age	Sustainably reduce global poverty and hunger
3	Per capita expenditures of USG targeted beneficiaries	Inclusive agricultural sector growth
4	Women's Empowerment in Agriculture Index	Inclusive agricultural sector growth
5	Prevalence of stunted children under five years of age	Improve nutritional status of children
6	Prevalence of wasted children under five years of age	Improve nutritional status of children
7	Prevalence of underweight women	Improve nutritional status of women
8	Prevalence of households with moderate or severe hunger	Increased resilience of vulnerable communities and households
9	Prevalence of children 6-23 months receiving a minimum acceptable diet	Improved access to diverse and quality foods
10	Women's Dietary Diversity: Mean number of food groups consumed by women of reproductive age	Improved access to diverse and quality foods
11	Prevalence of exclusive breastfeeding of children under six months of age	Improved nutrition-related behaviors

The primary objective of this project was to conduct the population-based survey in the ZOI and estimate the 11 Feed the Future indicators as the starting point against which intervention impacts and outcomes may be measured. These baseline indicators also provide a description of the nature of the situations being measured, and thus, provide context for crafting strategic interventions required to achieve desired objectives and measuring progress towards those objectives. The estimated indicators (and their contexts) may also be useful in cross-country comparisons to facilitate discussions about changes and scaling up of intervention strategies. This report, therefore, presents the estimated indicators in ways that facilitate effective monitoring and evaluation of planned or ongoing intervention initiatives in the ZOI.

Report Layout

The next section will present an overview of the survey design and enumeration process. It also describes the process of calculating the survey weights in order to extrapolate the results to the broader population. This is followed by presentation of social and demographic characteristics of the population in order to develop context for the indicators.

Following this overview, each of the 11 indicators is presented in separate sections. Each section is presented in a very similar manner, with the Feed the Future indicator estimated for the entire ZOI and then broken down into sub-populations. These sub-populations reflect the level of disaggregation required for USAID reporting purposes including RING and Non-RING interventions zones, by gendered households, rural and urban locations, and political regions. In addition, indictors for children are broken down by age and gender. These sub-population statistics help to identify the sources of variation for each indicator in the ZOI. Appendix C contains statistics and tests of differences for all indicators. Statistical significance tests of differences between sub-populations are limited to a 5 percent or lower. The foregoing suggests that whenever a result is cited as "not statistically significant," it implies that the level of significance falls above the 5 percent level. Appendix D provides the sampling error measures for all the indicators with the exception of Women's Empowerment in Agriculture Index.

Statistics for each indicator and its sub-population values include the prevalence rate and its absolute and relative contribution components. The prevalence rate describes the overall incidence of a Feed the Future indicator in the ZOI and subgroups. The absolute contribution is the amount of the prevalence that comes from a subgroup. By definition, the prevalence rate is the sum of the absolute contributions from each sub-population.

The relative contribution is a measure of the indicator within the context of the sub-population. It is, therefore, a measure of the indicator at the sub-population level when the relative shares of population of the sub-populations are recognized. To illustrate, while poverty prevalence rates may be similar in two sub-populations, a drastic difference between the populations in the two sub-populations would make the relative contribution of the sub-population with a lower population much lower than that of the sub-population with higher population. The final section of the report provides a summary of the principal results. It is expected that these results will provide a foundation or reference for monitoring the progress of intervention projects and evaluating their achievements over time.

Methodological Overview

The following two subsections provide an overview of the process used to develop and implement the survey. The survey was modified from the base survey developed by the Bureau of Food Security and then programmed for enumeration on laptop PCs. The survey, including programming, training of enumerators, enumeration and data collation took place from the beginning of April to the end of September 2012.

The information in this section is adapted from the final report submitted by ISSER to METSS in November 2012 as part of ts contractual obligations to provide survey and enumeration services for this project. Earlier versions of this report are found in the Survey Protocol document developed by METSS, in collaboration with ISSER in April 2012.

Survey Design

The sampling process was built around the objectives of the Ghana country strategy discussed in the previous section. The prevalence rates for poverty, stunting and underweight specifically for the ZOI in Ghana, available from the Ghana Living Standards Survey Rounds 3 through 5 (GLSS V) and the Ghana Demographic and Health Survey (GDHS) of 2008, provided the foundation for designing the sampling strategy of the survey. Recall that the ZOI included only seven Brong Ahafo administrative districts. However, the reference studies did not allow district level extraction so in the sample design, we used information pertaining to all of Brong Ahafo. The discussion in this section of this report is based on the final report submitted to METSS by ISSER as part of its contractual obligation to support this research. Earlier versions of the survey design and protocol, which formed part of this final report, were developed by METSS in collaboration with ISSER and people like Anne Swindale of the Bureau of Food Security, Washington, DC in April 2012.

In developing the survey design, let i = 1, 2, 3 define the three indicators of interest – poverty, stunting, and underweight. Additionally, let the following assumptions frame the calculation of adequate sample size to produce accurate measures of baseline estimates for the three indicators in the ZOI:

1. The initial prevalence rate of poverty (p_{11}) for the ZOI estimated from the GLSS V was 0.567. This rate is assumed to decline by 1 percent per year between 2012 and 2017, giving an estimated ending prevalence rate of poverty (p_{21}) of 0.517.

2. The initial prevalence rate of stunting for children younger than 60 months (p_{12}) was 0.322. Assuming an annual decline of 1.32 percent, the ending prevalence rate (p_{22}) is estimated at 0.256.

3. The initial prevalence of underweight children under 60 months (p_{13}) was 0.219 and ending rate (p_{23}) is estimated at 0.176 under an assumption of 1.32 percent decline per annum over five years.

4. Type I error (α) is assumed at 5 percent.

5. Type II error (β) is assumed at 20 percent.

Based on the foregoing assumptions, Equation (1) is used to estimate the sample size for each of the indicators, n_i:

$$n_i = \left\{ \left[\frac{(p_{1i}q_{1i}) + (p_{2i}q_{2i})}{(p_{2i} - p_{1i})^2} \right] \times \left(Z_{1-\alpha} + Z_{1-\beta} \right)^2 \right\} \times Deff_i \quad \forall\, i = 1,2,3 \tag{1}$$

where q_{1i} is 1-p_{1i} and q_{2i} is 1-p_{2i} and $Z_{1-\alpha}$ and $Z_{1-\beta}$ measure the standard Z-scores at the 95 percent and 80 percent levels respectively. $Deff_i$ is the design effect for the sampling design for indicator i. It is estimated at 3.40, 1.21 and 1.25 for the prevalence of poverty, stunting and underweight, respectively. Applying these estimates produces nominal sample sizes of 4,164, 702, and 1,321 for the poverty, stunting and underweight indicators.

The nominal sample sizes based on the stunting and underweight indicators were inflated to account for households without children in the required age group of 0-59 months, and the inflated figures were further inflated by 10 percent to account for potential non-response. The effective sample sizes based on the foregoing for each of the design indicators are presented in Table 3.

Table 3: Effective Sample Size based on the Three Design Indicators

Design Indicators	Nominal n	Inflated for HH Without Children	10% Non-Response Inflation Rate	Effective n
1. Prevalence of poverty	4,164	0	416	4,580
2. Prevalence of stunting	702	1,140	114	1,254
3. Prevalence of underweight	1,321	2,144	214	2,358

Source: ISSER's computation based on GLSS V and 2008 GDHS

Although the approach above yielded three possible sample sizes, the highest (4,580) is used as the appropriate sample size because it would be sufficient for estimating the poverty indicator across the two strata defined by the areas where there will be RING intervention initiatives (RING Zone) and the areas where there will not be such intervention initiatives (Non-RING Zone). Thus, the Non-RING Zone is used as a counterfactual for impact evaluation of the RING intervention activities. Given that both the stunting and underweight indicators are for children, it is necessary to obtain a sample size of at least 2,358 in order to successfully estimate the prevalence rate for underweight children. Furthermore, since the underweight indicator gives a larger sample size than the stunting indicator, it would be required to obtain a sample size of at least 2,358 within the RING Zone. This sample size can adhere to the estimation of the stunting indicator with sufficient power (0.8) and significance (0.05). The estimated sample size was rounded up to the effective sample size of 4,600, further providing cushion for potential non-response and/or further increasing the power if effective sample size is achieved.

The poverty indicator, because of its coverage, was used to allocate the total sample size among the regions in the ZOI. The design effects estimated by ISSER using the GLSS V produced estimates of 15.92, 5.26 and 3.41 for the Northern, Upper East, and Upper West Regions, respectively. These estimates indicate that using the often recommended *Deff* of 2.0 would lead to an underestimation of sample sizes in this particular case. However, the estimates for the first two regions would produce extremely large and pragmatically challenging sample sizes. Therefore, the lowest of the three estimated design effects, i.e., 3.41, was used to determine the distribution of the sample across the participating regions.

Survey Sample and Instrument Design

A two-stage probability sampling approach was used in drawing the survey sample. The first stage involved the selection of enumeration areas (EAs) in the 2010 Ghana Census using the probability proportional to size (PPS) method. The second stage used a systematic sampling approach to select households in each sampled EA.

Given the effective sample size of 4,600 and the custom of drawing a sample of 20 households from each EA, a total of 230 EAs within the ZOI was drawn by the Ghana Statistical Service (GSS). To ensure the achievement of the minimum RING Zone households of 2,360, care was taken to have all the 118 RING Zone EAs in the sample of 230 EAs. METSS worked with GSS to develop a comprehensive listing of households with location and name of household head in the selected EAs to overcome the absence of an existing list with location and household head name. ISSER then used a systematic sampling approach on this comprehensive list of households and household head names to draw the second stage household sample.

The eleven modules making up the survey instrument were designed to capture the requisite information necessary for the estimation of the baseline indicators. The modules and their questionnaires were provided

by Bureau of Food Security and modified to reflect local contexts in a number of areas, e.g., relevant crops and locally available foods, and the use of local examples to enhance the explicitness of the questions. The following two documents prepared by USAID (2012) provided guidance for the modifications:

- *Volume 8: Population-Based Survey Instrument for Feed the Future Zone of Influence Indicators with Revised WEAI Module (Available at http://feedthefuture.gov/resource/volume-8-population-based-survey-instrument-feed-future-zone-influence-indicators)*
- *Volume 2: Baseline Guidance (Available at http://feedthefuture.gov/resource/volume-2-feed-future-baseline-guidance).*

METSS coded the different modules of the survey instrument into electronic forms that were loaded into eNCORE, database management - software capable of running on portable notebook computers. The electronic survey tool was then available to all enumerators, making it possible for them to collect data using the Computer-Assisted Personal Interview (CAPI) approach. METSS developed a manual for training enumerators in the use eNCORE and for use as a reference guide during field work.

Enumerator Recruitment and Training

ISSER and METSS collaboraed to recruit and train 82 people as field assistants for the survey. The recruitment criteria encompassed education, fluency in one or more of the languages spoken in the ZOI, and computer literacy. The training involved a 14-day residential program from June 14 to July 1, 2012. It started with taking all of the recruits through a paper version of the survey instrument and conducting a comprehension test to determine their competency to perform successfully as enumerators. Successful enumerators were then introduced to the computer-based version of the questionnaire and trained on its administration. Again, trainees took a competency test to assess their ability to effectively use the tool in the enumeration process. Successful candidates at this stage were then taken through training on the use of the anthropometric equipment (weighing scales, microtoiles, infantometer, and the stadiometer). This training was performed by a professional nutritionist familiar with these tools. Finally, enumerators were trained in using the Trimble® GPS equipment to record Global Positioning System (GPS) coordinates of all dwellings visited.

Enumerators receiving hands-on training of the Trimble® GPS devices they used in collecting GPS information about households they interviewed in Kumbungu in Northern Region.

Trainees took a final written test at the end of the training activities to test overall attitude, knowledge and competency using all the survey tools. Seventy-six enumerators out of the original 82 recruited were selected to conduct the fieldwork. This group was then taken through a session on ethical issues in research. Everyone involved with the research, including the enumerators, METSS and ISSER staff, signed the confidentiality agreement that had been developed for use with the project after all the training was completed.

Survey Implementation

Field Work

Using the CAPI approach to data collection, enumerators administered the questionnaire by reading the questions from a computer and entering responses directly to the computer. The interface tool used drop-down and button menus wherever possible to speed up enumeration, but also provided space for entry of unspecified responses. To speed up the interview process and reduce risks of potential errors, we preloaded identification details of selected households onto each enumerator's computer. The CAPI program was also designed to have all the necessary logic flows so that appropriate responses could be completed as a result of previous responses and unneeded fields resulting from previous answers skipped automatically. Implausible and spurious responses were highlighted to improve data quality and reduce enumerator and respondent fatigue.

A principal risk of the CAPI approach was power failure. To mitigate this risk, supervisors were supplied extra computers to use when those being used by enumerators needed their batteries recharged and there was no electricity power to do it. Supervisors were also provided cash so they could take computers to locations where they could be charged and returned quickly to enumerators. As a final back stop to the power problem, enumerators were each provided with paper questionnaires to use should their computer power fail and they could not get access to another computer. The feedback from enumerators and supervisors indicated that the need to use paper questionnaires occurred in less than one percent of all the interviews that were conducted. This would suggest that this power risk was managed effectively.

Enumerators were organized into five people, with one of them having supervisory responsibilities. EA assignment to teams was based on team members' language skills. On average, each team was responsible for between three and five EAs. The expected daily average workload per enumerator determined the estimated number of days spent by each team in an EA. Significant redundancies were built into the process to allow for

Obtaining the consent from potential interview respondents was a critical ethical standard that was implemented in this project. To this end, enumerators were required to secure the verifiable consent of each person interviewed prior to initiating the interview in each household. Where the respondent was not literate in the English language, the consent form was translated to them in their own language. They were then asked to provide their thumb print on the form if they consented to the interview. The consent forms were collected from each enumerator and filed at the METSS-Ghana office.

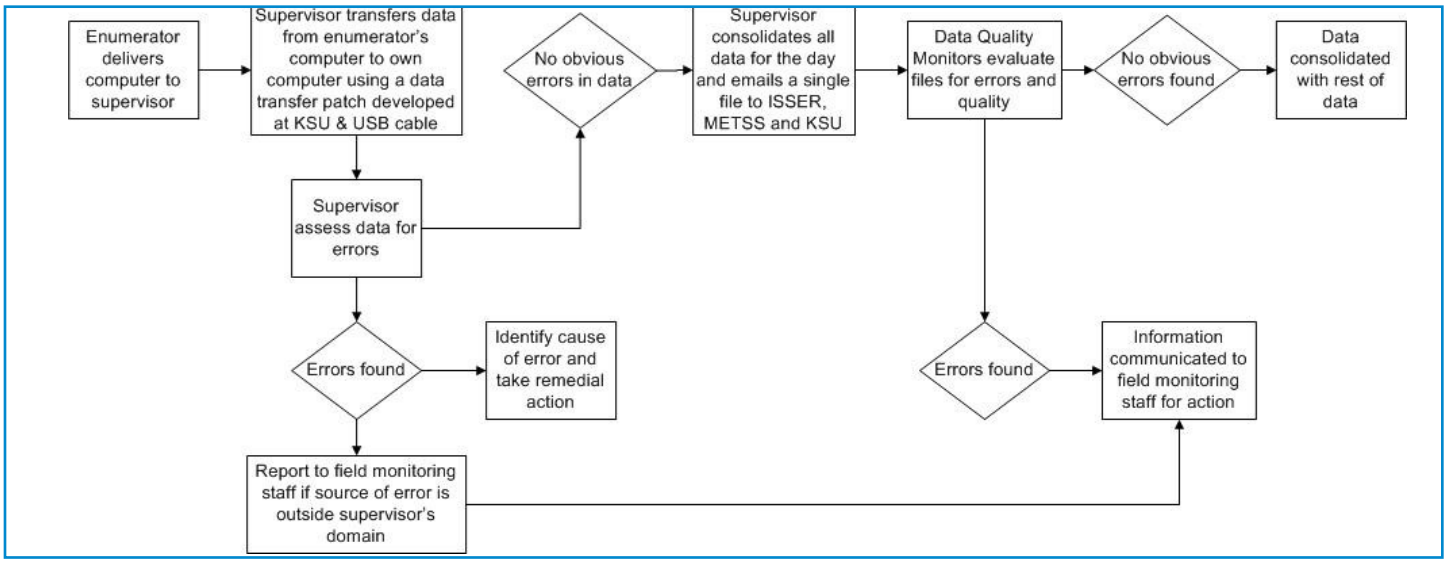
There is one case where the respondent was suspicious of the enumerator (a stranger) asking for his thumb print for something that he could not verify. To address this respondent's anxiety, the enumerator requested for a local school teacher to be brought in to do the translation. Once the teacher translated it for the respondent, he willingly provided his thumb print and the interview proceeded. This corresponding picture shows a respondent providing his thumbprint on the consent form in Buemali in Northern Region.

multiple visits to the same household. For example, enumerators were expected to make at least three visits to each of their assigned households and only if no contact could be made after those would the household be declared "unavailable." Also, enumerators were expected to make at least two visits to each contacted household to complete the interview to avoid respondent fatigue. They were expected to complete Modules 1 through 10 during the first visit and Module 11 during the second. It is worth noting that enumerators were encouraged to look for signs that indicated their subjects would not be available for future visits. When they felt this was the case, then they were encouraged to complete the survey in the first visit to avoid the risk of not completing the survey.

The fieldwork itself took place between July 1 and August 17, 2012. Throughout the period of the fieldwork, both ISSER and METSS monitoring teams paid unannounced visits to various teams to observe them at work, discuss any challenges they may be having and trouble shoot identified problems. The survey management team also developed a number of data assemblage protocols to ensure data security, completeness and accuracy. The process used in doing this is illustrated in Figure 2.

To ensure data security and maintain continuous assessment of data quality, the survey management team developed a number of data assembling protocols (Figure 2). Data collected by enumerators were consolidated on a daily basis by their supervisors, who used the consolidation process to inspect the data for errors. The supervisors, then, transmitted the data to the database systems at ISSER, METSS and Kansas State University

Figure 2: Data Transfer and Quality Management Assurance Protocols



to ensure a continuous quality monitoring. This also provided storage of the data at the end of each day in four places: the supervisor's computer; ISSER; METSS; and Kansas State University. In addition to having the consolidated files on their computers, supervisors also backed up their data at the end of each day onto flash drives that were provided for that purpose. By maintaining close contact between the field and the METSS office in Accra and its researchers in the US, the enumerators and their supervisors were able to get real-time feedback that we believe improved data quality and created the possibility of identifying and addressing emerging challenges quickly.

Survey Completion Rates

Only one of the 230 EAs targeted was not surveyed. This was a result of flooding that had washed away the only road leading to the EA. At the household level, 4,410 of the 4,600 targeted households were interviewed. This implied a completion rate of 95.9 percent. The completion rate by strata was 95.8 percent in the RING Zone and 95.5 percent in the Non-RING Zone, respectively. The completion rates by modules and sub-modules are presented in Table 4. The table shows that the response rates for each of the modules compared with the

estimated sample size suggested the sample exceeded its minimum required adequacy. For example, while the required sample size for the poverty indicator was 4,164, the number of households interviewed was 4,410, approximately 6 percent higher than needed.

Sampling Weight Computation[3]

Response rate estimates at both sampling stages and for the two strata were both found to be unequal. This provides a good reason to develop sampling weights to address the inequalities. To estimate sampling weights for this multi-stage design, the 2010 Ghana Population Census was used as the reference population of

Table 4: Survey Completion Rates by Module

Module	Eligibility Criteria	Number Eligible	Number Interviewed	Response Rate (%)
Household Identification*	All Household Heads Sampled	4,600	4,410	95.9
Dwelling Characteristics	All Household Heads Interviewed	4,410	4,363	98.9
Household Demography		4,410	4,410	100.0
Household Hunger Scale		4,410	4,398	99.7
Cultivation of Key Crops		4,410	4,395	99.7
Food Consumption Expenditure		4,410	4,355	98.8
Non-Food Consumption		4,410	4,305	97.6
Other Non-Food Consumption		4,410	4,224	95.8
Housing Expenditure		4,410	4,235	96.0
Durable Goods Expenditure		4,410	4,333	98.3
Women Dietary Diversity	All Women Aged 15-49 Years	5,214	4,572	87.7
Children Minimum Acceptable Diet	All Children Aged 6-23 Months	946	871	92.1
Exclusive Breastfeeding	All Children Aged 0-5 Months	377	349	92.6
Women Anthropometry	All Women Aged 15-49 Years	5,214	4,513	86.6
Children Anthropometry	All Children 0-59 Months	3,697	3,361	90.9
Role in Decision Making	Primary and Secondary Respondents	7,445	7,091	95.2
Access to Productive Capital		7,445	6,991	93.9
Access to Credit		7,445	6,993	93.9
Individual Leadership and Influence in the community		7,445	6,893	92.6
Group Membership and Influence		7,445	7,026	94.4
Decision Making		7,445	6,993	93.9
Motivation for Decision Making		7,445	7,018	94.3
Time Use		7,445	6,983	93.8
Satisfaction with Time Use		7,445	6,786	91.1

*Household head

3 For the purposes of this research, $Y_j = 20$ for all i's (EAs).

households in each of the two strata. The total number of households in each EA in each stratum (*Nij*) is as recorded in the Census report. The sum of *Nij* over *i,* i.e., (*Nij*), gives the total number of households in the *jth* stratum. Suppose that is the number of households in the sample that are from the *ith* EA and the *jth* stratum, then let *Xj* be the number of EAs in the *jth* stratum and *Yij* be the number of selected households in the *ith* EA allocated to the *jth* stratum. Given the foregoing, the probability of selecting a particular EA in the *jth* stratum (first stage probability) is defined as:

$$\pi_{ij} = \frac{X_j N_{ij}}{\sum_{i=1} N_{ij}} \tag{2}$$

The probability of selecting a household in a selected EA in a particular stratum (second stage probability) is defined as:

$$\rho_{ij} = \frac{Y_j}{N_{ij}^*} \tag{3}$$

The overall probability (ρ_{ij}) of selecting a household in the i^{th} EA in the j^{th} stratum is the product of the probabilities at the two stages, i.e.:

$$p_{ij} = \pi_{ij}\rho_{ij} \tag{4}$$

The weighting factor (w_{ij}) of the i^{th} household in the j^{th} stratum is the reciprocal of the overall probability of selecting that household:

$$w_{ij} = 1/\ p_{ij} \tag{5}$$

For the purposes of this project, the number of households with completed interviews in the i^{th} EA and the j^{th} stratum (N'_{ij}), and the total number of households selected in that EA and stratum Y_{ij} were used to determine the final weights. The final weight (w'_{ij}) for a sample household in each EA in each stratum is defined as:

$$w'_{ij} = w_{ij}(Y_{ij} / Y'_{ij}) \tag{6}$$

In addition to the household weights illustrated above, weights were also computed for the individual level modules – children aged 0-5 months; children aged 6-23 months; children 0-5 years; and women aged 15-49 years – using similar methods. The estimated weights differ by the number of eligible people in each stratum and the number of completed interviews. Upon estimating the weights for the different groups in the data, it is common practice to normalize the sampling weights. The sum of the normalized weights for the observations in the sample is defined to equal the number of observations in the sample. Therefore, the actual number of observations, through the normalization process, becomes closer to what the number of observations should be. In short, the normalization process rescales the survey weights.

Challenges Related to the Survey Process

As expected, the size and location of the survey created challenges for each module despite the high completion rates reported above. The principal challenges are organized under three headings: household identification and enumeration; equipment; and timing. The main challenge under household identifications involves the difficulty of identifying the sample households because their sample identification numbers, which had been written in chalk on external walls, had been washed off by the rains. Getting access to reliable geo-location information for the households in the sample would have addressed this issue.

Another problem related to household identification that emerged was the differences in household contacts' official names and the names by which they were known in their community. To get to households whose contact's official name differed from their common name in their community when the household identification number has washed off caused delays. This problem would not have existed had reliable geo-location information for each selected household been available.

Given how widespread this household identification problem was, all enumerators were recalled to the "field headquarters" and provided training on how to deal with the challenge. This meeting also allowed enumerators

to share other experiences they were having with the enumeration process and discuss solutions. For example, a few instances of challenges with the eNCORE software were reported, leading to its assessment, recalibration and reinstallation on all the enumerators' computers.

Equipment

Respondents were interviewed in their homes as they mostly went about their chores. This meant that interruptions were common, increasing interviewing times and, hence, the duration that computers were running per interview. This cut significantly into estimated computer battery charge life and reduced the number of interviews that could be completed on a full charge. Attempts were made to rent portable generators for enumeration teams but this proved impossible. So, supervisors became responsible for charging computers, trading charged computers with enumerators and taking discharged computers to find places where they could be charged before the ones being used ran out of charge. It also implied saving interview files to flash drives and reloading them to computers with power to continue the interviews. This slowed down the process but did not create insurmountable problems.

Transmitting data files from the field was also a problem in locations with poor cell phone network service. Transmissions sometimes timed out due to network access problems, an outcome that frustrated supervisors immensely. However, supervisors revealed their dedication to the project by staying up late in order to get better bandwidth to complete their transmissions. However, there were times when they are just unable to transmit files because of these network problems. Although this challenge did not directly affect the survey process, it did affect the continuous feedback and data protection system that had been set up.

An unanticipated challenge was the survey contractor's inability to secure adequate supplies of infantometer, microtoiles, and weighing scales for all enumeration teams at the same time in the field. This problem was addressed by sharing available equipment among the teams. While this solution slowed down the enumeration process, and indeed may have contributed to the lower response rates seen for women and children anthropometry modules, its overall effect was limited.

Timing of Survey

The duration of the survey coincided with the rainy season and the major farming season in the ZOI. Thus, respondents were often away at their farms during the day. To address the risk of missing respondents, enumerators had to start interviews very early in the morning or do them late in the evening. However, some respondents were unwilling to spend their early morning or their evenings in an interview because they were eager to get out or were tired. To compensate for this inconvenience, a token gift – a tablet of soap – was offered. This was not obviously enough for many of them and enumerators could complete the interviews in many cases through pleading and drawing on the relationship capital of local leaders.

The rains made one EA completely inaccessible because the only road leading into the area was washed away. Enumerators were, in other cases, transported across flooded plains by canoes or just braved it and crossed rivers on foot. In some cases, their vehicles became stuck in mud and had to be pulled out by tractors. All these challenges increased the cost of the survey in both time and cash. They also highlight the infrastructural challenges in the ZOI.

Ramadan, the important Muslim month of prayer and fasting, fell in the middle of the survey period. Therefore, the timing of the survey is expected to affect the estimates of food consumption among the Muslim population in the ZOI. Therefore, it is possible that estimates of household food consumption expenditures and women's dietary diversity indicators may be lower than would have been outside of the Ramadan period. While children are not expected to fast during Ramadan, some families endeavor to train their children in this very important activity of the Muslim faith. Households in which children are encouraged or expected to participate may also present lower than expected estimates of children's minimum acceptable diet indicator.

In summary, the data collection process was very successful despite the foregoing challenges. The project

managers and contractors implemented protocols that allowed problems to be identified and solutions implemented in a timely matter. Although the experiences and lessons learned by the METSS team include more than the foregoing list, we take time to highlight the following recommendations.

- The survey execution team must work closely with the national statistics agency well ahead of when the survey is scheduled to commence in facilitating the sampling execution.
- The survey execution team must provide the national statistics agency with geo-location tools so that they do not have to mark the walls of the selected houses but use the GPS location as an indelible reference mark for enumerators' use. This will reduce challenges of identification and head of household name errors.
- Given that equipment such as infantometer, microtoiles, and weighing scales will be needed for the mid-term and final surveys, and given the importance of their availability in the completion of interviews on time and on response rates, it is prudent to develop a bank of such tools and equipment with organizations such as United Nations Children's Fund (UNICEF), Ministry of Health, WHO and others who also use them frequently. This will allow all organizations, including METSS, to have access to them as necessary to complete their assignments on time.
- If results are going to be comparable, the mid-term and final term surveys must be performed around the same time to control for the potential impact of timing on estimated results. This implies that these future surveys may have to deal with the rains again. It is important that the distribution of locations with severe infrastructural constraints is incorporated in the enumeration plan so that those locations are completed as early as possible to potentially avoid the rains and their effect.

At the end of the day, enumerators and supervisors gathered to review and transmit the day's data to the monitors by cell phone modems. These transmissions could be slow and often timed out before completion.

In this picture, Yacob Zereyesus (standing) is visiting with an enumeration team during a field visit in July 2012. Sitting on the far right is Patrick Fosu-Siaw, METSS' M&E Technical Specialist.

Overview of the Sample Population

The survey used a two-stage sampling approach to draw 20 households from each of the 230 EAs in the ZOI, giving a potential 4,600 households in the sample. Completion rate at the first stage (EA) was 99.6 percent (229 out of 230 EAs). At the household level, a total of 4,410 households were interviewed, implying a completion rate of about 95.9 percent. The summary results for the weighted data are presented on these households to account for unequal probabilities, non-coverage of the population and non-response.

Demographic and Socioeconomic Characteristics

The total number of individual respondents for the weighted sample was 24,860. This included adults and children. When extrapolated to the population, this sample represents 5.16 million people. The analyses of demographic and socioeconomic characteristics were conducted using STATA 12. The variables of interest covered in this section included gender, gendered households, education, age, household size, marital status, ethnicity and religious affiliations. Agricultural resources and household assets were also analyzed to provide a context for understanding the overall results of this research. The ensuing analyses were also conducted looking at RING and Non-RING Zone and regional comparisons.

Gendered Household Distribution

We categorized the 4,410 households interviewed into three groups based on the composition of adults present in the household. They were: (1) Households with male and female adults; (2) Households with a male adult and no female adult; and (3) Households with a female adult and no male adult. This categorization differs from the traditional "household head" approach and avoids some of the embedded presumptions about gendered responsibilities and dynamics. The data show that "Male and Female Adults" households account for about 92.0 percent of interviewed households with 4.9 percent are "Female Adult Only" and 3.1 percent are "Male Adult Only" households. "Male and Female Adults" households accounted for 95.8 percent in the RING Zone compared to 89.7 percent in the Non-RING Zone. However, only 2.0 percent and 2.3 percent of RING Zone households fall under "Female Adult Only" and "Male Adult Only" categories compared with 6.6 percent and 3.6 percent respectively in the Non-RING Zone.

Household Size

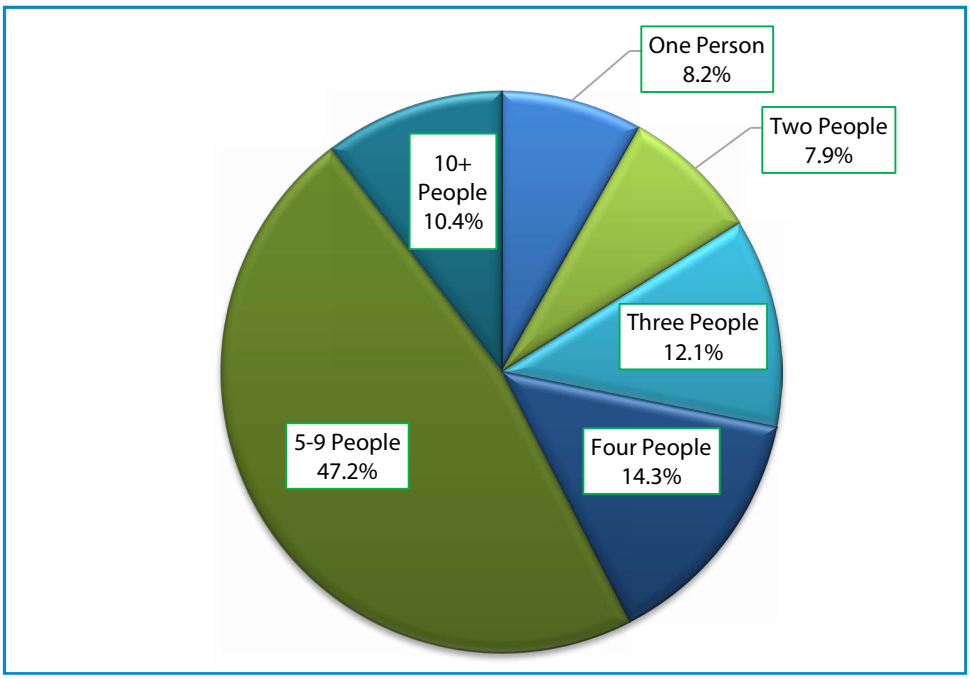
The average household size is 5.5, with a linearized standard error of 0.1 and 95 percent confidence interval of 5.3 to 5.7 people. The average household size in the RING Zone is slightly higher at 5.8 compared to 5.3 people in the Non-RING Zone. The difference between these two is statistically significant at the 5 percent level. The mean household size for "Male and Female Adults" households is 6.2 people compared to 3.1 people for "Female Adult Only" households and 1.8 people for "Male Adult Only" households. The differences between the three pairs of average household size for the three categories are all statistically significant at the 1 percent level.

The distribution of the households, however, reveals the structure of households in the communities (Figure 3). Approximately 47.2 percent of all respondent households have between five and nine people while only about 10.4 percent have ten or more people. Household sizes have a direct effect on household wealth, which influences nutrition and poverty (Agbaje et al., 2013; Dzator, 2013; Dungumaro, 2008). Dzator (2013), for example, found that large household size did not only adversely affect the wealth situation of the household but also the mental health of the household head. The likelihood of this situation was higher if the household head was female.

Distribution of Respondents by Gender

The weighted sample shows that approximately 49.5 percent of respondents are female and 50.5 percent male.

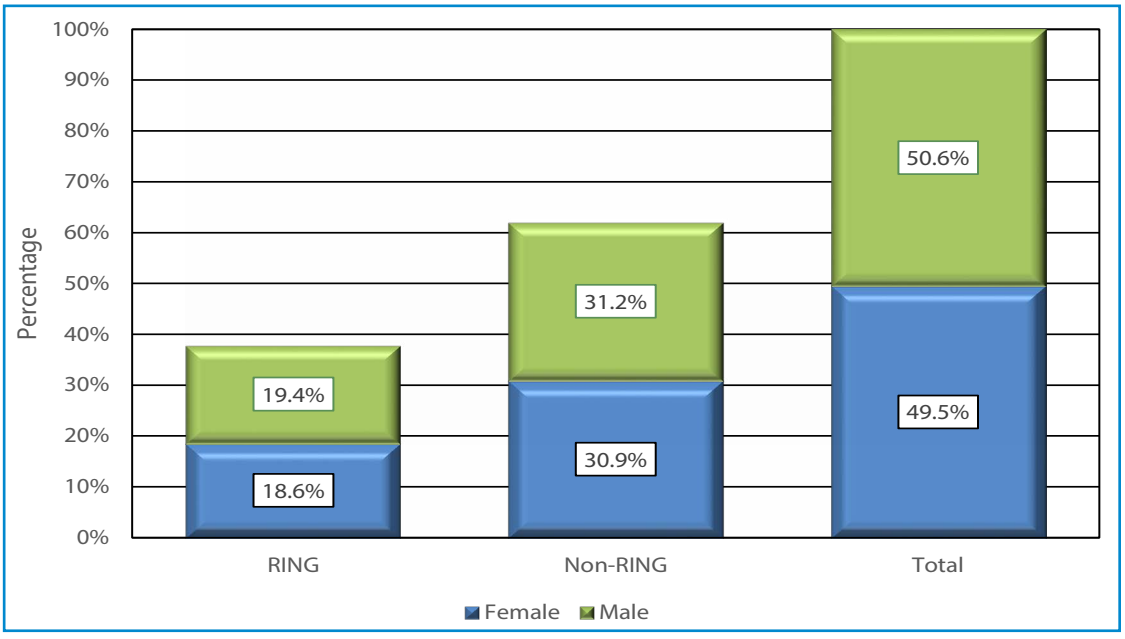
Figure 3: Distribution of Households by Household Size (N = 4,410)



The difference between these proportions is statistically significant at the 1 percent level, suggesting that the number of females and males in the weighted sample differed. Approximately 18.6 percent of females and 19.4 percent of males in the sample reside in the RING Zone compared to 30.9 and 31.2 percent in the Non-RING Zone. It is important to note that while the total population of the RING Zone is within Northern Region, 32.9 percent of Northern Region's respondents are not in the RING Zone. This implies that the distribution of respondents between the strata is 37.9 percent for the RING Zone and 62.1 percent in the Non-RING Zone. The foregoing suggests that 48.9 percent of the respondents in the RING Zone are female compared to 49.8 percent in Non-RING Zone.

Locale was dichotomized into rural and urban communities. The results show that 77.9 percent of respondents resided in rural communities while the remaining 22.1 percent lived in urban communities. About 78.0 percent of males compared to 77.7 percent of females live in rural communities and there was no statistical difference

Figure 4: Distribution of Respondents by Strata and Gender (N = 24,860)



between them. Of rural residents, 49.4 percent is female compared to 49.8 percent of urban residents. There was no statistical difference between these either.

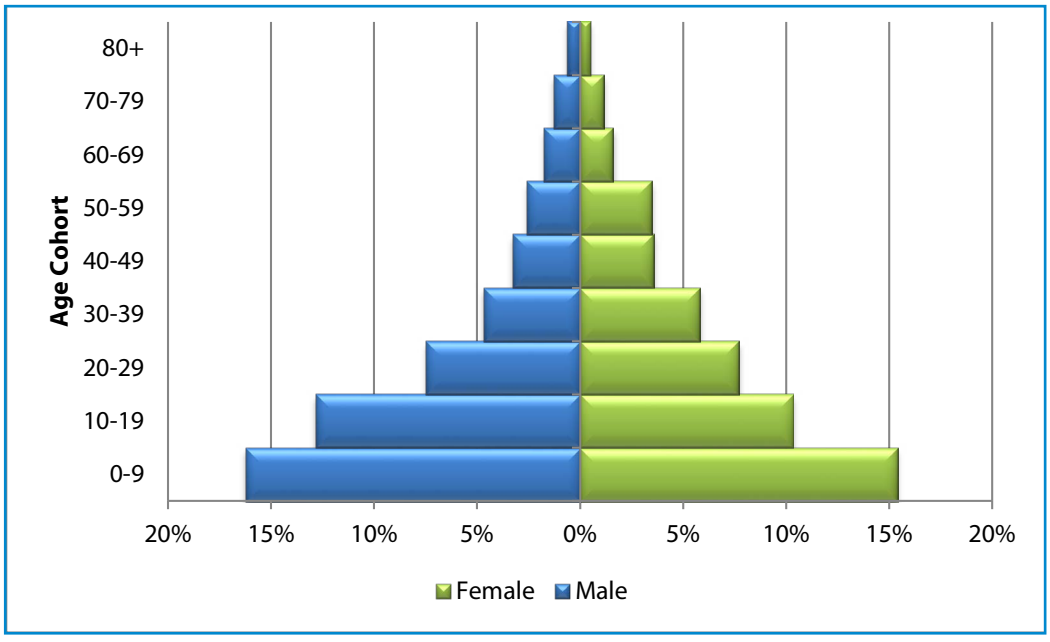
Approximately 18.6 percent of females and 19.4 percent of males in the sample reside in the RING Zone compared to 30.9 and 31.2 percent in the Non-RING Zone. This implies that the distribution of respondents between the strata is 37.9 percent for the RING Zone and 62.1 percent in the Non-RING Zone. The foregoing suggests that 48.9 percent of the respondents in the RING Zone are female compared to 49.8 percent in Non-RING Zone.

Distribution of Respondents by Age

The distribution of the sample by 10-year age cohorts and gender is presented as an age pyramid in Figure 4. Overall, the population pyramid indicates rapid population growth characteristic of a region (or nation) in the second or third stage of the demographic transition. Respondents age 0 to 9 years account for 31.6 percent of the sample while the 10-19-year cohort accounted for 23.1 percent. The 20-29 and 30-39-year cohorts respectively accounted for 15.2 percent and 10.5 percent while the 40-49 and 50-59-year cohorts accounted for 6.8 percent and 6 percent. The remaining cohorts – 60-69, 70-79 and 80 or older – account for 3.3 percent, 2.4 percent and 1.1 percent, respectively. Overall, children under 15 years constitute 44.6 percent of the population and this proportion is similar to the proportion found in Nigeria and Ethiopia. Combining this group with the elderly, and dividing by the adult population segment, produces a dependency ratio of approximately 0.98. This large proportion of dependents in the sample will directly affect the household poverty rates that are estimated in the next section of this report.

Figure 5 shows that the proportion of males in the sample declines from the third cohort. This may be explained by the fact that rural-urban migration often occurs around this time when the search for employment and/or education moves more males than females away from their communities. For example, males accounted for 12.8 percent while females accounted for 10.3 percent of the population in the 10-19-year cohort. However, males accounted for 7.5 percent in the 30-39-year cohort. Reed et al. (2010), in their study of coastal Ghana, note that women are significantly less mobile than men, especially during childbearing years, about 15 years to 49 years. In line with the foregoing study, the distribution changes in later years (post-60 years cohorts), when the proportion of males in the sample exceeds that of females. This may be explained by the tendency of males who were driven by economic and other reasons to emigrate during their youth to return to their communities in their golden years.

Figure 5: Distribution of Respondents by Age Cohort and Gender (N = 24,243)

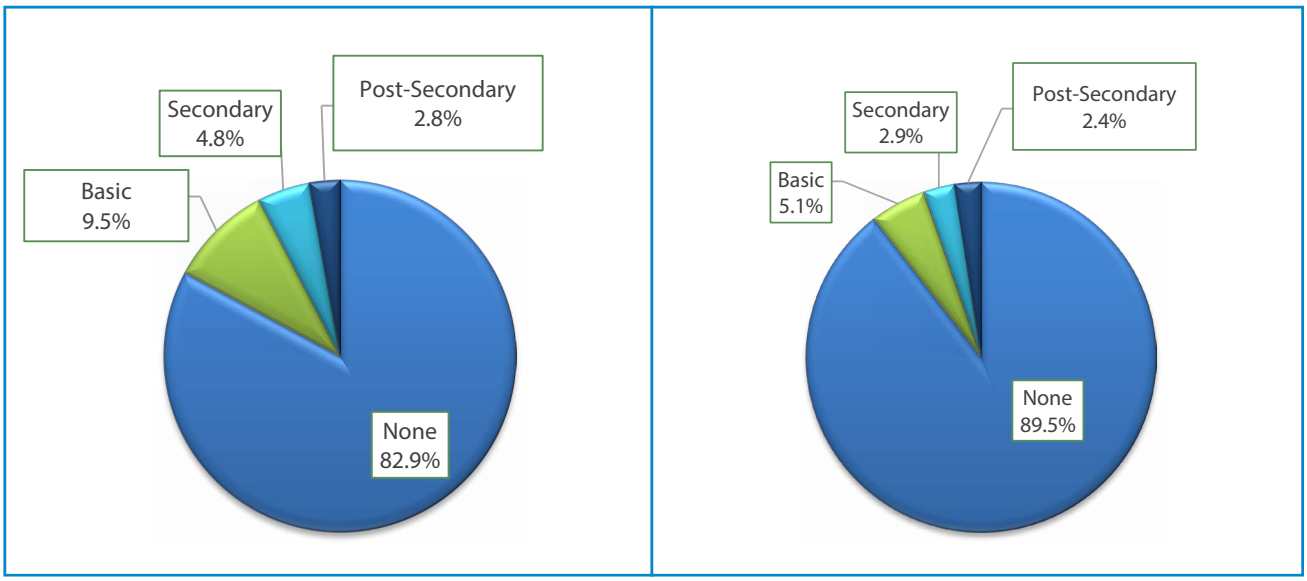


Educational Attainment

There were 17,829 responses to the question about the highest level of formal education attained. The responses were categorized into the following education levels: None (covering those without any formal education attainment); Basic (encompassing those with either Middle School Leaving Certificate (MSLC) or the Basic Education Certificate Examination (BECE)); Secondary (including those with a General Certificate of Education (GCE) O/A Level, vocational/commercial school training, and teacher training education); Post-Secondary (encompassing those with Higher National Diplomas and university education). Overall, 85.4 percent of respondents indicated not having any formal education. Those with Basic education as their highest level of attainment accounted for about 7.8 percent while Secondary and Post-Secondary attainment are respectively 4.1 percent and 2.7 percent of eligible respondents.

Figure 6 shows the distribution of the respondents by their education level and strata. It shows that 89.5 percent of respondents in the RING Zone do not have any formal education compared to 82.9 percent in the Non-RING Zone. Nearly 10 percent of Non-RING Zone respondents had Basic education compared to 5.1 percent of RING Zone respondents. This higher proportion in the Non-RING Zone remains for the remaining two categories. The distribution of education by gender shows about 85.6 percent of men and 84.3 percent of women had no formal education and 7.8 percent of males and 9.2 percent of females had Basic education. Of the male respondents, 3.8 percent and 2.8 percent had Secondary education and Post-Secondary education, respectively, compared to 4.4 percent and 2.2 percent of females in the same regards. This is in line with results from other studies (see Bloch et al. (1998) for example) that show that while the proportion of females matches males in Basic and even Secondary level education, they fall behind in the Post-Secondary category. This will contribute directly to issues defining empowerment and associated dimensions of health, food, and nutrition.

Figure 6: Distribution of Highest Level of Education Attainment by Strata (N = 17,829)

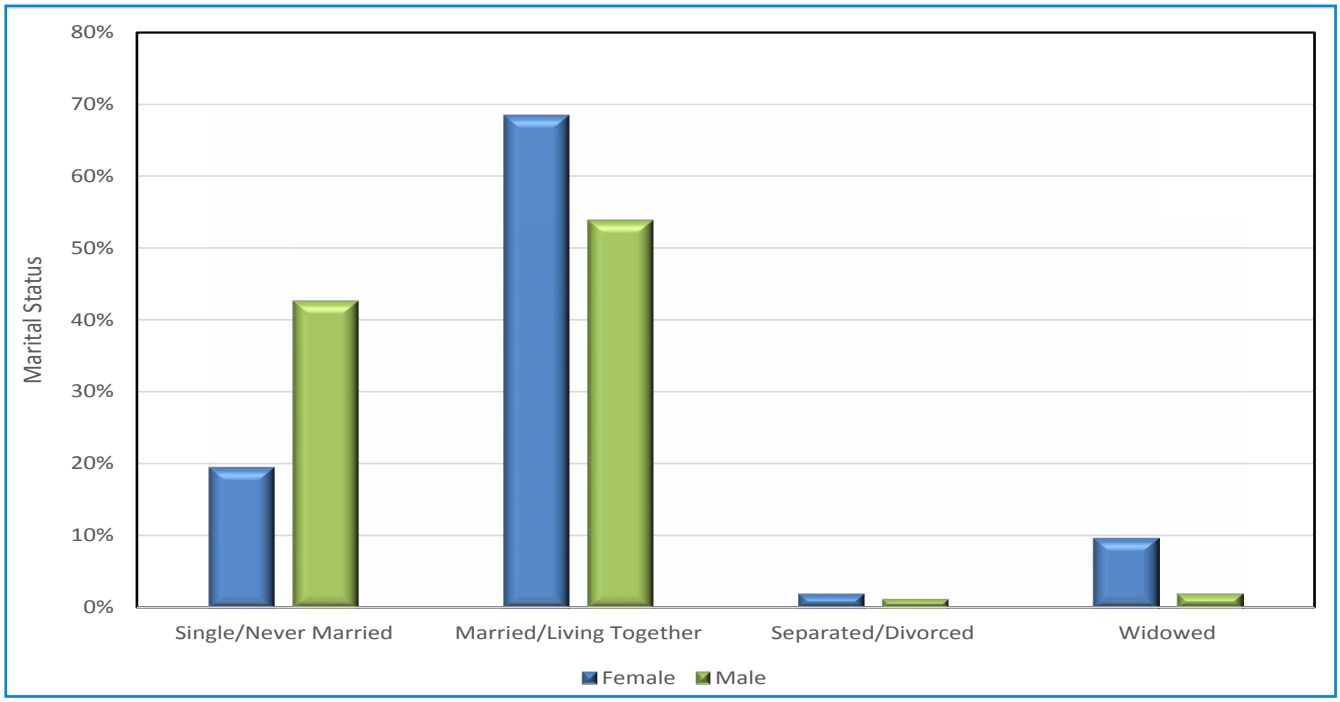


The distribution of highest level of educational attainment can distort literacy levels since respondents may still be in school. To this end, respondents were asked to indicate whether they were still in school. The results show that 51.9 percent of respondents indicated currently attending school. Of those indicating they are currently attending school, 39.7 percent are located in the RING Zone and 56.9 percent are male. Approximately 10.3 percent more males than females in the RING Zone indicated being currently in school, a difference that was statistically significant at the 1 percent level. Similarly, 8.9 percent more males than females in the Non-RING Zone indicated being currently in school, a difference that was statistically significant at the 1 percent level.

Marital Status

Marital status was categorized into four groups: (a) Single/Never Married; (b) Married/Living Together; (c) Separated/Divorced; and (d) Widowed. Approximately 58.9 percent of respondents were in the Single/Never Married group, largely reflecting the high percentage of youths in the population. When respondents aged 15 year or more are the only ones considered (N = 13,069), the proportion of Single/Never Married category declines to 31.2 percent and 61.2 percent are in the Married/Living Together category. Approximately 1.7 percent are divorced or separated and 5.9 percent indicated being widowed. Figure 7 disaggregates the marital status on gender. It shows that while single males account for nearly 43.0 percent of the males 15 years or older, single females account for 20.0 percent of females in this age category. Married females account for more than two-thirds of the females in the 15 years or more age category compared to 53.9 percent married males' share of the males in this age category. The proportion of separated or divorced females is about twice the proportion of males while the proportion of widowed females is nearly five times that of males. This might illuminate larger issues not directly the intention of this study. The marital status profiles are disaggregated for comparisons between the strata. The marital status profile of the females in the RING Zone is statistically different from that of females in the Non-RING Zone at the 1 percent level.

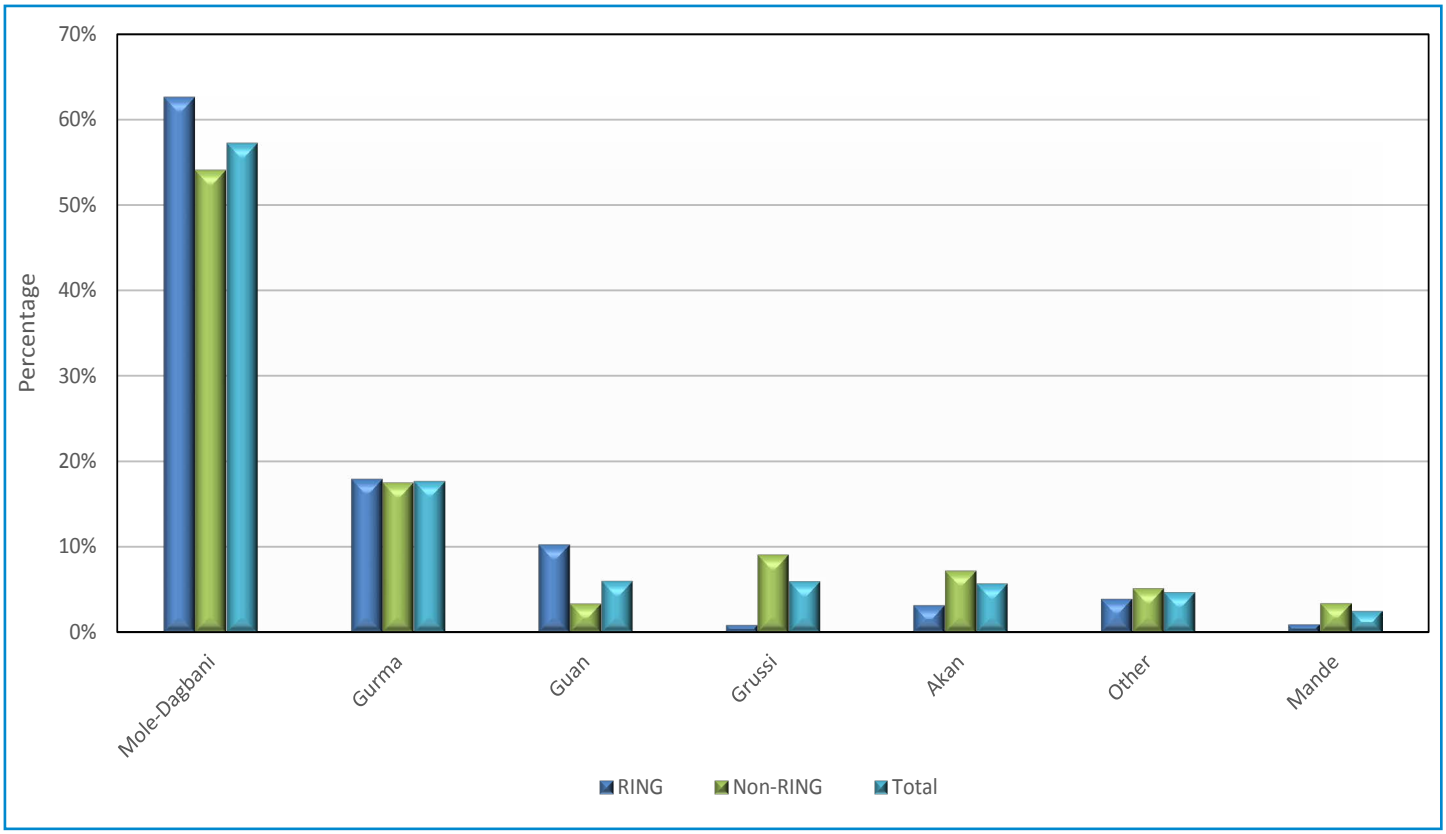
Figure 7: Marital Status by Gender for Respondents Aged 15 Years or More (N = 13,069)



Ethnicity

Ghana is made up of numerous ethnic groups and the number of these groups within a relatively small area, such as the ZOI, can be significant. The distribution of the sample by ethnicity within each stratum and the total in the sample is presented in Figure 8. It shows that Mole-Dagbani is the predominant ethnic group in both strata, accounting for nearly 63 percent in the RING Zone and 54.1 percent in the Non-RING Zone. Overall, Mole-Dagbani accounts for 57.4 percent of all respondents. The next dominant ethnic group is the Gurma, accounting for about 18 percent in both strata and 17.7 percent in total. The remaining ethnic groups are less than 10 percent in each stratum with the exception of Guan, which accounts for 10.3 percent in the RING Zone but only 3.4 percent in the Non-RING Zone. The "Other" ethnic group comprises Ga-Adangbes, mainly from the Greater Accra Region, and Ewes, mainly from the Volta Region and unspecified others.

Figure 8: Distribution of Respondents by Ethnic Groups and Strata (N = 24,243)



Religious Affiliation

The distribution of the population in the ZOI by respondents' religious affiliation shows that about 48.7 percent are Muslim, 31.5 percent are Christian, 18.4 percent belong to traditional religions and the remainder have no religious affiliation. Approximately 26.7 percent of the Muslim respondents are in the RING Zone compared to 22.0 percent in the Non-RING Zone. However, only 5.6 percent of respondents who are Christian are in the RING Zone compared to 25.9 percent in the Non-RING Zone. The majority of Traditionalists are in the Non-RING Zone.

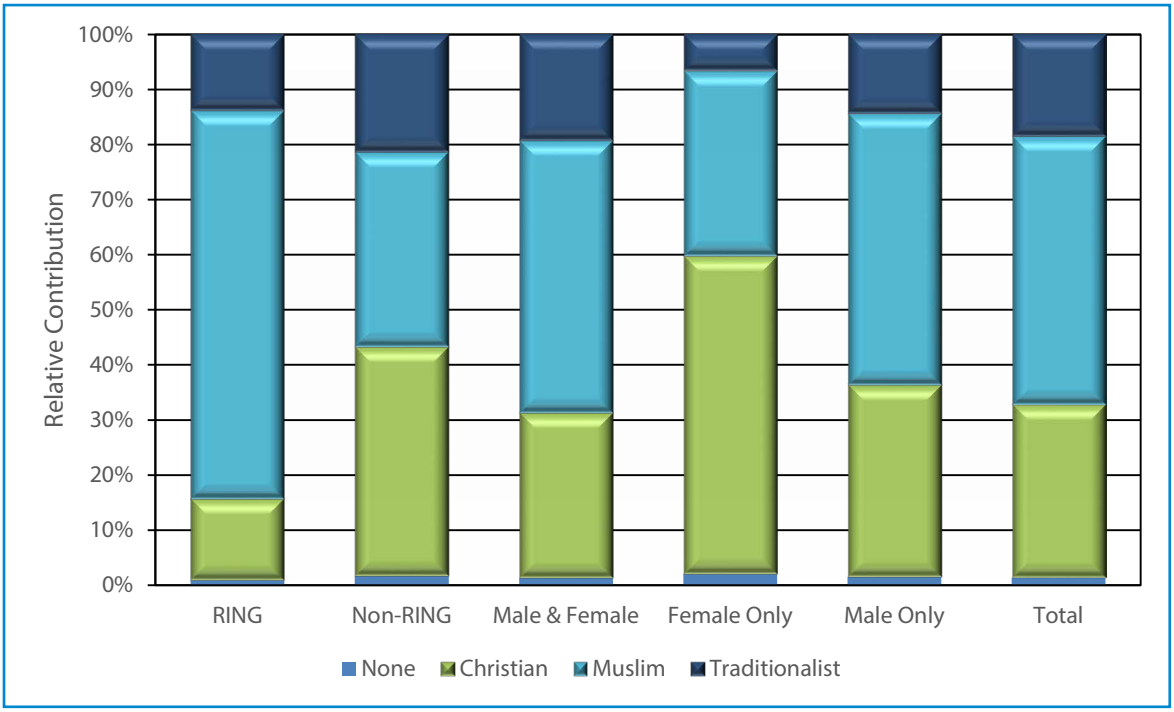
The relative contributions of the strata to the different religions are presented in Figure 9. It shows that about 70.4 percent of residents in the RING Zone are Muslim and 14.9 percent are Christian. However, 41.6 percent of Non-RING Zone residents are Christian and 35.1 percent are Muslim. The difference between the distributions of religions in the two strata is statistically significant at the 1 percent level. Figure 9 also shows the relative contributions of the different religions in each type of gendered households. It shows that while 57.7 percent of residents in "Female Adult Only" households are Christian, nearly half of the residents in "Male and Female Adults" and "Male Adult Only" households are Muslim. There are relatively more Traditionalists in "Male and Female Adults" households than in either of the other two gendered household types.

Agricultural Resources and Household Assets

Agricultural Land

Like most of Ghana, agriculture is the primary economic activity in the ZOI. As a result, agricultural land ownership and tenure systems are fundamental to the economic well-being in agricultural communities in the

Figure 9: Relative Contribution of the Respondents' Religions by Strata and Gendered Households



ZOI. The survey asked respondents to provide an estimate of the land planted to the focus crops for the Feed the Future initiative in Ghana – maize, rice, and soybeans. The average total acreage planted to these crops per household in the sample (N = 4,395) is 3.6 acres, with a standard deviation of about 5.6 acres. However, this estimate includes nearly 24.7 percent of the households that did not cultivate any of the focus crops (Figure 10). Of those households that planted the focus crops, 4.6 percent (203 households) allocated less than 1 acre, while 11.6 percent (510 households) allocated between 1 to 2 acres. Approximately 7.9 percent of households (345 households) allocated 10 or more acres to the three focus crops. The focus-crop land allocation by strata shows that with the exception of the 10 or more acres group, the number of Non-RING Zone households exceeded that of RING Zone Households in all groups. The distribution of land allocated to focus crops by gendered households shows that a larger proportion of "Male and Female Adults" households allocated more land to the focus crops in each land allocation group than "Male Adult Only" and "Female Adult Only" households together (Figure 11).

The average acreage allocated to maize, rice, and soybeans in the ZOI are estimated at 2.4 acres, 0.8 acres and 0.4 acres, respectively. The sample sizes for the three crops are 4,385, 4,391, and 4,394, respectively. The average cropland allocation across the two strata is presented in Figure 12. The figure shows that average acreage for all the crops is lower in the Non-RING Zone. Average maize, rice and soybean acreage in the RING Zone is 3.1, 1.4, and 0.5 acres, respectively. A similar distribution is observed for gendered households (Figure 13). This distribution would suggest that of the three focus crops, maize is the staple food crop for the people in the ZOI.

Figure 10: Number of Households by Land Allocated to Focus Crops and Strata

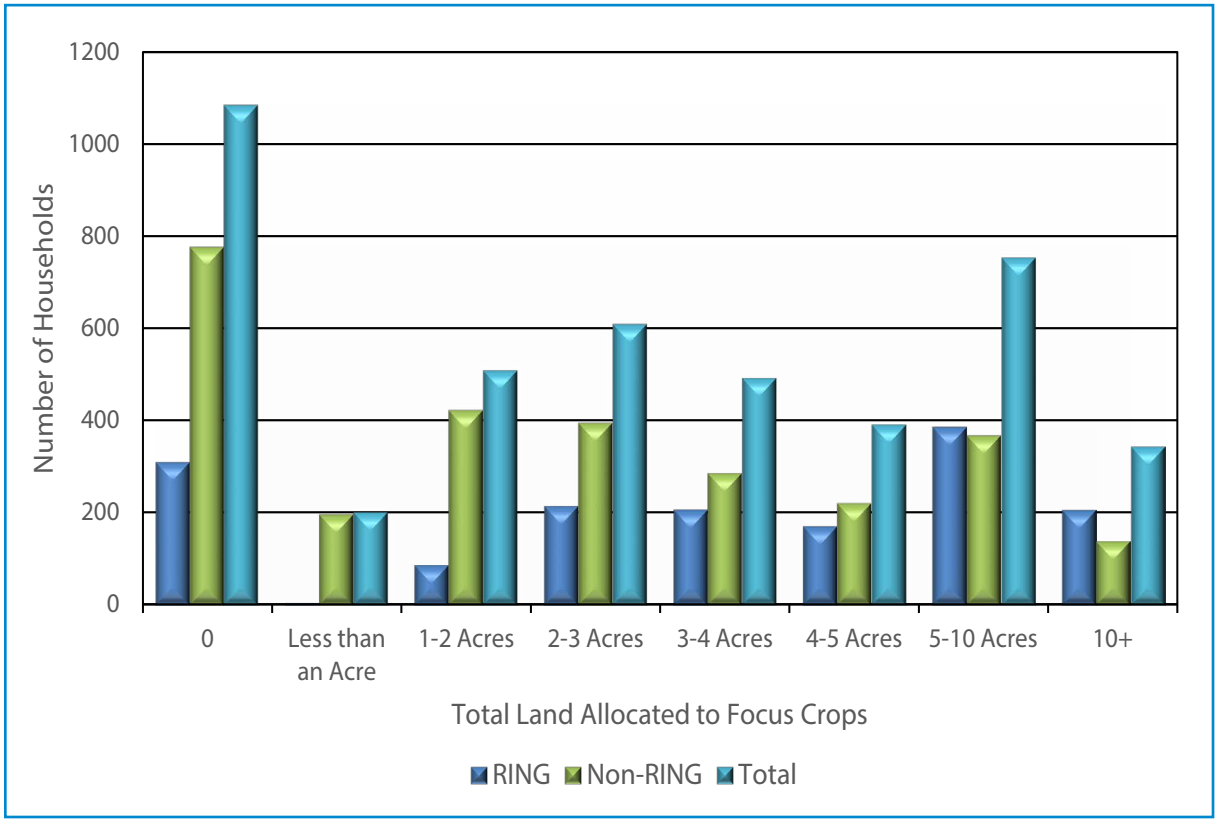


Figure 11: Distribution of Households by Land Allocated to Focus Crops and Gendered Household

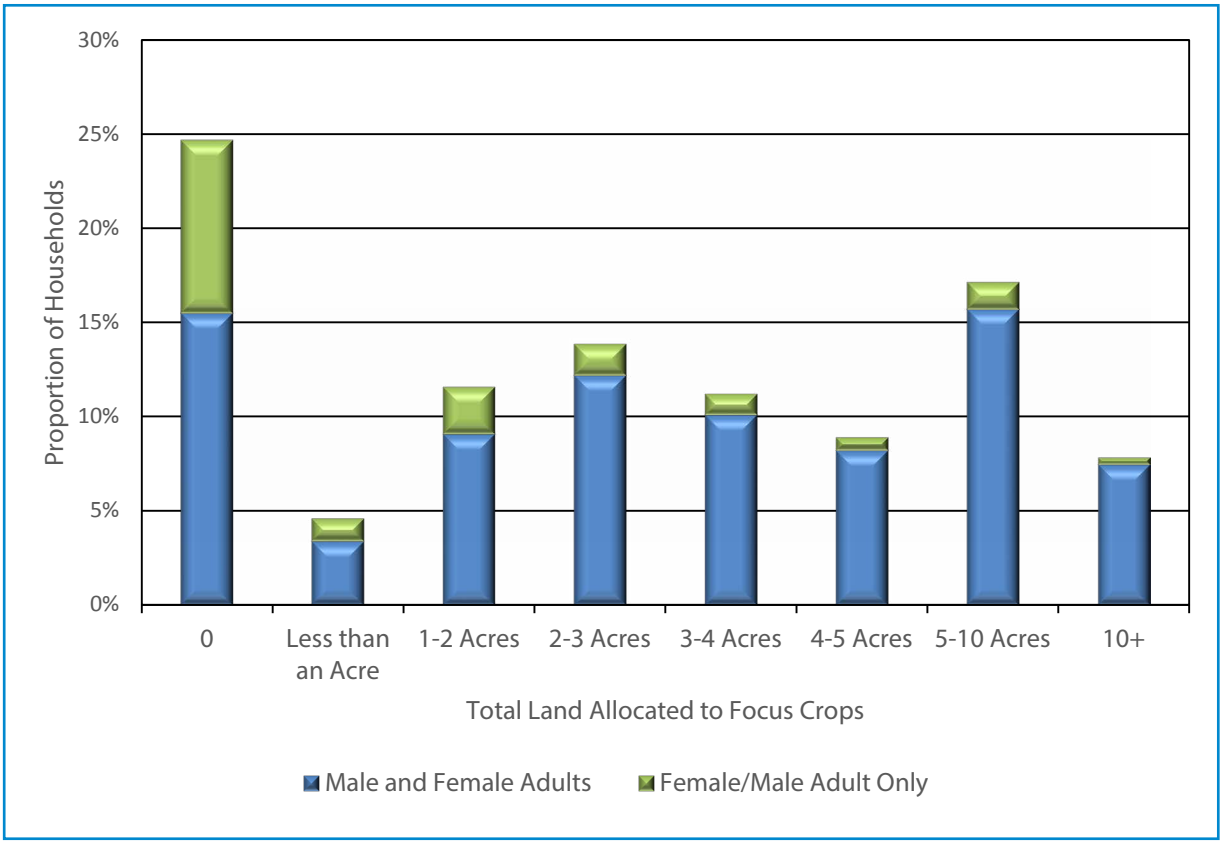


Figure 12: Household Average Acreage Allocation to Focus Crops by Strata

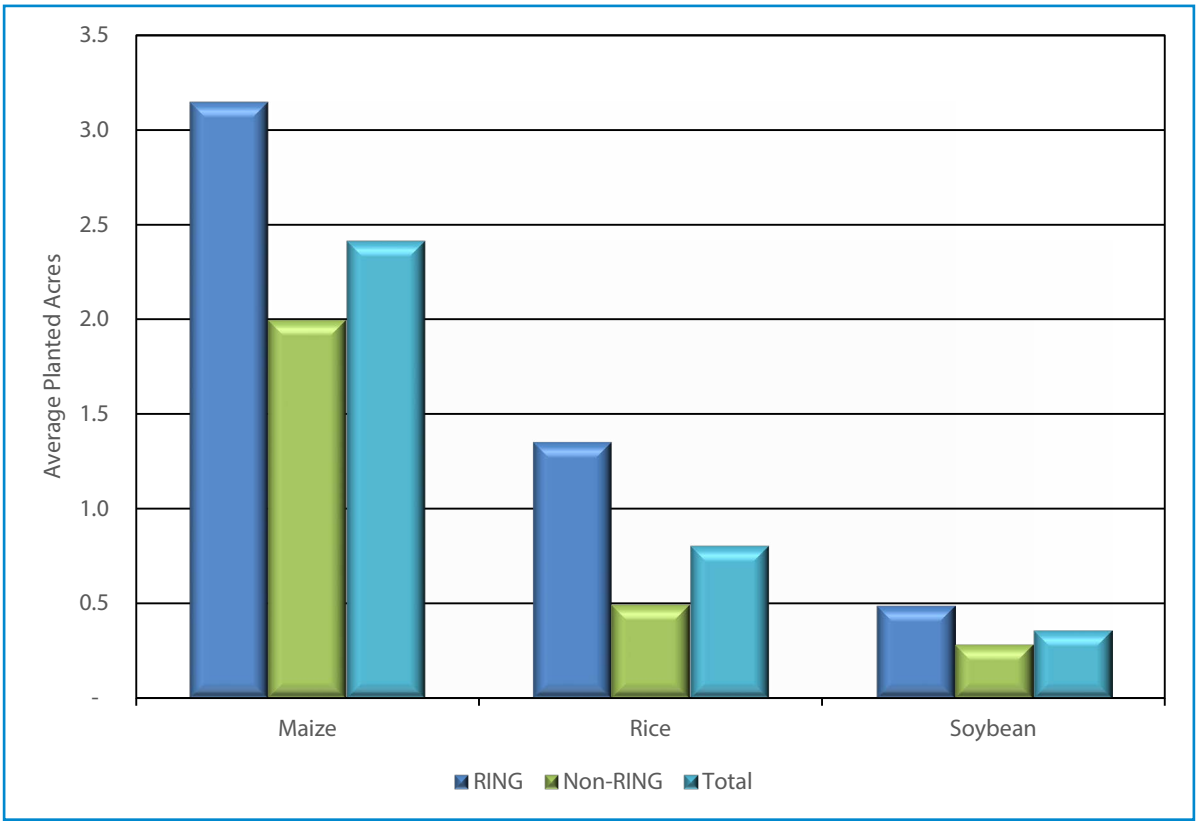


Figure 13: Average Acreage Allocated to Focus Crops by Gendered Households

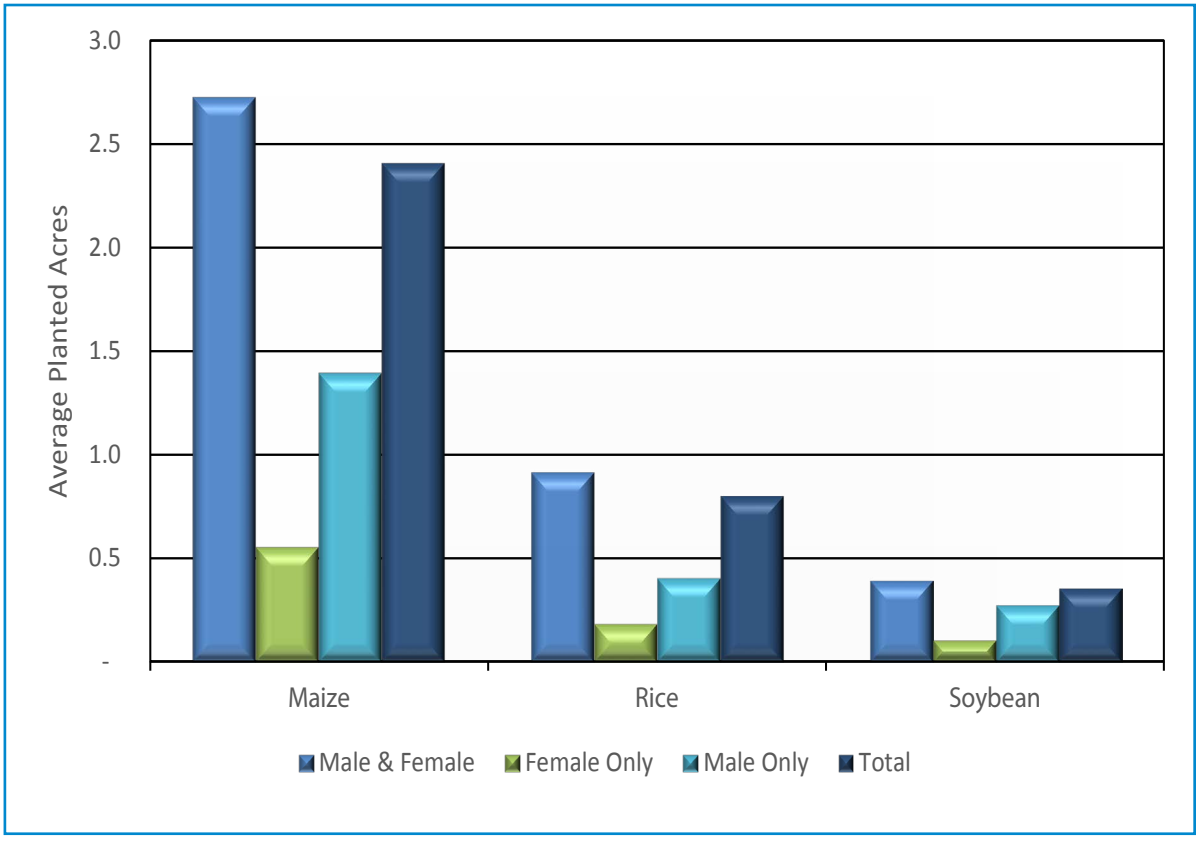
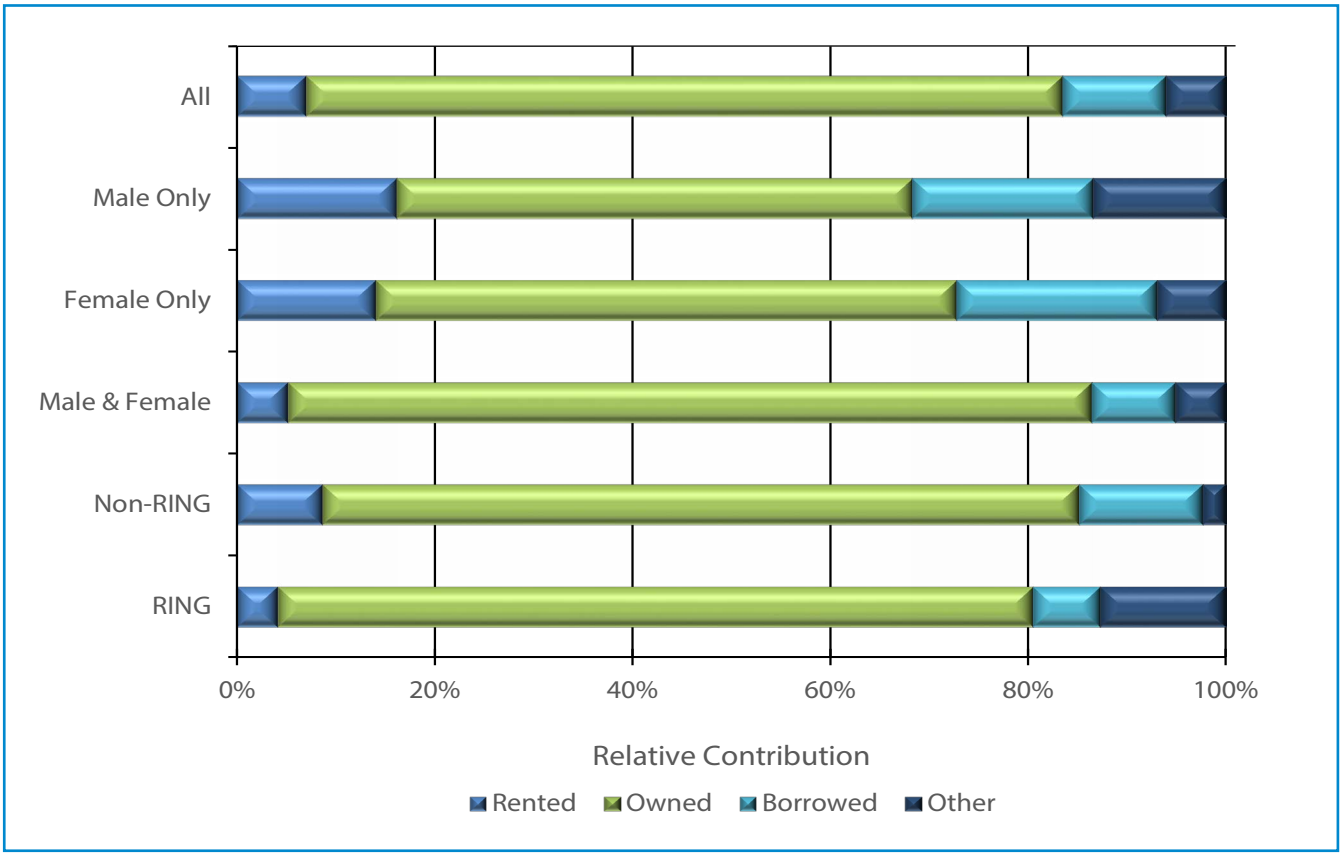


Figure 14: Distribution of Households by Tenancy Characteristics



Tenancy, Dwelling and Utility

Respondents are classified by their tenancy in their dwelling. They may own or rent their dwelling, or it may have been borrowed from a relative or friend or some other unspecified arrangement. This latter category is different from renting the dwelling because renters pay a monthly fee for use of the dwelling but borrowed dwellings are usually pro-bono with a quid pro quo of maintenance or other in-kind service. The dwelling may belong to a relative or a benefactor.

Figure 14 shows a very high proportion of respondents in all categories indicating that they own their dwellings. The ownership rate in the RING Zone was 76.4 percent, same as is for the total sample. The highest ownership rate is "Male and Female Adults" households, coming in at 81.2 percent. The lowest ownership rate is 52.2 percent for "Male Adult Only" households. "Female Adult Only" respondents had the highest percentage of borrowed dwelling at 20.3 percent, followed by "Male Adult Only" respondents at 18.3 percent. The lowest rent and borrowed rates are found for the RING Zone households.

The characteristics of the dwelling and utilities of the households are evaluated on the basis of roofing material, exterior walls and flooring material in the dwelling, sources of water, energy, and waste disposal options available to the household's residents.

Roofing materials are classified as follows: (a) Thatch; (b) Corrugated metal sheets; (c) Others – defined to encompass wood, asbestos slates, mud bricks, bamboo, and etc. The data shows that about 29.3 percent of households are roofed with thatch while 64.2 percent are roofed with corrugated metal sheets. Households in the RING Zone are almost divided equally between thatch and corrugated metal sheets. However, only 16.3 percent of households in the Non-RING Zone have thatch roof compared to 74.4 percent for corrugated metal sheets.

Disaggregating on gendered household basis, the results show that 31.7 percent of "Male and Female Adults" households have roofs made of thatch compared with 12.6 percent and 24.1 percent for "Female Adult Only" and "Male Adult Only" households. Approximately 80.9 percent of the roofs of "Female Adult Only" households are corrugated metal sheet, compared to 70.5 percent and 61.7 percent for "Male Adult Only" and "Male and Female Adults" households, respectively.

Flooring materials are grouped into: (1) Earth/Mud; (2) Concrete or cement; and (3) Other – encompassing stones, burned bricks, vinyl or other tiles, and etc. Approximately 63.5 percent of households have concrete or cement flooring while 29.5 percent reported having earth/mud flooring. The proportion of RING Zone households with concrete/cement flooring is 71.8 percent compared to 63.5 percent in the Non-RING Zone. Conversely, the proportion of Non-RING Zone households with earth/mud flooring is 31.5 percent compared to 26.4 percent in the RING Zone. Similarly, the majority of households on gendered household basis indicated having concrete/cement flooring. The proportion was above 66.3 percent in all cases. Approximately 30.2 percent of "Male and Female Adults" households have earth/mud flooring, while only 24.5 percent of "Female Adult Only" households had it.

Nearly three-quarters of respondents indicated that the exterior walls of their dwellings are constructed with mud or mud bricks while 24.0 percent identified cement or concrete blocks as the construction materials for their exterior walls. These were the two dominant building materials in the study area. Other building materials were rarely used. For example, only 0.3 percent of respondents have metal or slate sheets and burnt bricks as the construction material for the external walls of their dwelling.

While the majority (51.2 percent) of respondents indicated that their dwelling is in "moderately good" condition overall, the proportion was larger (59.7 percent) in the RING Zone than was found in the Non-RING Zone (45.9 percent). More than a quarter of respondents in each strata indicated that the physical state of their dwelling was in a "poor to very poor" condition. "Male and Female Adults" households are more likely to indicate that their dwelling is in "moderate" condition. However, only 25.1 percent of "Male Adult Only" households indicated their dwelling was in an overall "poor to very poor" condition.

Water sources are categorized as follows: (a) Piped (into the home); (b) Public tap; (c) Private/Protected Source (boreholes, dug wells, and etc.); (d) Natural Source (lakes, rivers, rain water harvest, and etc.); and (e) Other. The primary source of drinking water in the ZOI is private/protected sources. This category accounted for about 53.4 percent of all household water sources. Natural and public tap are the next two common sources of water, accounting for 22.0 percent and 15.1 percent, respectively. The distribution was not different by strata, except that the proportion of households accessing their water from private sources was 64.1 percent in the Non-RING Zone compared to 31.6 percent in the RING Zone. The proportion of households getting water from natural sources was 15.8 percent and 31.6 percent, respectively. A larger proportion of RING Zone households (21.3 percent) are getting their water from public taps than Non-RING households (11.3 percent).

The foregoing distribution was similar for gendered households. However, while 62.0 percent of "Female Adult Only" households accessed water from private sources, the proportion for "Male Adult Only" and "Male and Female Adults" households is 49.1 percent and 53.0 percent, respectively. A larger proportion of "Male and Female Adults" households get their water from natural sources in contrast to 13.2 percent and 13.7 percent for "Female Adult Only" and "Male Adult Only" households.

The dominant source of cooking fuel in the ZOI is firewood, accounting for 80.3 percent of all respondents. For households in the RING Zone and Non-RING Zone, firewood is the primary cooking fuel for 85.8 percent and 77.2 percent of the households, respectively. Charcoal is a far second, with an overall prevalence of 14.4 percent and a relative contribution of 10.9 percent and 16.4 percent for the RING Zone and Non-RING Zone. Electricity is only a minor cooking energy source, available in only 3.0 percent of the cases as a source of cooking fuel. Nearly 84.0 percent of "Male and Female Adults" households in the RING Zone indicated using firewood compared to 65.3 percent and 61.2 percent for "Female Adult Only" and "Male Adult Only" households. Contrarily, while one quarter of households in the single adult households indicated charcoal as their primary cooking fuel, only 11.9 percent of "Male and Female Adults" households selected this source.

Overall, 31.9 percent of households indicated being on the electricity grid while another 33.5 percent selected lanterns, candles and paraffin lamps (liquid fuels) as their primary source of lighting. Torch lights, solar and similar battery-operated lamps were selected by another 31.1 percent of respondents while 3.4 percent indicated getting their light from other sources, such as fire pits. A relatively larger proportion (38.7 percent) of households in the RING Zone depended on liquid fuels for their light compared to 33.4 percent of Non-RING households indicating battery-operated lamps as their primary lighting source. Electricity as lighting source was 30.8 percent and 32.6 percent, respectively. Nearly 49.0 percent of "Male Adult Only" households selected electricity as the primary source of lighting compared to 28.7 percent of "Male and Female Adults" households and 42.6 percent of "Female Adult Only" households. Liquid fuel lighting, at 6.1 percent of respondents, was the dominant lighting source in "Male and Female Adults" households.

Household waste in the ZOI is disposed of mainly in private dumps (36.2 percent) or dumped in public or otherwise unprotected location (42.1 percent). Some local governments may have community garbage dumps and this is the garbage disposal option of 17.2 percent of households. Only 4.0 percent of households indicated their garbage is collected by government or a private company. The distribution is very similar between the strata and among the gendered households.

Summary of Demographic and Socioeconomic Indicators

The sample is largely composed of people under the age of 20 with slightly more males than females. It is composed of numerous ethnic backgrounds, but the single largest ethnic group is Mole-Dagbani, accounting for nearly 60.0 percent of respondents. While the sample presents numerous religions, Muslims account for nearly half of the respondents. The dominant gendered household type is "Male and Female Adults" households, accounting for 92.0 percent of all households. The average household size is about six people but 57.6 percent of all households have five or more people. The level of formal educational attainment in the sample is relatively low on average. Of respondents older than 18 years, nearly 76 percent had no formal education while 13 percent had basic education level.

Most households owned their own homes or they were considered "borrowed." Dwellings are roofed with corrugated sheet metal 64.0 percent of the time and thatch 29.0 percent of the time, with the remainder consisting of several alternatives. Floors were similarly divided between concrete, dirt and other. Most of the households obtained water from private sources including wells, boreholes or natural sources consisting of streams, lakes or impoundments. Most households used firewood for cooking fuel and only 32.0 percent of the homes were connected to the electrical grid. Approximately 74.0 percent of the exterior walls of dwellings in the study area are constructed with mud or mud brick while about 24.0 percent are of cement block.

Per Capita Expenditure and Poverty Indicators

One of the principal objectives of the Feed the Future Initiative is to reduce poverty. Therefore, understanding the poverty situation in the ZOI is critical for monitoring and evaluating intervention activities. Despite its importance, poverty has also been one of the most difficult variables to estimate. Poverty is often discussed in absolute or relative terms. Absolute poverty defines poverty as insufficient resources in a household or community to maintain life. Relative poverty, on the other hand, presents individuals and communities as poor by their exclusion from economic and cultural resources. We do not engage in the ongoing debate about which approach to use in this report. What we do is provide an economic framework for measuring consumption and poverty consistent with best practices in the literature.

Consumption Aggregate-Methodology

Consumption is used as a proxy for poverty. Following Deaton and Zaidi (2002) and Lanjouw (2009), estimation of aggregate consumption is based on the theoretical foundation of the money metric utility. This approach defines standards of living by the amount of money required to achieve defined standards levels of living. Within this framework, consumption is defined to comprise four main sub-aggregates: food items, non-food items, consumer durables, and housing. The definitions used and the methods used to capture them in the research are outlined in the following paragraphs.

Household Food Consumption

The population-based survey used the seven-day recall period of respondents' household food consumption as input to measure household food consumption. The reported food consumption for the week was then converted into annual food expenditure in order to harmonize the results with the other sub-aggregates of the consumption variable.

Household food consumption is disaggregated into purchased, home produced, and gifts. In cases where households reported purchased and home produced or gifts as part of their total food consumption, the monetary value of the home produced food or food gift is imputed using the unit price for the purchased food. In cases where households did not report any purchased food items, the unit price of the home produced food and food gift is determined by the median price of food items consumed by similar households in the same district within the ZOI.

Consumer Durables

Consumer durables, unlike food and non-food items, are not exhausted in consumption and provide repeated service. As such, it is important to value them over their duration of use instead of in the period of acquisition.

The valuation of the durable goods is based on extracting the "user cost or value" generated from its use during the time period of analysis. The population-based survey did not collect data on the purchase value of the durable goods. The data collected encompassed the quantity, age, and current value of durable goods owned by the household.

Following Deaton and Zaidi (2002), the "user cost" for durable goods may be estimated using the following equation:

$$P_t(r_t - \pi_t + \delta) \tag{7}$$

where P_t is the current value of the durable good, $(r_t - \pi_t)$ is the real rate of interest, r_t is the general nominal rate at time t, π_t is the rate of inflation for each durable good at time t, δ is the rate of depreciation for the durable good, and t represents time in years. Since the depreciation rate is not available for each durable good

registered in the survey, Equation 8 was used to estimate the depreciation rate for each durable good:

$$\delta - \pi = 1 - \left(\frac{P_t}{P_{t-T}} \right)^{\frac{1}{T}} \tag{8}$$

where the current value of the durable good is P_t, and the age of the item is t while its useful lifespan is T years. Taking the natural log of Equation 8 and rearranging the results produces Equation 9:

$$\ln(P_t) = \ln(P_{t-T}) - T \ln(1 - \delta + \pi) \tag{9}$$

δ - π may be estimated by regressing the current value of the durable good on the age of the durable good in T years. The constant is the value of the durable good when it was newly purchased. Once δ - π is computed, this information can be used with the nominal interest rate to derive the $(r_t - \pi_t + \delta)$. For the purpose of this current analysis, the Bank of Ghana (www.bog.gov.gh) stated nominal interest rate of 15 percent at the time of analysis is used. Finally, the "user cost" of the good is calculated by multiplying $(r_t - \pi_t + \delta)$ by the current value of each of the durable good owned by the household.

Housing

Housing data was collected on different types of tenancy: owned, rented, borrowed, or other arrangement. If the dwelling was rented, then the rental price was reported. If respondents indicated owning the dwelling, they were asked to provide an estimate of the current value of their dwelling, its age, and its current estimated rental price had they been renting.

Non-Food Consumption

Non-durables are defined to include all items other than food, durables, and housing. They include both purchased and non-purchased goods, such as building material (bamboo and wood poles used for building and grass thatch for roofing), and firewood for cooking. Purchased items may include liquid fuel (kerosene, petrol, and etc.), school fees, books and uniforms, and health care expenses. Consumption of nondurable items is measured using one of four different recall time periods: weekly, monthly, quarterly, or on an annual basis.

Consumption Aggregates Summary

The food, nonfood, consumer durables, and housing components are aggregated to estimate the total annual consumption expenditure for each household, which was then divided by household size and by 365 days to generalize the per capita daily expenditure. Although expenditures were collected in current Ghana cedis, they were converted into 2010 U.S. dollar equivalent to facilitate international comparisons.

The calculation of money metric utility requires that the nominal consumption aggregate be deflated by a Paasche price index, which adjusts for cost of living across households by varying the household weights. For this analysis, the Paasche price index, P_p^h, is defined as:

$$P_p^h = \frac{p^h * q^h}{p^0 * q^h} \tag{10}$$

where p^h and q^h are the price and quantity faced by the household and p^0 is the household's reference price. Since the weights for the price index are based on the quantities consumed by the household, they can differ from one household to another. The above equation can be rewritten and approximated in logs as follows:

$$P_p^h = \left(\sum w_k^h \left(\frac{p_k^0}{p_k^h} \right) \right)^{-1}$$
$$\ln P_p^h \cong \sum w_k^h \ln \left(\frac{p_k^h}{p_k^0} \right) \tag{11}$$

where w_k^h is the share of household h's budget devoted to good k. The reference price vector, p^0, is the median of the prices observed from the individual households. The Paasche Index for food consumption was developed to adjust for cost-of-living differences due to the relatively smaller data variability in the food expenditure records as compared to the other sub-aggregates, especially durable goods and housing, which were prone to outliers and extreme data points.

Consumption Aggregates Results

The foregoing assumptions and procedures are used to estimate the consumption aggregates. Of the 4,410 households in the sample, 4,365 had complete information on consumption. Forty-five household did not provide any information on any of the consumption aggregates and were excluded from the analyses. There were also a number of respondent households with missing responses. In the food sub-aggregate, 117 responses were missing while 322 responses were missing in the durables sub-aggregate. The housing and non-food sub-aggregates had 175 and 115 missing responses, respectively.

Without making significant restrictive assumptions, it was difficult to classify these missing data into any of the traditional missing data categories: Missing Complete At Random (MCAR); Missing at Random (MAR); and Missing Not At Random (MNAR). To minimize data loss and potential bias in the estimates, missing data in each consumption sub-aggregate were replaced with the sample mean. The principal advantage of this is that complete case analysis could be performed on the summary of consumption aggregates. However, this method has the potential to reduce variability in the data. This solution also has the potential to weaken covariance and correlation estimates in the data because it ignores potential relationships between variables (Little and Rubin, 1987). Given the relative number of missing data, this risk was considered lower than the loss of completeness in the data, and hence worth taking.

Table 5 presents the summary statistics of the estimated real daily consumption per household.[4] The overall mean daily per capita consumption in the ZOI is $4.01. The mean daily per capita consumption in RING and Non-RING strata is $3.54 and $4.27, respectively, and these consumption values are statistically equivalent. The mean daily per capita consumption in "Male Adult Only" households of $9.58/day is almost twice as large as the per capita consumption of $5.01/day in "Female Adult Only" and almost three times as large as "Male and Female Adults" households' of $3.23/day. The paired differences in the mean per capita consumption between the three gendered household types are statistically significant. The foregoing is unsurprising because "Male Adult Only" households have the lowest average household size, followed by "Female Adult Only".

Regional comparisons show that Brong Ahafo has the highest mean per capita consumption value ($6.39), and Upper East has the lowest mean value ($3.34). The regional differences in consumption levels are not statistically significant except for the differences between Brong Ahafo and the other three regions. The mean values for rural and urban households are $3.38 and $5.88 respectively, and the difference in consumption between these two locales is statistically different.

The quintile distribution of the daily per capita consumption is presented in Table 6. The average daily per capita consumption for the bottom 20 and top 20 percentiles of the population is $0.92 and $10.77, respectively. The upper 20 percentile share is more than half of the total consumption in the ZOI, while the bottom 20 percent share is less than five percent of the total consumption. Differences are even starker when the distribution is broken down by deciles instead of quintiles. The difference between the bottom 10 and top 10 percentiles is about $14.22. The corresponding consumption shares for the bottom and top deciles are approximately 1.7 percent and 37.1 percent respectively, reinforcing the notion of a highly unequal distribution of expenditures.

4 Unless otherwise specified, all currency is in 2010 US$.

Table 5: Summary Statistics for the Real Daily Consumption Expenditure per Capita in 2010 US$ Constant Prices by Disaggregated Sub-Groups

	Mean Real Expenditure $	Linearized Standard Error	95% Confidence Interval		Median Value	Weighted Household Count
			Lower	Upper		
ZOI	4.01	0.18	3.66	4.35	2.58	4,360
Strata						
RING	3.54	0.16	3.23	3.86	2.59	1,577
Non-RING	4.27	0.26	3.76	4.78	2.58	2,783
Regions						
Brong Ahafo	6.39	0.55	5.31	7.46	3.96	678
Northern	3.71	0.14	3.44	3.98	2.55	2,263
Upper East	3.34	0.33	2.69	3.99	2.35	811
Upper West	3.36	0.62	2.15	4.58	1.86	608
Gendered Household Types						
Male & Female Adults	3.23	0.12	2.99	3.47	2.34	3,550
Female Adult Only	5.01	0.36	4.29	5.72	3.48	381
Male Adult Only	9.58	0.80	8.01	11.16	7.25	429
Locale						
Rural	3.38	0.15	3.09	3.67	2.31	3,258
Urban	5.88	0.59	5.05	6.71	3.59	1,102

Table 6: Real per Capita Consumption per Day by Quintiles in 2010 Constant US$

Indicator	Quintile of Per Capita Real Consumption					Average
	Lowest	Lower Middle	Middle	Upper Middle	Upper	
Average Real Per Capita Consumption/Day	0.92	1.69	2.58	4.05	10.77	4.01
Consumption in the ZOI	4.58	8.53	13.16	20.48	53.25	100

Developing Poverty Measures

International poverty lines allow comparison of poverty estimates across countries by making adjustments for differences in the purchasing power of currencies. The new international poverty line is $1.25 per person per day measured in 2005 Purchasing Power Parity (PPP) terms (World Bank, 2008). This new poverty line maintains the same standard of extreme poverty, but adjusts it using the latest information on the cost of living in the developing countries. The reader must note that the estimated poverty rates are presented in 2005 U.S. dollar PPP and are not inflated to 2010 U.S. dollar PPP as was done with household expenditures despite being calculated from the same data. This is to facilitate comparison among the countries.

The three commonly reported aspects of consumption poverty that are particularly important for this research are:

1. Poverty Prevalence index (poverty headcount) – the proportion of households identified as poor or

falling below the established poverty line based on the number of people in the household;

2. Poverty Gap index (depth of poverty) – the extent to which those identified as poor fall below the poverty line; and

3. Squared Poverty Gap index (poverty severity) – a measure of the inequality among the poor.

A summary of the estimation procedures followed to compute the above poverty measures is described below. For a detailed discussion on these topics, see Ravallion (1992). Following Foster et al. (1984), the general formula for calculating the different poverty indices is:

$$P_{\alpha} = \frac{1}{n}\sum_{i=1}^{n}\left[\frac{z - y_i}{z}\right]^{\alpha} \tag{12}$$

where P_{α} is the poverty index of interest with a subscript, α, indicating a non-negative parameter equal to 0, 1, and 2 to capture the prevalence, depth, and severity measures. The variable, z, is the poverty line and y_i is the aggregate consumption for each household or individual, i.[5]

Prevalence of Poverty

The World Bank's poverty line of U.S.$1.25 per person per day, measured in 2005 PPP terms, is used in this study to estimate the prevalence of poverty, the poverty gap and poverty severity. The real daily per capita expenditure was converted from the Ghana cedi (GH₵) to 2005 U.S. dollar PPP based on the 2005 PPP conversion factor of 0.45 for private consumption for Ghana, and adjusted for reported inflation in the country during the survey period. The inflation adjustment used the December 2005 CPI value of 183.7 and July 2012 CPI value of 412.4 (Ghana Statistical Service, 2012b).

There is a higher prevalence of poverty in "Male and Female Adults" households (25.4 percent with a margin of error of ± 3.4 percent) compared to "Female Adult Only" households (10.8 percent ± 4.5 percent margin of error) and "Male Adults Only" (5.7 percent ± 2.7 percent margin of error). The differences in prevalence rates between "Male and Female Adults" and the other gendered household categories are statistically significant at the 1 percent level. Approximately, 93 percent of the entire households living below the poverty line are "Male and Female Adults" households, 4.2 percent are "Female Adult Only" households, and less than 3 percent are "Male Adult Only" households.

The average daily consumption per capita for residents in rural locales of the ZOI is $3.38 ± $0.29 compared to urban residents' $5.88 ± $0.82. The prevalence of poverty among rural households is 25.9 percent compared to 11.1 percent of urban households. The standard errors for the rural and urban prevalence rates are 1.8 percent and 1.5 percent, respectively. The difference in poverty prevalence rates between these two locales is statistically significant at the 1 percent level. The relative contributions of the two locales to the prevalence of households living under the poverty line are 87.4 percent for rural and 12.5 percent for urban. Their absolute contributions, i.e., their contributions within the sample are 19.4 percent and 28.2 percent, respectively.

Upper West Region has the highest prevalence rate for poverty (34.7 percent with a margin of error of ± 7.7 percent), while Brong Ahafo has the lowest rate (6.1 percent ± 2.5 percent margin of error). Northern Region's prevalence rate is 21.6 percent with a margin of error of ± 3.9 percent, compared to Upper East's of 28.1 percent ± 6.2 percent margin of error. The differences between poverty prevalence rates in Brong Ahafo and the other three regions are statistically significant at the 1 percent level. Upper East and Upper West have statistically equivalent poverty prevalence rates, while the difference in the prevalence rates between Northern and Upper East is statistically significant at the 1 percent level. Brong Ahafo, with 4.2 percent, presents the lowest relative

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5 In the implementation of this model to estimate the different poverty indices, if $(z-y_i)<0$, then $\left[\frac{z - y_i}{z}\right]^{\alpha} = 0$

contribution to poverty at this lower level while Northern Region's relative contribution of 50.5 percent is the highest. Upper East and Upper West presented relative contributions of 23.5 percent and 21.8 percent, respectively.

Poverty Gap Index

The Poverty Gap Index measures the extent to which the average daily expenditure of a household is below the poverty line. It is an indicator of the depth of poverty. Usually expressed as a percentage of the poverty line, the Poverty Gap Index may be used to estimate the minimum amount of resources required to lift those falling below the poverty line to the poverty line.

The average Poverty Gap Index based on the poverty line of $1.25 per capita per day is 6.7 percent with a margin of error of ± 1.1 percent. The depth of poverty within the RING Zone is 6.9 percent compared to 6.6 percent in the Non-RING Zone with standard errors of 0.9 percent and 0.7 percent, respectively. The average poverty gaps are very similar between RING and Non-RING Zones but since the population in the Non-RING Zone is so much larger, it contributes 62.8 percent towards the average, while the population in the RING Zone contributes 37.3 percent towards the Poverty Gap Index. The Poverty Gap Index of 3.0 percent (with a margin error of ± 1.3 percent) for "Female Adult Only" and 1.5 percent ± 0.9 percent margin of error for "Male Adult Only" are significantly below that of the ZOI's Poverty Gap Index. On the other hand, the "Male and Female Adults" households' depth of poverty is about 7.8 percent with a margin of error ± 1.3 percent, about 15.3 percent higher than the mean depth of poverty in the ZOI.

The depth of poverty in rural and urban households is 8.0 percent and 2.8 percent, respectively. Rural and urban households' respective share of the depth of poverty is 89.3 percent and 10.7 percent. Similarly, Northern, Upper East, Upper West and Brong Ahafo regions' respective contributions to the overall Poverty Gap Index are 51.7 percent, 25.4 percent, 19.6 percent, and 3.3 percent.

Severity of Poverty

The severity of poverty is measured as the square of the depth of poverty. It provides an indication of the degree of inequality among those determined to be poor and facilitates comparison across groups.

The severity of poverty index in ZOI of this study is estimated at about 3.0 percent with a margin of error of ± 0.6 percent. The severity of poverty in the RING and Non-RING Zones are approximately 3.0 percent, with standard errors of 0.5 percent and 0.4 percent, respectively. About 35.7 percent of the total severity of poverty in the ZOI is attributed to the RING Zone compared to 64.3 percent to the Non-RING Zone similar to the findings on the poverty gap. "Male and Female Adults" households have the highest severity of poverty index (3.5 percent with a margin of error of ± 0.7 percent), compared to "Female Adult Only" households' 1.1 percent ± 0.6 percent margin of error and "Male Adult Only" households' 0.6 percent ± 0.4 percent margin of error. There is relatively more severe poverty in Upper East (4.4 percent with a margin of error of ± 1.8 percent) than Upper West (4.1 percent with a margin of error of ± 1.7 percent), Northern (3.0 percent ± 0.8 percent margin of error), and Brong Ahafo (0.5 percent with a margin of error ± 0.3 percent).

Conclusion

The approach used in estimating poverty in the ZOI resulted in the prevalence of poverty being less than one in every four people. It is important to recognize that the estimates were conducted at the household level and not at the individual household member level. Thus, the estimate in this report may be a lower than most reported. Despite the methodological differences, the results of the average household consumption and the resultant poverty prevalence estimates point to opportunities to think differently about poverty in the ZOI (and probably in general). For example, that all the households falling below the poverty line had heads with formal education not exceeding basic level confirms a correlation between poverty and education. Likewise, that "Male and

Female Adults" households had higher proportions of poverty prevalence is directly related to household size and not gendered household status in particular. This also provides insights into potential policy interventions.

Women's Anthropometry

Anthropometry provides a simple, non-invasive, and inexpensive approach to assessing the health status of individuals. A simple tool in the anthropometry toolbox is the body mass index (BMI). It is easily used to identify underweight, overweight, and obesity in adults. Based on weight-for-height ratio, BMI is age independent in adults and not gender specific. Using weight, M, in kilograms, and height, H, in meters, BMI is defined as follows:

$$BMI = M / H^2 \tag{13}$$

BMI is used to classify people into the following groups:

- Underweight: BMI less than 18.5 kg/m^2;
- Normal: BMI between 18.50 kg/m^2 and 24.99 kg/m^2;
- Overweight: BMI between 25.00 kg/m^2 and 30.00 kg/m^2; and
- Obese: BMI greater than 30.00 kg/m^2.

Adult BMI in the underweight category has been found to be a more serious problem in developing countries because of women's role in the economic well-being and health of children and other dependents. This is even more critical where the activities supporting livelihood require significant physical capacity. For women whose daily economic activities involve farm and similar physically-exhausting work, being underweight can present serious implications for poverty and child nutrition. Indeed, research shows that underweight women are more likely to have a preterm delivery, children with low birth weight, intrauterine growth restriction and delivery complications (Sebire et al., 2001; Ehrenberg et al., 2003). Underweight women also have a positive association with malnourished children younger than five years (Rayhan and Khan, 2006).

BMI for Reproductive Age Women

The reproductive age of women is defined as 15 to 49 years. The number of women in the sample meeting this criterion was 5,214. However, complete height and weight measurements were available for 4,513 (86.6 percent) of women. Pregnancy distorts BMI estimates and so all women in the sample who indicated being pregnant were also excluded. This brought the eligible sample size to 4,139. An inspection of the data revealed 23 outliers whose BMIs were "extremely high" because of their weight/height profiles. These were treated as outliers and excluded from the final data used in the analysis. The weight, height and BMI of these excluded respondents are presented in Appendix B. The effective sample size used for the BMI analyses was, therefore, 4,116. The estimated population of this group in the ZOI is about 1.08 million.

The average height and weight of women of child-bearing age, after the foregoing adjustments, is 159.6 cm and 55.9 kg. The standard deviations are 8.2 cm and 9.2 kg, respectively. Respondents' height ranged from 121.0 cm to 198.1 cm while their weight ranged from 28.6 kg to 118.9 kg. The average age is 29.6 years. This summary provides the framework for analyzing and presenting the BMI results and assessing the prevalence of underweight women in the eligible sample.

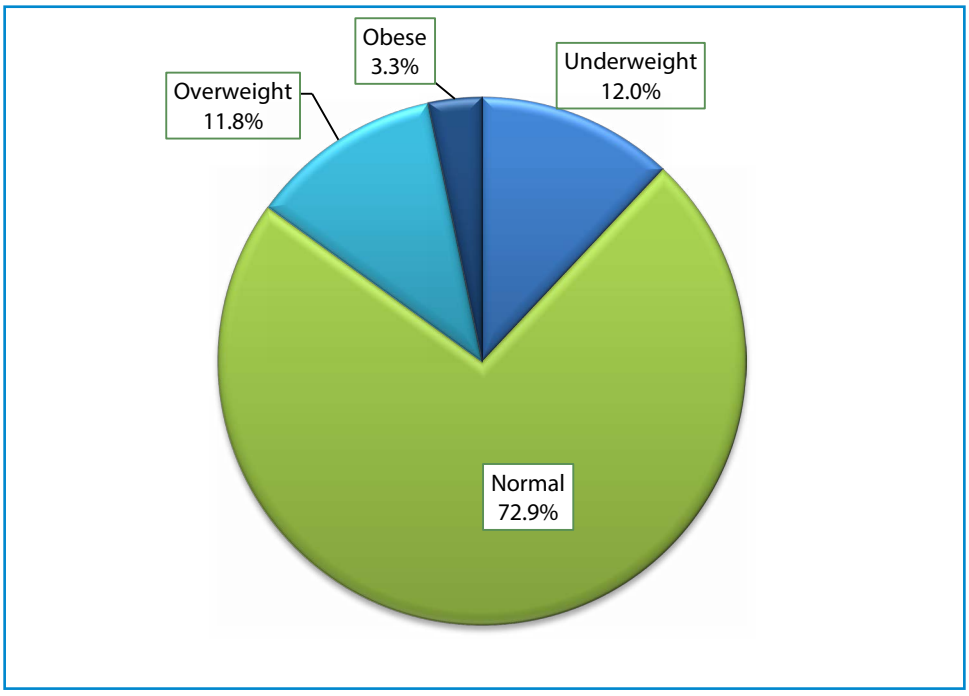
The distribution of women of reproductive age by strata is similar to the overall distribution of the sample – about 37.8 percent in the RING Zone and about 62.2 percent in the Non-RING Zone. There was no difference in the average age of women in "Male and Female Adults" gendered households and women in "Female Adult Only" gendered households. The average age by strata is 29.3 and 29.6 in RING and Non-RING Zone, respectively, and they are not statistically different from each other.

Figure 15 shows the distribution of reproductive-aged women by the BMI group. This also includes the prevalence estimates for each BMI group. It shows that 12.0 percent of the women are either underweight or overweight. Only 3.3 percent are in the obese group and the majority (72.9 percent) are in the normal group.

The BMI for the underweight women ranges from 10.3 kg/m^2 to 18.49 kg/m^2, with a mean and standard deviation of 17.2 kg/m^2 and 1.3 kg/m^2. The median is 17.5 kg/m^2. For the normal group, BMI ranged from 18.5 kg/m^2 to 24.99 kg/m^2, with a mean value of 21.5 kg/m^2, a standard deviation of 1.7 kg/m^2 and a median of 21.4 kg/m^2. Given that the majority of the women are in this normal BMI group, a mean being closer to the bottom end of the range suggests that there may be a lot more women who may be at risk of falling into the underweight group. Indeed, 698 women had BMI's between 18.5 kg/m^2 and 20.0 kg/m^2, with an average BMI of 19.3 kg/m^2 and a standard deviation of 0.4 kg/m^2.

The foregoing would suggest that intervention initiatives for underweight women must extend beyond the cut-off point of 18.5 kg/m^2 to capture those who may be vulnerable to becoming underweight given their socio-economic and other circumstances. WHO classifies underweight into three groups: severe thinness (BMI < 16.0 kg/m^2); moderate thinness (16.0 kg/m^2 ≤ BMI < 17.0 kg/m^2); and mild thinness (17.0 kg/m^2 ≤ BMI < 18.5 kg/m^2). The analysis shows that about 16.6 percent of each of the underweight women fall into the severe and moderate groups while about two-thirds are in the mild thinness group.

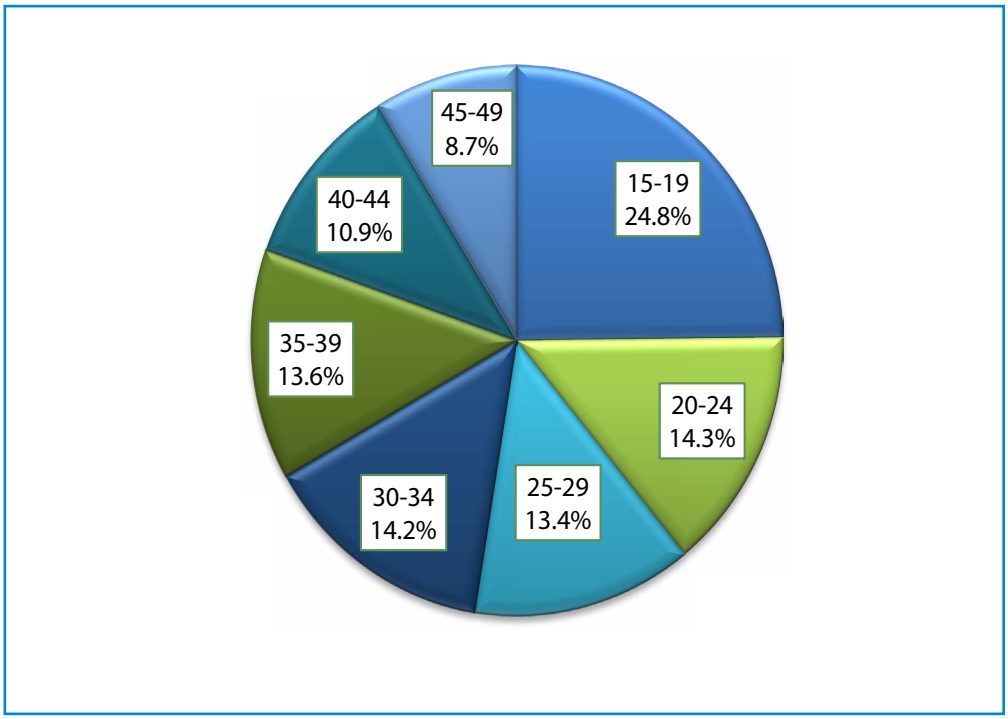
Figure 15: Distribution of Women of Child-Bearing Age by their BMI (N=4,116)



The average BMI for underweight women by strata is 17.5 kg/m^2 and 17.0 kg/m^2 for the RING Zone and the Non-RING Zone, respectively. The difference between the two was statistically significant at the 1 percent level. The mean BMI for women in the normal range for the RING and Non-RING Zones is, respectively, 21.6 kg/m^2 and 21.4 kg/m^2. The difference of about 0.2 is not significant. The average BMI for underweight women by gendered household is 17.1 kg/m^2 for "Male and Female Adults" households and 17.6 kg/m^2 for "Female Adult Only" households. The difference in the average BMI of underweight women between the two types of households is statistically significant at the 1 percent level. The average BMI for women in the normal BMI class by gendered households is 21.5 kg/m^2 for "Male and Female Adults" households and 21.8 kg/m^2 for "Female Adult Only" households. The difference between the two types of households for this BMI class is statistically significant at the 5 percent level.

Figure 16 shows the prevalence of underweight women by age cohort. It shows that women in the 15-19-year cohort account for the largest proportion of underweight women while older women – those in the 45-49-year cohort – account for the smallest proportion of underweight women. What is found in assessing the severity of the underweight problem with age is that the average BMI for underweight women peaks at about

Figure 16: Prevalence of Underweight Women by Age Cohort (N=4,116)

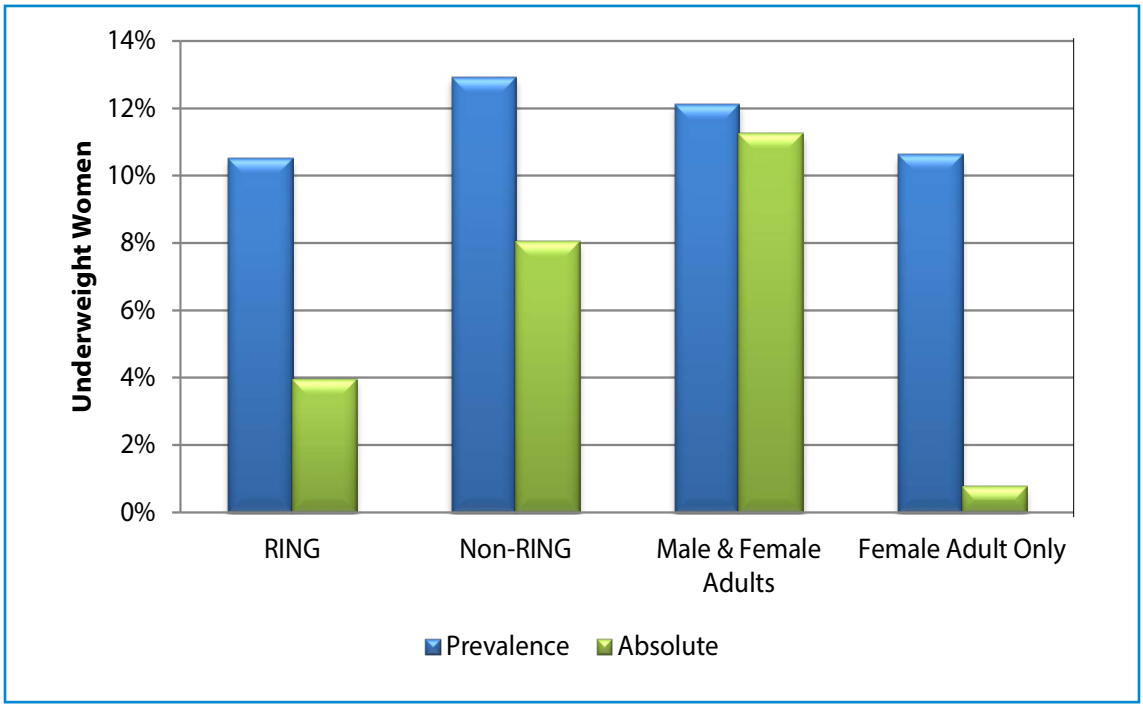


17.5 kg/m^2 for women of child-bearing age in the 30-34-year cohort in this sample. The differences, though, are not statistically significant.

The prevalence of underweight women in the RING Zone is 10.5 percent compared to the 12.9 percent in the Non-RING Zone (Figure 17). The absolute contribution of the RING Zone to the underweight women in the sample is only 4.0 percent. However, its relative contribution is 33.1 percent. The prevalence rates by gendered households shows 12.1 percent for "Male and Female Adults" households and 10.6 percent for "Female Adult Only" households, and they are not statistically different. The absolute contribution is 11.3 percent and 0.8 percent, respectively, suggesting that the contribution of "Female Adult Only" households to the population of underweight women is very small. The relative contribution is in excess of 93.7 percent for "Male and Female Adults" households, indicating, as expected, that "Male and Female Adults" households account for virtually all the underweight women in the sample.

The prevalence rates in rural and urban areas are 12.9 percent and 9.5 percent and are not statistically different. However, nearly 80.0 percent of the underweight women in the sample are residents in rural areas. Among the four regions, Brong Ahafo has the lowest prevalence rate (8.0 percent), followed by Northern (10.0 percent), and Upper West (13.2 percent). Upper East has the highest prevalence rate (20.5 percent), and this rate is significantly different from the prevalence rates in the other regions. Although Northern Region has a relatively small prevalence rate within the sample, it does account for nearly half of all the underweight women (47.4 percent) in the ZOI.

Figure 17: Prevalence of and Absolute Contributions to Underweight Women by Strata and Gendered Household Characteristics (N= 4,116)



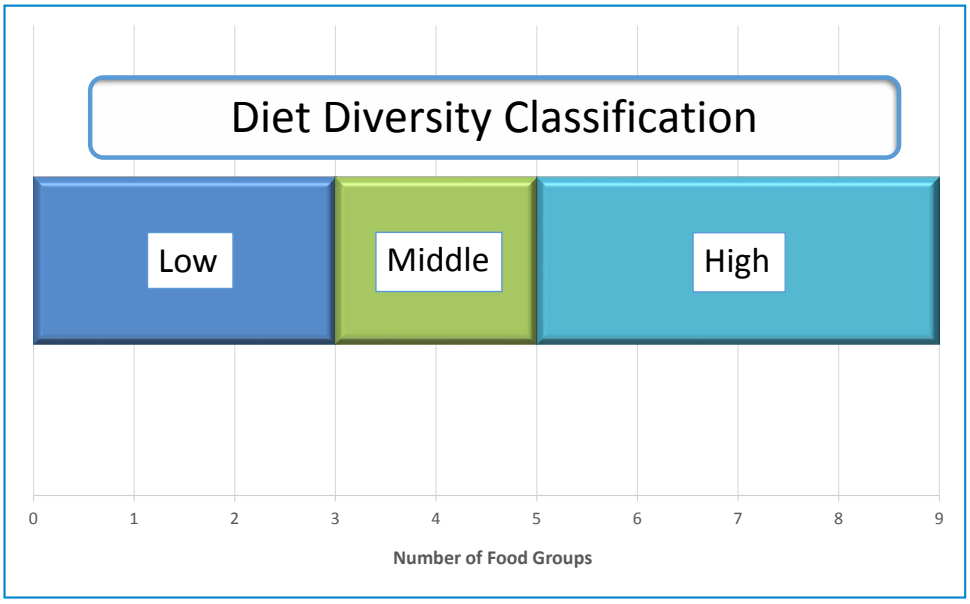
Women's Dietary Diversity

Diversity in diet has been shown to protect against chronic diseases (McCullough et al., 2002). It has been established that having a variety of grains, fruits, vegetables, and proteins yield higher energy intake (Foote et al., 2004). However, for most resource-poor women in developing countries, having adequate nutrient intake is a challenge, creating a number of diet-related health consequences. Dietary diversity is critical in assessing the nutrient adequacy in adults and adolescents (Mirmiran et al., 2004). Dietary diversity scores have been positively correlated with macronutrient and micronutrient adequacy of the diet for adolescents (Mirmiran et al., 2004) and adults (Ogle et al., 2001; Foote et al., 2004; Arimond et al., 2010). Savy et al. (2005) report a positive relationship between dietary diversity scores and nutritional status of adult women in rural Burkina Faso.

The Women's Dietary Diversity Score (WDDS) is designed specifically to capture the nutritional quality and nutrient adequacy of women's diet. The score is estimated using a count of nine food groups consumed over the preceding 24 hours. The food groups used in the dietary diversity score as developed by Kennedy et al. (2011) are presented in Table 7. Their approach suggests using the mean of the count of the food groups consumed by the respondent in estimating the score. That is, the average WDDS for a sample may be estimated as follows:

$$WDDS = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{9} FG_{ij} \tag{14}$$

where FG_{ij} is the food group j included in the count for respondent i and n is the number of people included in the estimation, i.e., the sample size.



Following Kennedy et al. (2011), the WDDS is classified into three categories: low, middle, and high dietary diversity. A woman consuming foods from less than three of the nine food groups is considered to have low diet diversity while the middle diet diversity is classified as consuming four to five different food groups. A diet that consists of foods from more than five food groups is considered to be a highly diverse diet. Low diversity diets present a higher probability of nutrient inadequacy in adults and could provide insights into food security (Haddad et al., 1994).

The nutritional status of women of reproductive age is of particular importance, as the health and well-being of both the mother and child is affected. Pregnant and lactating women require significant energy and micronutrients to meet increased metabolic demands placed on their biological systems. This group of women is vulnerable to developing micronutrient deficiencies and succumbing to the consequent effects of these deficiencies (Picciano, 2003; Ramakrishnan, 2002; Huffman et al. 1998). For example, micronutrient deficiencies in women's diets before and during pregnancy can increase the risk of adverse pregnancy outcomes

such as preeclampsia and increase the risk of irreversible effects on the child development in-utero such as neural tube defects (Ramakrishnan, 2002; and Huffman et al., 1998). Nutrient deficiencies in lactating women can also impact their health and development of their breastfed child (Huffman et al., 1998; and Bartley, Underwood, and Decklbaum, 2013). Micronutrient deficiencies, such as iron deficiency and anemia, can also affect a mother's ability to provide adequate care for her children and lower her income-generating potential (WHO, 2013).

Table 7: Food Groups and the Individual Foods Defining the Women's Dietary Diversity Indicator

Food Group	Individual Foods
Starchy Staples	**Cereals:** corn/maize, rice, meat, sorghum, mille or any other grains or foods made from these, e.g., bread, noodles, porridge, or other grain products **White roots and tubers:** white potatoes, white yams, cassava, or any other foods made from roots
Dark Green Leafy Vegetables	Dark green leafy vegetables, including wild forms and locally available Vitamin A-rich leaves such as amaranth, cassava leaves, kale, spinach
Other Vitamin A Rich Fruits and Vegetables	Vitamin A-rich vegetables and tubers: pumpkin, carrots, squash, or sweet potatoes that are orange inside, and other locally available Vitamin A-rich vegetables, e.g., red sweet pepper Vitamin A-rich fruits: ripe mangoes, cantaloupe, apricot, ripe papayas, dried peach, and 100 percent fruit juice made from these and other locally available Vitamin A-rich fruits Red palm oil
Other Fruits and Vegetables	Tomato, onion, eggplant, and other locally available vegetables Wild fruits and 100 percent fruit juice made
Organ Meat	Liver, kidney, heart, other organ meats or blood-based foods
Meat and Fish	Beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects **Fish and seafood:** fresh or dried fish or shellfish
Eggs	Eggs from chicken, duck, guinea fowl or any other egg
Legumes and Nuts	Dried beans, dried peas, lentils, nuts, seeds or foods made from these, e.g., hummus, peanut butter
Milk and Milk Products	Milk, cheese, yogurt, or other milk products

Adapted from Kennedy, Ballard, and Dop (2011).

Dietary Diversity Score for Reproductive Age Women

The sub-sample used in the analysis of dietary diversity is women of reproductive age, i.e., 15 to 49 years. There were 4,572 women in the sample who satisfied this criterion, accounting for about 38.1 percent of females in the sample. The effective sample size was 4,322, a result of non-response.[6]

The mean WDDS for this sample is 4.0 ± 1.6.[7] The 95 percent confidence interval ranged from a score of 3.9 to 4.1. The mean WDDS for each quartile in ascending order is 2.5, 4.0, 5.0, and 6.5, respectively. About 40.5 percent of the respondents fall into the low diet diversity group, 42.1 percent and 17.4 percent fall into the

6 See Survey Design and Execution section for more information.
7 Numbers reported after the ± sign represent the standard deviation of the variable.

middle and high diet diversity groups, respectively. Within the low diet diversity group, the mean WDDS is 2.5 ± 0.7. The results for the medium and high diet diversity groups are 4.4 ± 0.5 and 6.5 ± 0.7, respectively. The means for the three groups are statistically different from each other at the 1 percent level.

The mean WDDS is 3.8 ± 1.5 for rural residents compared to 4.6 ± 1.5 for urban residents. The difference between the mean WDDS for the two locales is statistically significant at the 1 percent significance level. This would suggest that urban women, with their higher average diet diversity, are probably also less vulnerable to micronutrient and macronutrient inadequacy than rural women.

The overall prevalence rate of women with low diversity in the ZOI is 40.5 percent. As expected, the prevalence of low diet diversity score in rural areas is 45.8 percent, compared to 24.6 percent in urban areas. The relative contributions of rural and urban areas to women with low WDDS score are 84.8 percent and 15.2 percent, respectively.

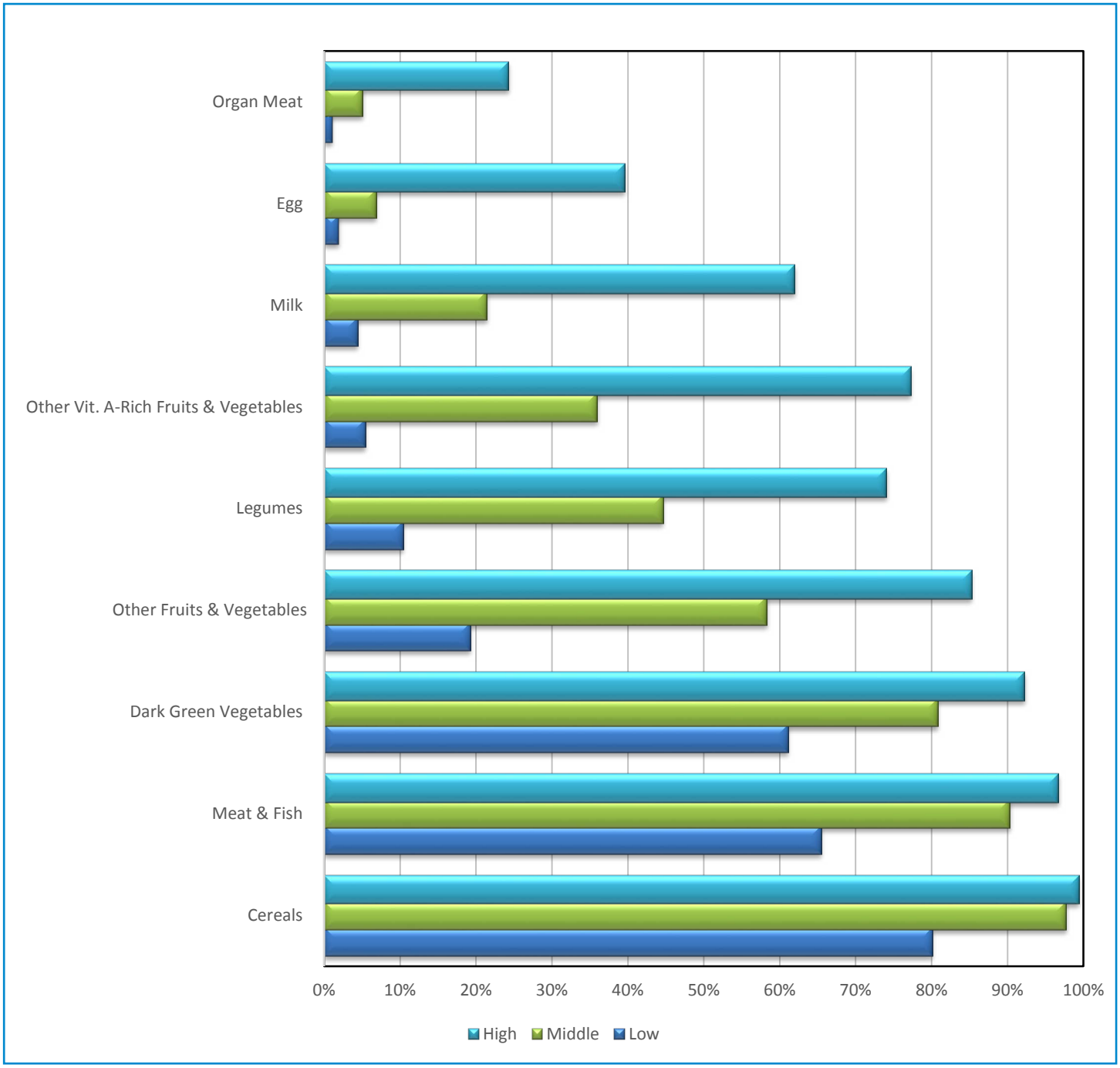
The prevalence of women with low dietary diversity in the Non-RING Zone is 41.4 percent, slightly higher but not statistically different from the RING Zone's prevalence rate of 39.1 percent. The absolute contribution for the Non-RING Zone is about 25.4 percent while its relative contribution is 62.7 percent. This contrasts with the absolute contribution of 15.1 percent and relative contribution of 37.3 percent in the RING Zone. Thus, the Non-RING Zone presents a larger proportion of the women who have low dietary diversity.

The prevalence rate for "Female Adult Only" households is 43.3 percent, which is higher than the prevalence rate for "Male and Female Adults" households' prevalence rate of 40.3 percent. However, there is no statistically significant difference between the two. The absolute contribution for "Male and Female Adults" households is 37.5 percent and their relative contribution is about 93 percent. Therefore, "Female Adult Only" households contribute only a small proportion of women with low dietary diversity in this sample.

Across the four regions in the study area, the prevalence rate for low dietary diversity ranges from 37.1 percent in Northern Region, 39.7 percent in Brong Ahafo, 42.8 percent in Upper West to 51.1 percent in Upper East Region. The differences in mean prevalence rates between Upper East and Northern and between Upper East and Brong Ahafo are statistically significant at the 1 percent and 5 percent levels, respectively. There was no significant difference between Upper East and Upper West in the prevalence of women with low dietary diversity. Although Northern Region has the lowest prevalence rate in women with low WDDS, it presents the highest absolute and relative contributions of 21.5 percent and 53.0 percent, respectively. Similar results were obtained in the case of underweight women.

Figure 18 shows the proportion of women consuming foods in the different food groups by dietary diversity levels. It shows that cereal is the dominant food group at all dietary diversity levels, with nearly all women at the high dietary diversity level and 80.1 percent of women in the low dietary diversity indicating they consumed products from that group. While less than 20 percent of women at the low dietary diversity level indicated consuming other fruits and vegetables, nearly 58.3 percent and 85.3 percent of those at the middle and high diet diversity levels indicated consuming other fruits and vegetables. Additionally, while nearly 62.0 percent of women in the high diet diversity level indicated consuming milk, the equivalent for the middle and the low diet are 21.3 percent and 4.4 percent. It is interesting to note that a larger proportion of women at the higher diet diversity level consume Vitamin A-rich fruits and vegetables than they consume legumes. Higher density proteins, such as eggs and milk, are virtually absent from the foods consumed by women at the low diet diversity level while at least a quarter of women at the high diet diversity level included those foods in their diets.

Figure 18: Proportion of Women Consuming Foods in Different Food Groups by Dietary Diversity Level



Children Malnutrition

Child malnutrition may be caused by a lack of access to adequate food supply, exposure to repeated illness, and/or improper practices by caregivers. Improving infant and young children feeding practices can positively improve nutritional and health statuses and promote healthy development. Previous studies have indicated that malnutrition in infants and young children generally first appears between four to six months of age, and peaks at about 21 months (Davis et al., 2003).

Child malnutrition is assessed in this study using two indicators: (1) Exclusive breastfeeding; and (2) Minimum Acceptable Diet. Exclusive breastfeeding criterion is based on the WHO and UNICEF recommendation that children under six months of age be exclusively breastfed. After those first six months, complementary foods may be introduced into the diet to meet the energy requirements necessary to support growth and development. The minimum acceptable diet recommendations are dependent on a child's age, whether the child is being breastfed, the extent of dietary diversity, and the meal frequency available to the child.

The children malnutrition indicators are estimated focusing on the two groups of children covered by the indicators – those younger than six months old, and those older than six months but younger than 24 months. Information for both indicators are collected by asking the mothers and caretakers of children in the two categories to recall the children's consumption of breast milk and other foods in the preceding 24 hours.

A sample size for the exclusive breastfeeding analysis was 377 children aged five months or younger. For the minimum acceptable diet analysis, the sample size was 946 children aged 6-23 months. The completion rate for both indicators was approximately 92.0 percent.[8] Therefore, the effective sample sizes for the estimation and analyses of the two indicators were 349 and 871, respectively.

Exclusive Breastfeeding

A child is considered exclusively breastfed when he/she does not consume any other liquids or foods other than breast milk.[9] A total of 60.5 percent of the children 0-5 months in the ZOI are exclusively breastfed. The prevalence rate for exclusively breastfed male children in that age group is 62.1 percent compared to 58.9 percent for female children of the same age group. This 3.2 percent difference is not statistically significant. The projected population of children 0-5 months in the ZOI is about 74,335 children, and it is estimated that 44,988 of those children are exclusively breastfed, with 52.0 percent being male and 48.0 percent being female.

Three-quarters of the children aged one month or younger are exclusively breastfed. The absolute contribution for this age group is 18 percent; however, the relative contribution is about 30.0 percent. As expected, the proportion of children exclusively breastfed declines with age. Thus, the prevalence rate for children aged 2-3 months is 66.5 percent, compared to 45.3 percent for children aged 4-5 months. The difference between the prevalence rates of these two groups of children is statistically significant at the 1 percent level. This is also consistent with the difference between the 4- to 5-month-old children and those at the age of one month or less. However, the difference between the one month or less age group and the 2- to 3-month-old is not statistically significant.

8 See Survey Design and Execution section for more information.

9 Vitamin drops and oral rehydration salts are not categorized as other liquids and are not included.

Figure 19: Prevalence of and Absolute Contribution to Exclusively Breastfed Children Under Six Months Old by Strata and Gendered Households (N=377)

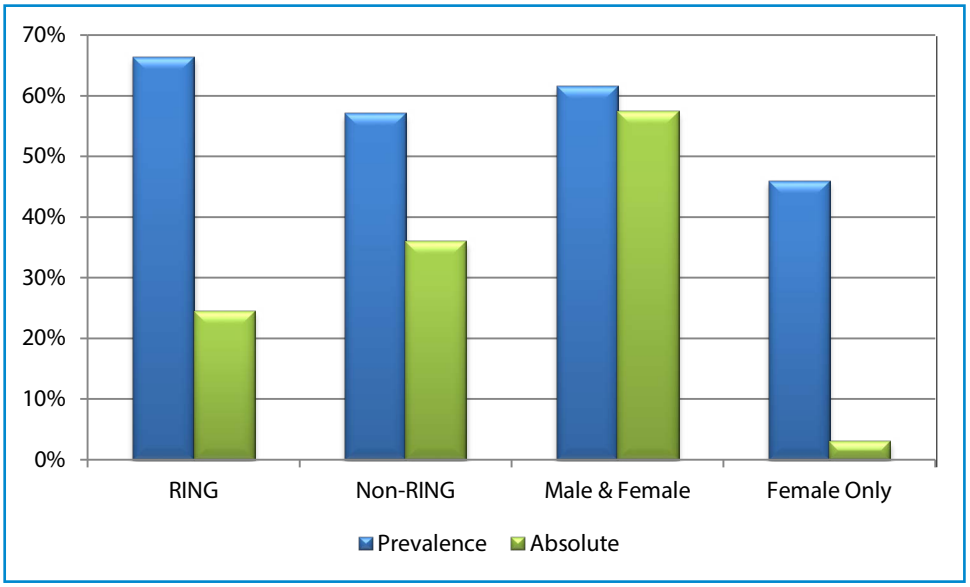


Figure 19 shows the prevalence rate and the absolute and relative contributions for exclusively breastfed children by strata and gendered households. The prevalence rate in the RING Zone is 66.5 percent and almost 10 percentage points higher than the Non-RING Zone's 57.1 percent. However, the difference between the two is not statistically significant. The absolute contribution for the Non-RING Zone is 36.0 percent; however, the relative contribution is nearly 60.0 percent. The prevalence rates for "Male and Female Adults" and "Female Adult Only" households are 61.6 percent and almost 46.0 percent, respectively. However, they are not statistically different from each other. In absolute terms, "Male and Female Adults" households contribute about 57.5 percent of the exclusively breastfed children but are responsible for approximately 95.0 percent in terms of relative contribution. The absolute contribution of "Female Adult Only" households is only about 3.0 percent and their relative contribution is 5.0 percent.

A comparison across the regions indicates that Northern Region has the highest prevalence rate (67.0 percent) of children exclusively breastfed, while Upper West has the lowest (44.5 percent). The prevalence rates for Brong Ahafo and Upper East are 54.3 percent and 49.1 percent, respectively. With the exception of the difference between Northern Region on the one hand and Upper East and Upper West on the other, there are no statistical differences between the region's prevalence rates. Northern Region also has the highest absolute and relative contributions; they are 42.2 percent and 70.0 percent, respectively. There is a 10 percent difference between the prevalence rate in urban and rural areas, but the difference is not statistically significant. The absolute contribution for rural areas is about 48.0 percent with a relative contribution of approximately 78.0 percent.

Minimum Acceptable Diet

The dietary diversity and minimum meal frequency criteria used in the estimation of minimum acceptable diet are presented in Table 8. Similarly, the seven food groups that go into the definition of the minimum dietary diversity are presented in Table 9. WHO/UNICEF guidelines for infant and young children feeding practices indicate the consumption of food products from at least four different food groups are associated with better quality diets for breastfed and non-breastfed children (WHO, 2008). Dietary diversity for breastfed children is based on seven food groups. For non-breastfed children, the dietary diversity is based on six food groups not including dairy products because they are required to have at least two milk feedings per day. The dietary diversity and meal frequency information for these two groups of children was gathered and based upon the 24 hours previous to the time of collection.

Table 8: Criteria for Minimum Dietary Diversity and Minimum Meal Frequency

Dimension	Criteria
Minimum Dietary Diversity	Breastfed: 4 or more groups out of 7 food groups Non-breastfed: 4 or more groups out of 6 food groups
Minimum Meal Frequency (solid, semi-solid, soft foods)	Breastfed, aged 6-8 months: 2 or more feedings Breastfed, aged 9-23 months: 3 or more feedings Non-breastfed, aged 6-23 months: 4 or more feedings

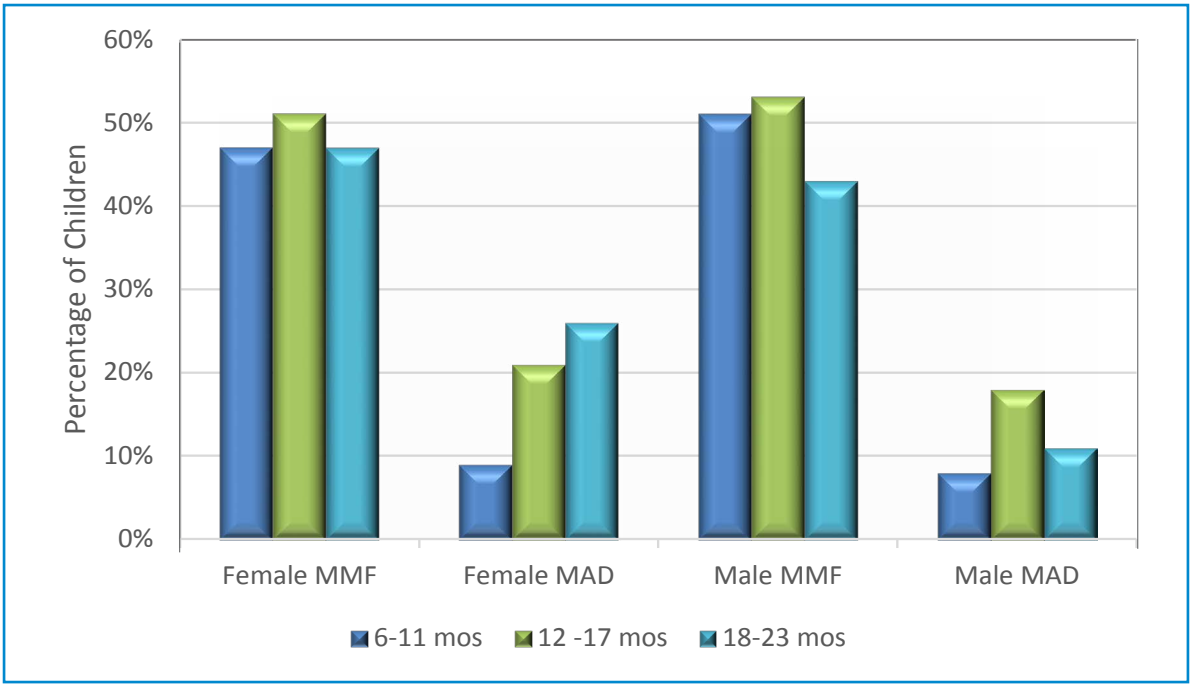
Table 9: Seven Food Groups and the Individual Foods the Comprise the Minimum Dietary Score for Breastfed

Food Group	Individual Foods
Grains, Roots and Tubers	Porridge (including thin), bread, rice, noodles, white potatoes, white yams, manioc, cassava, or any other foods made from grains or roots
Legumes and Nuts	Foods made from beans, peas, lentils, nuts, or seeds
Dairy Products	Infant formula, milk (e.g., tinned, powdered, or fresh), yogurt, cheese, or other milk products
Flesh Foods	Any meat (such as beef, pork, lamb, goat, chicken, or duck), fresh or dried fish, shellfish, or seafood
Eggs	Eggs
Vitamin-A Rich Fruits and Vegetables	Pumpkin, carrots, squash, sweet potatoes that are yellow or orange inside, any dark green leafy vegetables, ripe mangoes, ripe papayas, other local vitamin-A rich fruit, foods made with red palm oil, red palm nut, or red palm nut pulp sauce
Other Fruits and Vegetables	Any other fruits and vegetables

Adapted from WHO, 2010

The analysis shows that the proportion of breastfed children being fed a minimum acceptable diet increases with age. For example, nearly 9.0 percent of children aged 6-11 months meet the minimum acceptable diet requirements and compared to 19.0 percent for those 18-23 months. Figure 20 shows the distribution of children receiving minimum acceptable diet and minimum meal frequency by gender and age cohorts. The overall prevalence rate of those meeting the minimum meal frequency criterion is 49.6 percent for children aged 6-23 months. The prevalence rate for meeting the minimum meal frequency is 48.7 percent for female children and 50.5 percent for male children. There are no statistical differences between the prevalence rates for minimum meal frequency across the age groups for each gender or between the genders for each age group. When disaggregating the prevalence rates for minimum acceptable diet by gender, the differences in the prevalence rates between 6-11 months and 12-17 months are statistically significant for both genders. There is also a statistical difference between the prevalence rates for 6-11 months and 18-23 months for female children. The difference in the mean prevalence rates for minimum acceptable diet between the 6-11 month cohort and the 12-17 month cohort is 11.2 percent and between the 6-11 month cohort and the 18-23 month cohort is 10.6 percent. Both of these are statistically significant at the 1 percent level. The difference between the mean prevalence rates for minimum acceptable diet for the 12-17 month olds and the 18-23 month olds is not statistically significant.

Figure 20: Prevalence Rates of Children Receiving Minimum Meal Frequency (MMF) and Minimum Acceptable Diet (MAD) by Gender and Age Cohort (N=946)



The prevalence rate for children receiving a minimum acceptable diet in the RING Zone is 17.0 percent compared to 14.5 percent in the Non-RING Zone, and they are not statistically different. The RING Zone's absolute contribution is 7.1 percent and its relative contribution is 45.4 percent. The prevalence rate of children receiving a minimum acceptable diet in "Female Adult Only" households is 22.1 percent compared to 15.1 percent in "Male and Female Adults" households. These rates are not statistically different from each other. The prevalence rate for "Male Adult Only" households is zero. The absolute contribution for "Female Adult Only" households is close to 1.4 percent, while their relative contribution is 9.0 percent.

Looking for regional patterns, the prevalence of children being fed in accordance with the minimum acceptable diet criteria ranges from 13.2 percent in Upper East Region to 27.7 percent in Upper West Region. Although Northern Region has the second lowest prevalence rate among the four regions (13.9 percent), it has the largest absolute and relative contributions. Northern Region's absolute contribution is about 8.0 percent and its relative contribution is close to 53.0 percent. Rural areas in the ZOI have a prevalence rate of 15.1 percent, which is slightly lower than the rate of 17.6 percent for urban areas. The difference between the two are, however, not statistically significant.

Children Anthropometry

As in the case of women's anthropometry, the children anthropometry provides information about the health status of children in the ZOI through non-invasion processes. The data collection process was designed to facilitate three indicators of malnutrition: underweight; stunting; and wasting. The indicators reveal nutritional imbalances resulting in under-nutrition or malnutrition.

Stunting or height-for-age (H/A) is a measure of linear growth. Stunting indicates chronic malnutrition resulting from prolonged periods of inadequate nutrition or recurrent or current illness. Therefore, stunting may be interpreted as an indication of poor conditions in the child's environment. Eventually, stunting affects national economic productivity by its effects on the affected children's mental development and academic performance.

Wasting, or weight-for-height (W/H), is typically an indication of acute under-nutrition resulting from insufficient food intake and/or a high infectious disease incidence. Diseases, such as diarrhea, can trigger wasting if the child's food environment is already inadequate. The effect of wasting on the immune system can be severe, leading to increased severity and duration of existing diseases as well as susceptibility to infectious diseases. Wasting also increases the risk of death.

Underweight or weight-for-age (W/A) is a measure of both acute and chronic malnutrition. It can reflect wasting and/or stunting, making a difficult indicator to interpret. There is evidence that mildly underweight children have increased mortality risks and severely underweight children experience even higher mortality risks.

Reference Group and Standardized Z-Scores of Anthropometric Indicators

Well-nourished children 10 years or younger, regardless of ethnic backgrounds, have similar height and weight distribution and growth rates throughout the world (Cogill, 2003). Therefore, a reference population may be used to determine if children under 10 years of age are undernourished by comparing anthropometric indicators. These indicators are based on standardized z-scores calculated following the Anthropometric Indicators Measurement Guidelines (Cogill, 2003).

The z-score, z_{ij}, of the j^{th} individual for the i^{th} indicator is estimated as follows:

$$z_{ij} = \frac{v_{ij} - v_{Mi}}{\sigma_{Mi}} \tag{15}$$

where v_{ij} is the observed value of the i^{th} indicator for the j^{th} individual, and v_{Mi} and σ_{Mi} are the median and the standard deviation of the i^{th} indicator in the reference population, respectively. The international reference population is developed by the U.S. National Center for Health Statistics (NCHS) and supported by the WHO's Child Growth Standards (WHO, 1995). To be considered moderately or severely underweight, a child's weight-for-age value must be less than two z-scores below the median of the reference population. A severely underweight child has weight-for-age value z-scores that are three z-scores lower than the reference population's median weight-for-age value. A child is considered to be moderately or severely wasted if their weight-for-height measurement is below two z-scores from the median of the reference group. Children with z-scores below three z-scores are classified as severely wasted. A child with a height-for-age measurement two z-scores below the median measurement for the reference group is considered moderately or severely stunted while a child with a measurement three z-scores below is severely stunted.

Anthropometric measurements were collected for children younger than 60 months living in the ZOI. Of the 3,567 eligible children, valid measurements were obtained for 3,361 children, or 94.2 percent. The missing measurements may be due to their parents and/or the children not being available when enumerators visited the household.[10]

10 See the Survey Design and Execution section for more information.

In order to ensure that extreme measures did not distort estimation of prevalence rates, WHO has provided guidelines on the definition of extreme z-scores. When the z-score for any individual is greater than 5 or smaller than -5 in the wasting indicator, such observations are excluded from the analysis. For stunting, the boundaries for exclusion of z-scores are -6 and 6. For underweight, the z-score exclusion boundaries are -6 and 5. Thus, any observations with z-scores outside of these z-score ranges are excluded from the estimation of the relevant indicator. The proportion of the total sample excluded in the case of estimating the underweight indicator was 2.8 percent. The excluded observations in the estimations of the stunting and wasting indicators were 6.0 percent and 8.5 percent of the sample, respectively.

Source: WHO, 1995

Prevalence of Stunting, Underweight and Wasting

The estimated population of children younger than 60 months in the ZOI is 729,230. The sample was decomposed into seven age cohorts: 0-5 months; 6-11 months; 12-17 months; 18-23 months; 24-35 months; 36-47 months; and 48-59 months. The distribution of the sample by age cohorts is presented Figure 21. The figure shows that the largest cohort is the 36-47 month olds, accounting for about a quarter of all the children in the survey. Children older than 35 months account for about 47.0 percent of the sample while those younger than 12 months account for only 19.0 percent.

The overall prevalence rate for underweight children in this age group in the ZOI is 18.4 percent. For stunting and wasting, the overall prevalence rates are 36.1 percent and 11.0 percent, respectively. Table 10 shows the cut-off values for describing the severity of the estimated prevalence rates for each of the three indicators as defined by WHO (WHO, 1995; 1997). The foregoing results would suggest that there is a medium level of malnutrition based on the prevalence of underweight children in the ZOI, and a high degree of malnutrition based on the prevalence of stunted and wasted children.

Figure 21: Distribution of Children Younger than 60 Months by Age Cohort (N=3,361)

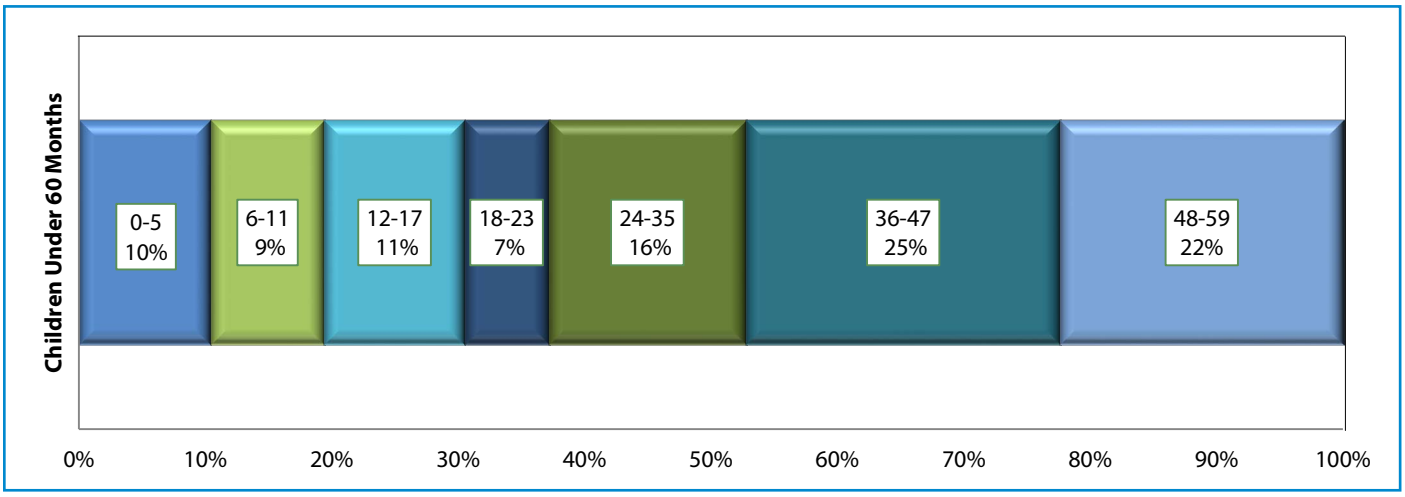


Table 10: Cut-Off Values of Child Anthropometry Indicators for Public Health Significance

Indicator	Severity of Malnutrition By Prevalence Ranges (%)			
	Low	Medium	High	Very high
Stunting	<20	20-29	**30-39**	>=40
Underweight	<10	**10-19**	20-29	>=30
Wasting	< 5	5-9	**10-14**	>=15

Source: WHO, 1995; 1997

Underweight Children

In the ZOI, 18.4 percent of the children younger than 60 months are determined to be underweight. The prevalence rate among male children is 18.2 percent compared to 18.7 percent for females of the same age group, and these rates are not statistically different. The weighted population of underweight children younger than 60 months in the ZOI is 134,251, consisting of 49.0 percent males and 51.0 percent females.

Figure 22 presents the prevalence rates for underweight children by age cohorts. It shows that prevalence rate for underweight children ranges from 9.8 percent for the 0-5 month olds to 21.0 percent for the 24-35 month olds. The prevalence rate for underweight children in the youngest age cohort at 9.8 percent is only about two-thirds the prevalence rate of the second youngest age cohort. However, the differences between the prevalence rates for the youngest age cohort and other cohorts are statistically significant from each other except for the youngest cohort and the second youngest cohort. The absolute contribution of the age cohorts is lowest for the 0-5 month olds and highest for the 36-47 month olds at less than 1 percent and 4.7 percent, respectively (Figure 22). Figure 23 presents the relative contributions of the different age cohorts to the underweight population. Children in the 0-5 month old cohort contribute less than 5 percent of the underweight children while the two oldest cohorts, 36-47 months and 48-59 months, together contribute to nearly half of all of the underweight children.

The prevalence rate of underweight children in the RING Zone is 19.8 percent compared to 17.5 percent for the Non-RING Zone. However, the difference is not statistically significant. The absolute contribution of the Non-RING Zone is about 10.4 percent, and higher than that of the RING Zone at about 8.0 percent. The Non-RING Zone's relative contribution is about 56.4 percent.

The prevalence and absolute and relative contributions of the different gendered households to underweight

Figure 22: Prevalence of and Absolute Contribution to Underweight Children by Age Cohort (N=3,361)

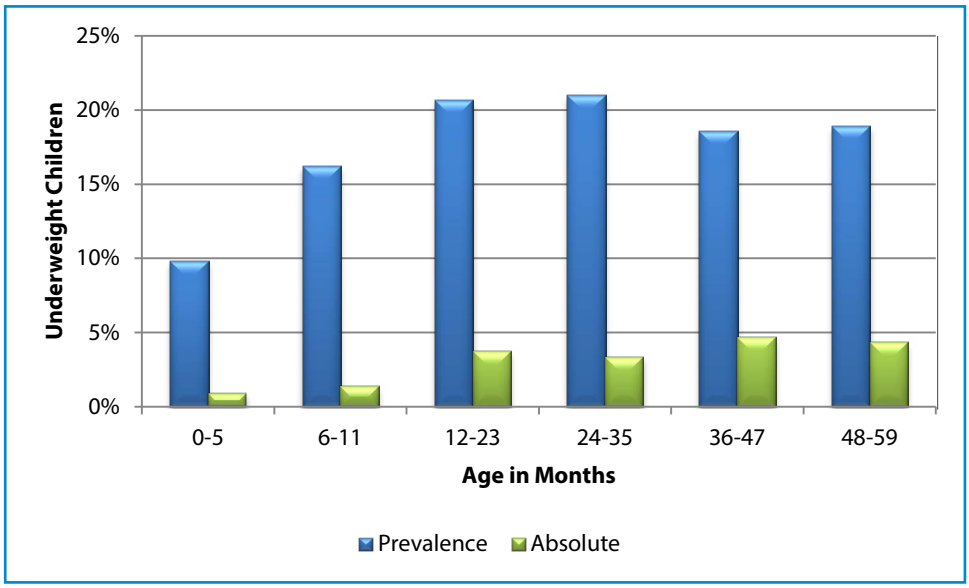
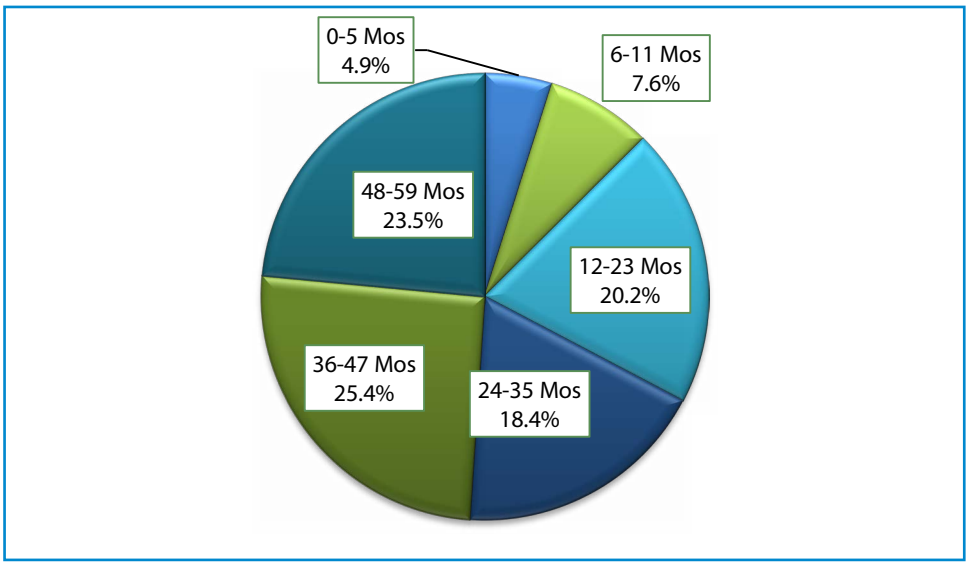


Figure 23: Relative Contribution of Underweight Children by Age Cohort (N=3,361)

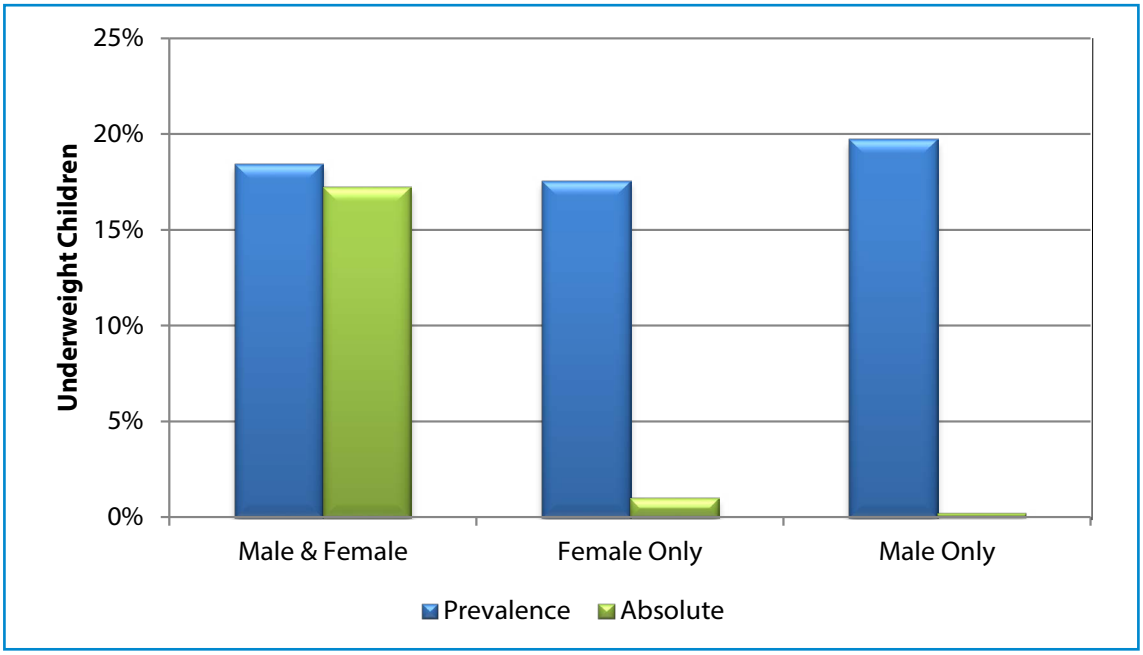


children are presented in Figure 24. "Male Adult Only" households have the highest prevalence rate of the three gendered household types (19.7 percent), followed by "Male and Female Adults" households (18.5 percent) and "Female Adult Only" households (17.5 percent). However, there is no statistical difference between these three gendered household types. The absolute contribution for "Male and Female Adults" households is approximately 17.2 percent, but their relative contribution to underweight children is nearly 94 percent.

Among the four regions, the prevalence rate is highest in Northern Region (22 percent) and lowest in Brong Ahafo (9.6 percent). The prevalence rates for Upper West and Upper East are 10.1 percent and 16.8 percent, respectively. These regional prevalence rates are statistically different for each other except for the differences between Brong Ahafo and Upper West and between Upper East and Upper West. Rural areas have higher proportions of underweight children, accounting for a prevalence of 19.3 percent, compared to urban areas' prevalence rate of 14.5 percent. The difference between the prevalence rates in the rural and urban areas is statistically significant at the 5 percent level. Rural areas have an absolute contribution of about 16.0 percent and a relative contribution of almost 85.0 percent.

An enumerator uses the mother/child scale to simultaneously measure the weight of the mother and child. The mother's weight is measured separately and is subtracted from the mother/child weight to determine the weight of the child.

Figure 24: Prevalence of and Absolute Contribution to Underweight Children by Gendered Household Characteristics (N=3,361)



Stunted Children

The estimated population of stunted children in the ZOI is 263,106, implying that the prevalence of stunted children in the ZOI is 36.1 percent. Stunting is more prevalent in male than female children, 38.2 percent to 34.0 percent, but not statistically different from each other at the 5 percent level. The absolute contribution for males is approximately 19.0 percent, but the relative contribution is almost 53.0 percent.

Figure 25 shows the distribution of stunted children by age cohorts. The prevalence rate of stunting seems to be bimodal with children younger than 12 months in one group and those 12 months and older in another. The prevalence rates of stunting for the children younger than 12 months is below 20 percent while those for the other group is higher than 35 percent, reaching as high as 43.8 percent for 36-47 month age cohort. The prevalence rates of the cohorts of children younger than 12 months are statistically different from those of the older cohorts. However, there is no statistical difference between the two youngest age cohorts. Also, the prevalence rate for stunted children at 24-35 months is statistically different from the rate at 36-47 months. As found with the contributions of the different cohorts to underweight children, the two older cohorts together account for the largest contribution of stunted children in absolute and relative terms. Indeed, these two cohorts together account for more than 55.0 percent, which is higher than what was found in the case of underweight children.

The distributions of stunted children by strata and gendered households are presented in Figure 26. The prevalence rate in the RING Zone is 38.2 percent compared to 34.6 percent in the Non-RING Zone, but they are not statistically different. Even though the prevalence rate is slightly lower in the Non-RING Zone, the absolute contribution is nearly 21.0 percent and the relative contribution is 57.0 percent. "Male and Female Adults" households and "Female Adult Only" households have prevalence rates of 35.8 percent and 35.0 percent, respectively, and they are not statistically different. However, "Male Adult Only" households have a prevalence rate that is about double the rate of the other two gendered household types (68.4 percent). The differences between "Male Adult Only" households and others are statistically significant at the 5 percent level.

Rural areas have a stunting prevalence of 38.1 percent compared to 27.5 percent in urban areas, and the difference is statistically significant. Looking at the trends across the regions, Northern Region has the highest prevalence rate (39.2 percent) for stunted children, followed by Upper East (36.2 percent), Brong Ahafo (29.9 percent), and Upper West (25.1 percent). The prevalence rates for the following regions are detected to be statistically different at the 5 percent level: Brong Ahafo and Northern; Northern and Upper West; and Upper East and Upper West.

An enumerator with the help of an assistant uses a measuring board to accurately measure the height of a child 24 months of age or older.

Figure 25: Prevalence of and Absolute Contribution to Stunted Children by Age Cohort (N= 3,361)

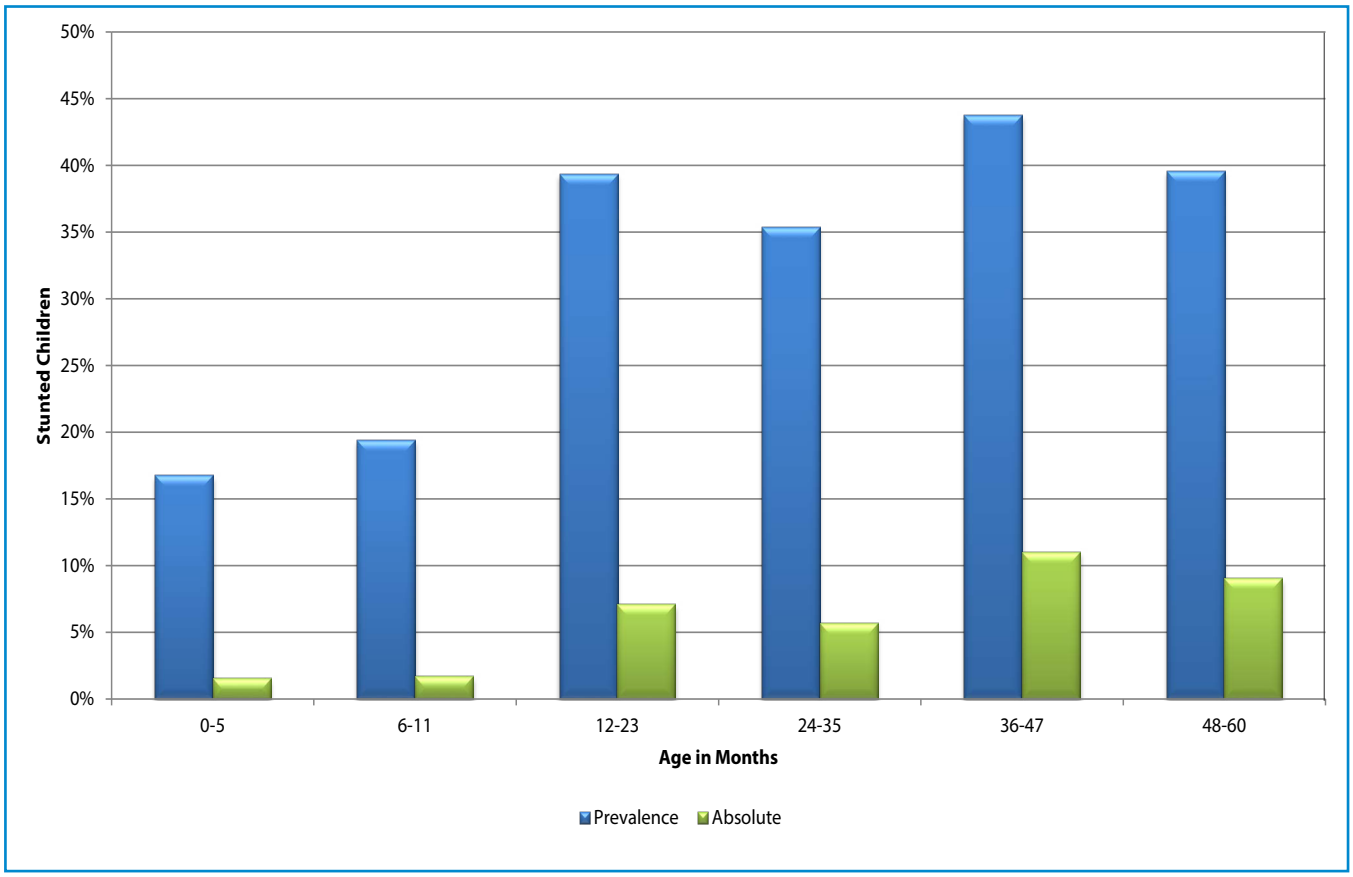
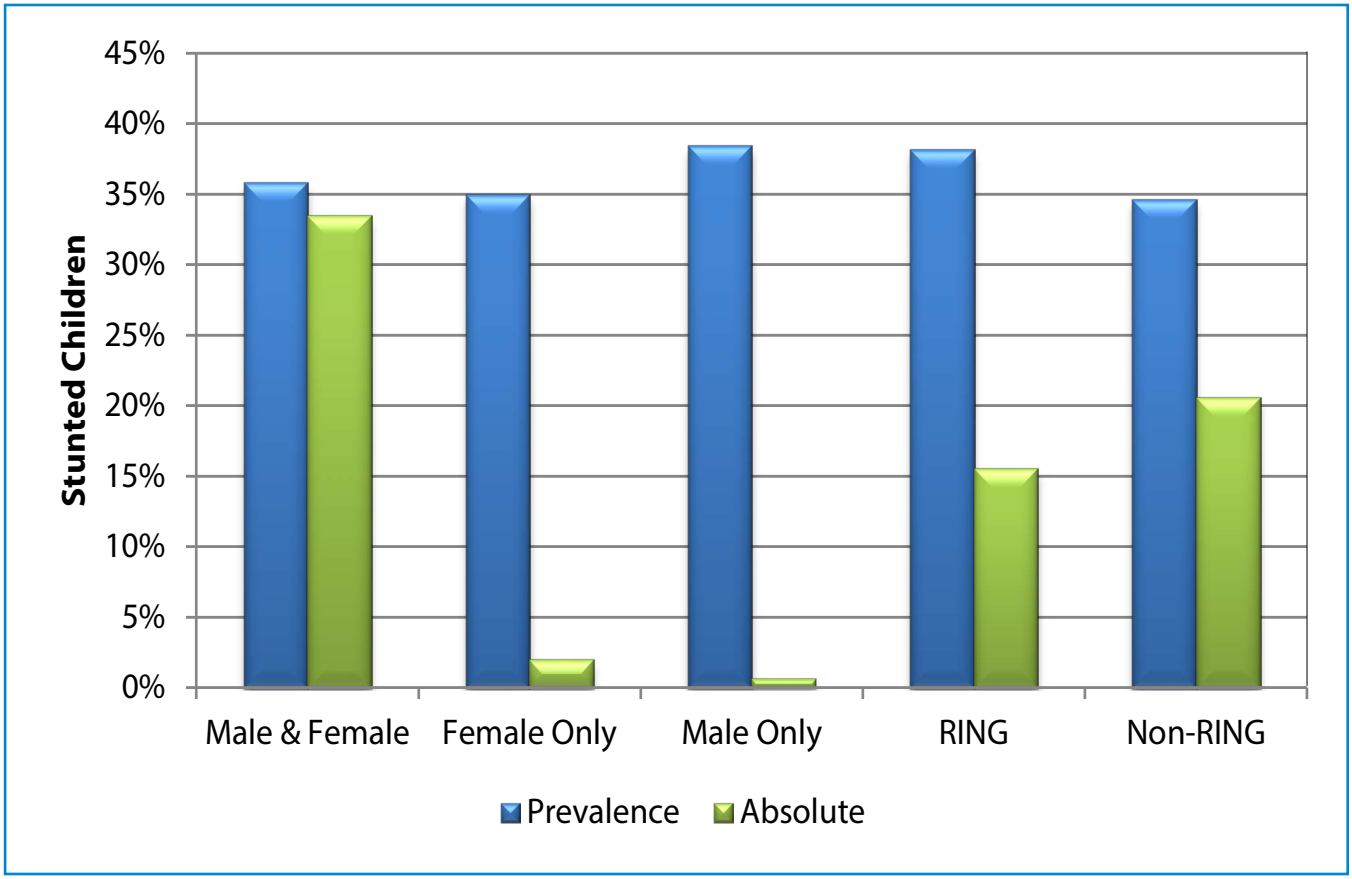


Figure 26: Prevalence of and Absolute Contribution to Stunted Children by Strata and Gendered Household Characteristics (N=3,361)

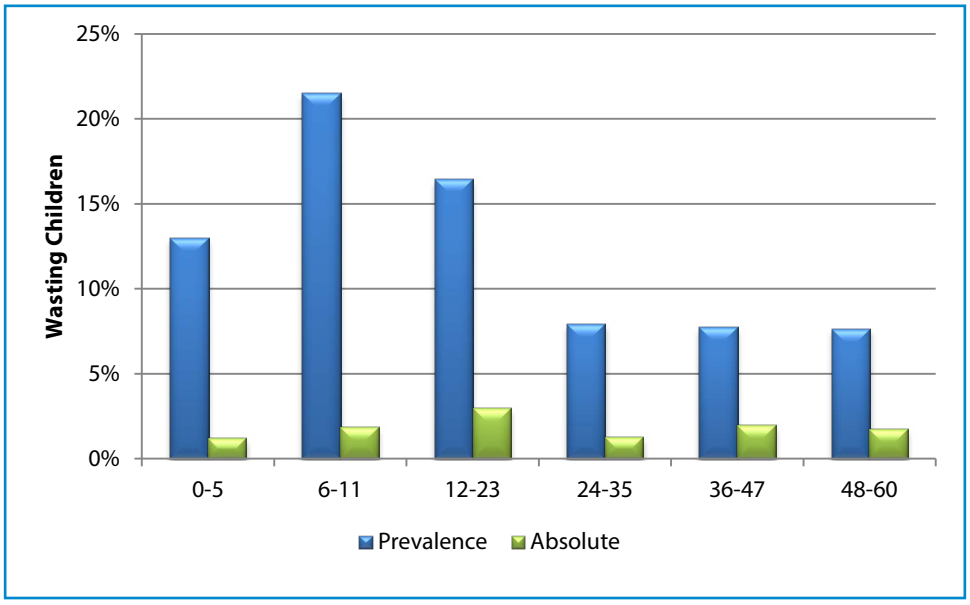


Wasted Children

The estimated population of children younger than 60 months in the ZOI is 729,230. The prevalence rate of wasted among this group is 11.0 percent. Thus, the estimated number of children wasting is approximately 80,142. The proportion of female children in this age group considered wasted is 10.7 percent, which is slightly lower than the proportion of wasted male children (11.3 percent). However, these proportions are not statistically different. The relative contribution of females to the number of wasting children is 48.7 percent.

Figure 27 shows that children younger than 24 months are more likely to exhibit wasting than those 24 months or older. The prevalence rates of wasting for the cohorts in this group are all below 10 percent compared to the younger cohorts whose rates are above 10 percent. For example, while the 6-11 month age cohort presented a wasting prevalence rate of 21.5 percent, those of the three cohorts starting at the 24-35 month age cohort were between 7.6 and 7.9 percent. The absolute contributions of all the age cohorts are relatively small, between 1.2 percent and 2.9 percent, presented by the 0-5 month and the 12-23 month age cohorts, respectively. The relative contribution of the latter cohort is also the largest, accounting for 26.9 percent. Thus, unlike for underweight and stunting, the older age cohorts are not the largest relative contributors to wasting. Additionally, the relative contributions by the different age cohorts are almost evenly distributed among three age cohorts within two percentage points of each and another two cohorts are within one percentage point of each other. The former cohorts are the 6-11 month-olds, 36-47 month-olds and 48-59 month-olds presenting relative contributions of 16.9 percent, 17.8 percent and 15.9 percent. The latter cohorts are the 0-5 month-olds and 24-35 month-olds who registered relative contributions of 10.8 percent and 11.6 percent.

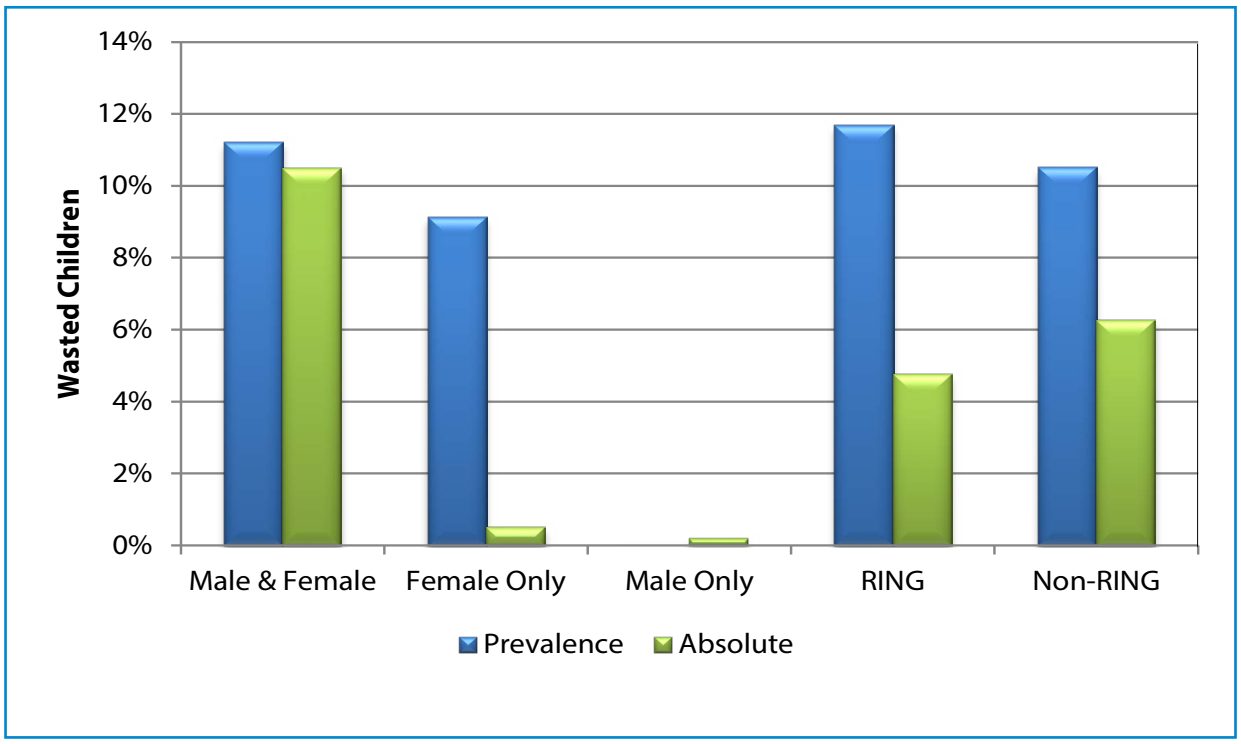
Figure 27: Prevalence of and Absolute Contribution to Wasting in Children by Age Cohort (N=3,361)



Although there is no statistical difference between the prevalence rates for the age cohorts, 6-11 and 12-23, these two age cohorts are both statistically different from the other age cohorts except for the difference between 0-5 month-olds and 12-23 month-olds.

Figure 28 shows the wasting prevalence and absolute contribution to wasting by the different strata and gendered households. The prevalence rate for wasted children in the RING Zone is 11.7 percent compared to 10.5 percent in the Non-RING Zone, but the difference in these rates is not statistically significant. The absolute and relative contributions for the Non-RING Zone is 6.2 percent and 56.8 percent, respectively, which is larger than contributions of the RING Zone. "Male and Female Adults" households have a prevalence rate of 11.2 percent, which is higher but not statistically different from the prevalence rate for "Female Adult Only" households (9.1 percent). "Male Adult Only" households did not contribute any wasting children. The absolute

Figure 28: Prevalence of and Absolute Contribution to Wasting in Children Younger than 60 Months by Strata and Gendered Household Characteristics (N=3,361)



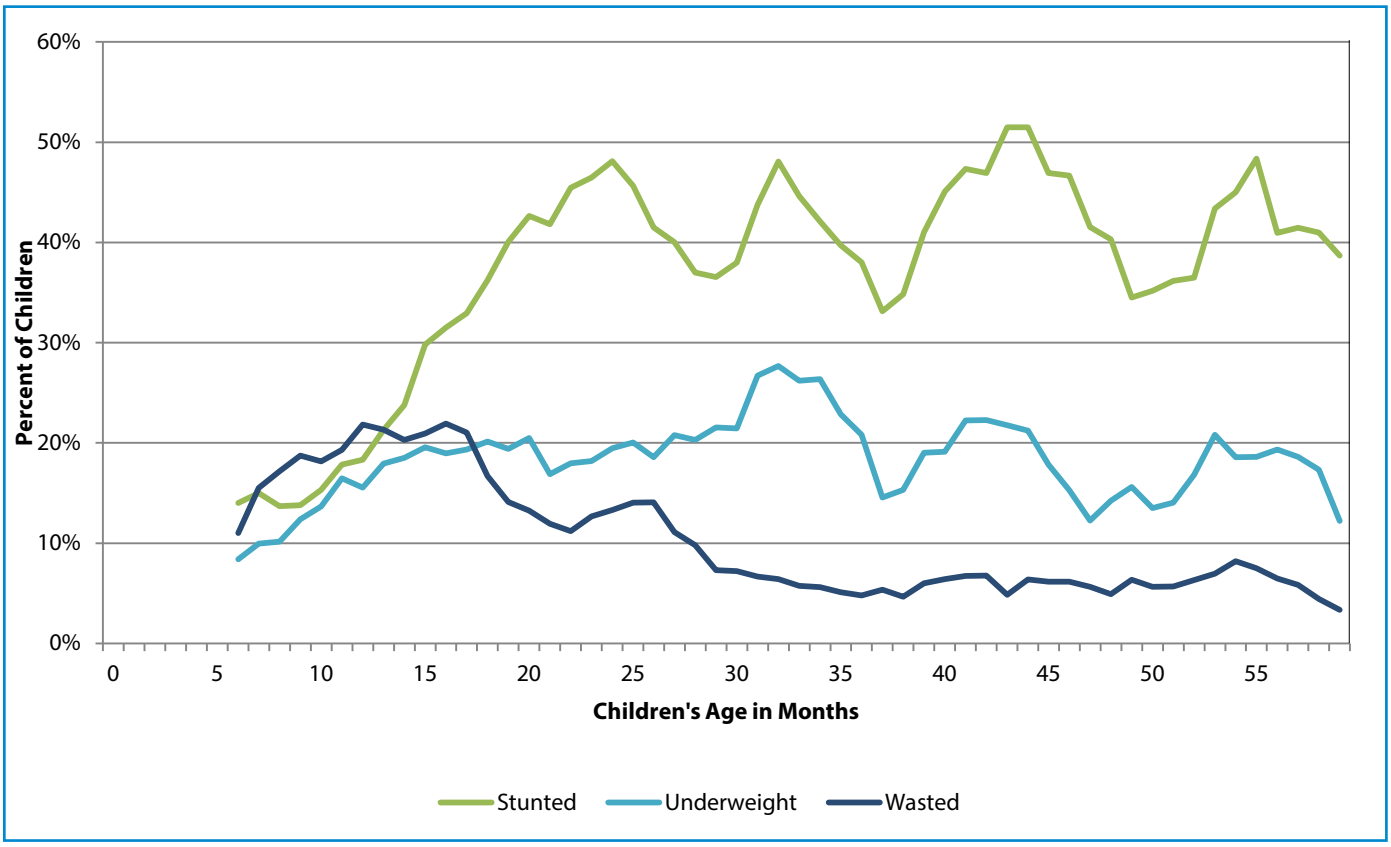
contribution for "Male and Female Adults" households is 10.5 percent, but their relative contribution is 95.3 percent.

Wasting children are more prevalent in Northern (12.8 percent) and Upper East (11.9 percent) Regions. The prevalence rates in Brong Ahafo and Upper West are only 5.4 percent and 5.8 percent, respectively. Northern Region has the largest absolute and relative contribution – an absolute contribution of 8.0 percent and a relative contribution of 72.8 percent. The prevalence rates differed statistically between the regions with the exception of between Northern and Upper East and between Brong Ahafo and Upper West. The prevalence rate for wasting children in urban areas is approximately 12.0 percent, which is higher than the 10.8 percent for rural areas. This was a reversal of the comparison between urban and rural of prevalence rates of underweight and stunting children. However, the difference between the prevalence rates of wasted children in rural and urban locales is not statistically significant. The absolute contribution for rural areas to wasting children is approximately 9.0 percent while their relative contribution is nearly 78.9 percent.

The Prevalence of Malnutrition by Age

The six-month moving average of the mean of the malnutrition indicators for the 0-59 month old children is presented in Figure 29. It shows that average prevalence of stunted children increases very rapidly in the first two years of the children's life while the average prevalence of underweight children and wasted children increase in the 18 months and the first year of the children's life, respectively, but not as rapidly as average prevalence of stunted children. Additionally, while the moving average of the prevalence of wasted children declines with the age of the children, the average prevalence of stunted and underweight children seem to persist at maximum levels. These suggest that while wasted-related problems may be addressed effectively with time, underweight and stunted problems may be more challenging to address. Indeed, Esfarjani et al. (2013) show that birth weight, maternal age and father's height are major contributing factors to stunting for first graders in Teheran, Iran. Mani (2012) notes that intervention at early ages and increasing access to health services can contribute to larger recovery of stunting.

Figure 29: Six-Month Moving Average of the Percentage of Qualifying Children in Each Malnutrition Indicator by Age for the ZOI



Household Hunger Scale

The Household Hunger Scale (HHS) facilitates cross-cultural equivalency in food-insecure areas. The indicator measures the quantity, and not the quality, of food accessible to a household. Two types of indicators, a categorical HHS indicator and a median HHS, can be constructed from the HHS.[11]

The categorical HHS indicator consists of three categories based on the value of the HHS score as follows:

- 0-1: Little to no hunger in the household;
- 2-3: Moderate hunger in the household; and
- 4-6: Severe hunger in the household.

In this study, the moderate and severe hunger categories are combined into a single category. To estimate the HHS, a household member is asked a series of questions about food accessibility and the frequency of food insecure situations over a 4-week or 30-day recall period. Frequent occurrence of food insecure situations is associated with increasing severity of food insecurity or hunger within the household. A total of 4,398 households were interviewed for the HHS indicator, representing a 99.7 percent response rate.

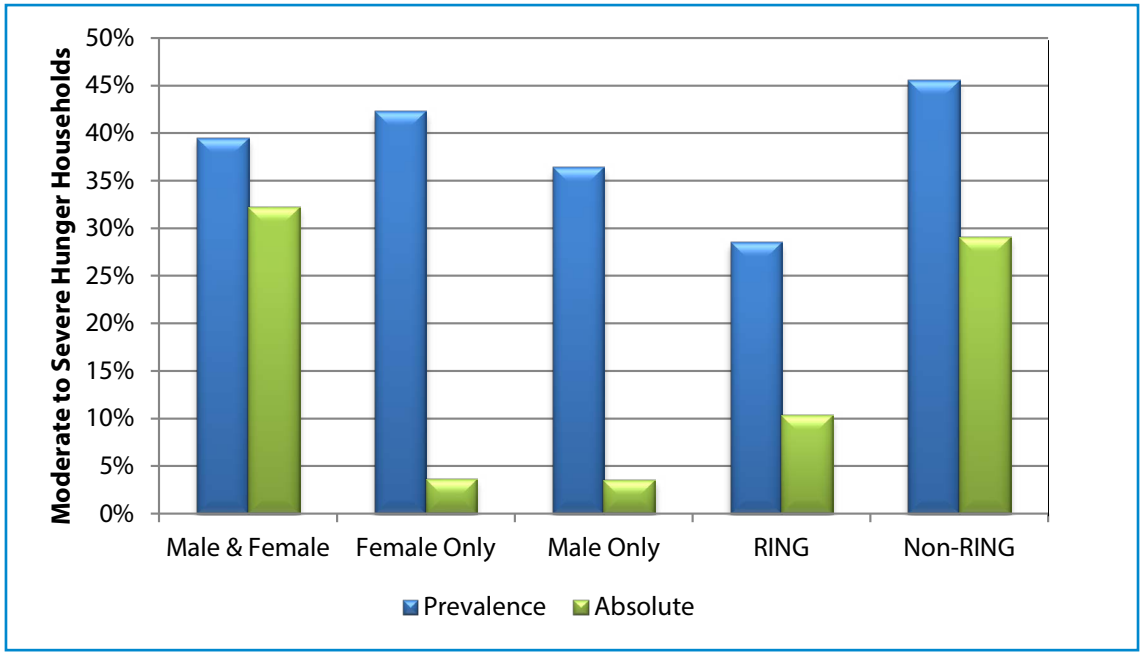
The overall prevalence rate of households with moderate to severe hunger in the ZOI is 39.4 percent. The estimated population of households with moderate to severe hunger in the ZOI is 370,223. Figure 30 shows the prevalence rates for household hunger by gendered household type and strata. "Female Adult Only" households have the highest prevalence rate at 42.3 percent, followed by "Male and Female Adults" households at 39.5 percent. "Male Adult Only" households' prevalence rate is estimated at 36.4 percent. The prevalence rates for the different gendered households are not statistically different from each other. The absolute contribution for "Male and Female Adults" households is 32.2 percent, but their relative contribution is 81.8 percent. The relative contribution of "Female Adult Only" and "Male Adult Only" households to the prevalence of hunger is approximately 9.2 and 9.1, respectively.

The prevalence rate in the RING Zone is 28.5 percent compared to 45.6 percent in the Non-RING Zone. The difference between the prevalence rates in the two strata is determined to be statistically significant at the 1 percent level. The absolute and relative contribution of the Non-RING Zone is 29.1 percent and 73.9 percent, respectively. The results show that rural households are more likely to experience moderate to severe hunger than urban households, with the prevalence rate in rural at 43.3 percent and urban at 28.1 percent. The difference between the prevalence rates in these two locales is statistically significant at the 1 percent level. The absolute and relative contribution of rural households to moderate to severe hunger is 32.4 percent and 82.0 percent, respectively.

Within the four regions, Brong Ahafo had the lowest prevalence rate (26.5 percent) while Upper East had the highest rate (59.7 percent). The prevalence rates for Northern and Upper West are 31.1 and 57.5 percent, respectively. Although Northern Region has the second lowest prevalence rate, its relative contribution to households with moderate to severe hunger is the largest at 40.9 percent. It also has the largest absolute contribution of 16.1 percent. The differences between the four regions are statistically significant at the 1 percent level except for the differences between Brong Ahafo and Northern and between Upper East and Upper West.

11 Ballard et al. (2011) state that the HHS score is not recommended for analysis, e.g., t-tests, because of the fact that the HHS is not generally normally distributed.

Figure 30: Prevalence of and Absolute Contribution to Households with Moderate to Severe Hunger by Gendered Household Type and Strata (N=4,398)



Women's Empowerment in Agriculture Index (WEAI)

The role of women in the economic, social, and cultural life of communities is referenced numerous times in the preceding pages of this report. Page and Czuba (1999) envisage empowerment as a multidimensional social process that enables individuals and/or groups to gain control over their own lives and livelihoods. They argue that empowerment stimulates people to help them shape their own destinies. The Women's Empowerment in Agriculture Index (WEAI), developed recently by USAID, International Food Policy Research Institute (IFPRI) and the Oxford Poverty and Human Development Initiative (OPHI), facilitates the monitoring, evaluation and diagnoses of the empowerment of women in the agricultural sector. The WEAI recognizes and leverages the multidimensionality of empowerment in its conceptualization and construction.

The WEAI is constructed using two weighted sub-indexes developed by Alkire et al. (2013): (i) The Five Domain Empowerment (5DE) Index; and (ii) The Gender Parity Index (GPI).[12] Both components range from zero to one and higher values indicate a greater level of empowerment. The WEAI is formally calculated as:

$$WEAI = \alpha(5DE) + (1-\alpha)(GPI) \tag{16}$$

Initial analyses of the WEAI have placed 90 percent of the weight (α) on the 5DE Index and the remainder on the GPI. The 5DE Index is based on the Alkire-Foster methodology, and it constructs an empowerment score for each woman in the sample (Alkire-Foster, 2007). The score is a summation of the level of achievement in 10 indicators grouped into five domains: production, resources, income, leadership, and time (Table 11). Specific questions relating to each indicator have been developed with closed-ended scaled qualitative responses.

Table 11: Composition of the 5DE Index and Weights

Domain	Indicators	Weight
Production	Input in productive decisions	1/10
	Relative autonomy in production	1/10
Resources	Ownership of land and assets	1/15
	Decisions on the purchase, sale, or transfer of assets	1/15
	Access to decisions about credit	1/15
Income	Control over use of income	1/5
Leadership	Group membership	1/10
	Speaking in public	1/10
Time	Workload	1/10
	Leisure	1/10

Source: Alkire (2013)

The production domain measures if a woman has sole or joint decision making over agricultural practices, as well as relative autonomy in agricultural production decisions. The resources domain is divided into ownership of agricultural and non-agricultural household assets, access to these resources, and the individual's role, participation and power in decisions about the purchase or sale of these assets, and access to and decisions about credit. The income domain measures control over income and expenditures generated from food crops, cash crops, livestock production, non-farm activities, wage and salary work, and fish culture. Women's income is compared relative to men's income. The leadership domain measures membership in community organizations and an individual's comfort level for public speaking. The time domain measures the allocation of time to productive and domestic tasks and satisfaction with available time for leisure activities. The time indicator is derived from a detailed 24-hour time allocation recall module.

12 For a full discussion of the WEAI and numerous case studies from different countries, please visit the IFPRI website (http://www.ifpri.org/publication/women-s-empowerment-agriculture-index).

The response to each question (a "sub-indicator") is compared against pre-defined cut-off values and then aggregated into to the indicator level. The responses from each question are used to determine whether "adequacy" has been achieved. The definition of "adequacy" varies depending upon the sub-indicators used to construct the higher-level indicator. Overall, a person is defined as "empowered" if he or she has achieved adequacy in four of the five domains defined in Table 11.

The 5DE Index summarizes either "empowerment" or "disempowerment" and can be constructed to measure the magnitude of either dimension. While the interest is in empowering individuals, it is more instructive to view disempowerment and target the sources of disempowerment through policy or project interventions. Following Alkire et al. (2013), the disempowerment index (M_0) is calculated as the product of the headcount ratio of those who are disempowered, H_p, and the intensity of disempowerment, A_p, i.e.:

$$M_0 = H_p A_p \tag{17}$$

The headcount ratio is calculated as the percentage of the population that is considered "disempowered" according to the series of questions described above, and A_p is the weighted average inadequacy score of disempowered individuals. An individual is considered "disempowered" if his or her inadequacy score is greater than 20 percent. The average inadequacy scale measures the intensity of disempowerment or the gap. Calculation of A_p is described in Alkire et al. (2013). Finally the 5DE Index measure is calculated as:

$$5DE = 1 - M_0 \tag{18}$$

The 5DE Index measure can be calculated across the entire sample (or sub-samples) of men and women who completed the survey.

The second component of the WEAI is the GPI, and it is used to measure the relative difference between the 5DE Index measure of a man and woman in the same household. It is based on the Foster-Greer-Thorbeck Poverty Gap and is calculated in a similar manner to the 5DE Index (Foster et al., 1984). The GPI is formulated as:

$$GPI = 1 - H_{GPI} I_{GPI} \tag{19}$$

where H_{GPI} measures the proportion of households in which the female does not achieve gender parity with her male counterpart, and the I_{GPI} measures the average empowerment gap between men and women who have not achieved gender parity in the household. As described above, the overall WEAI measure only places a 10 percent weight on the GPI.

Data were collected to calculate adequacy in each of the five domains of production, resources, income, leadership, and time to calculate the 5DE Index measure. Despite having a total sample size of 7,091 male and female respondents eligible to participate in the WEAI survey module, only 4,990 respondents, comprising 2,316 females and 2,674 males, completed all of the questions. To calculate the GPI, responses from both genders within the same household are required. The survey sample had 2,556 households where both a male and a female were present; however, only 1,602 households completed all of the modules for the female and male components. Thus, approximately three times more estimates of the 5DE Index than of the GPI were generated.

WEAI Results in the Ghana ZOI

Table 12 presents results that are comparable with the pilot studies reported in Alkire et al. (2013). The results of the WEAI for rural women were calculated with STATA code developed by the WEAI development team. The results show that 72.5 percent of the women in the ZOI are disempowered. Tests of independence between adequacy counts and gender were rejected for all sub-indices except for "satisfaction with the time available for leisure activities" (Figure 31). The average inadequacy score of disempowered women is about 41.0 percent, indicating that despite the high disempowerment among these women, they experience adequate achievement in about 59.0 percent of the domains in the 5DE Index. On average, 81.1 percent of the women are experiencing

Table 12: WEAI and Related Indices in the ZOI of Ghana*

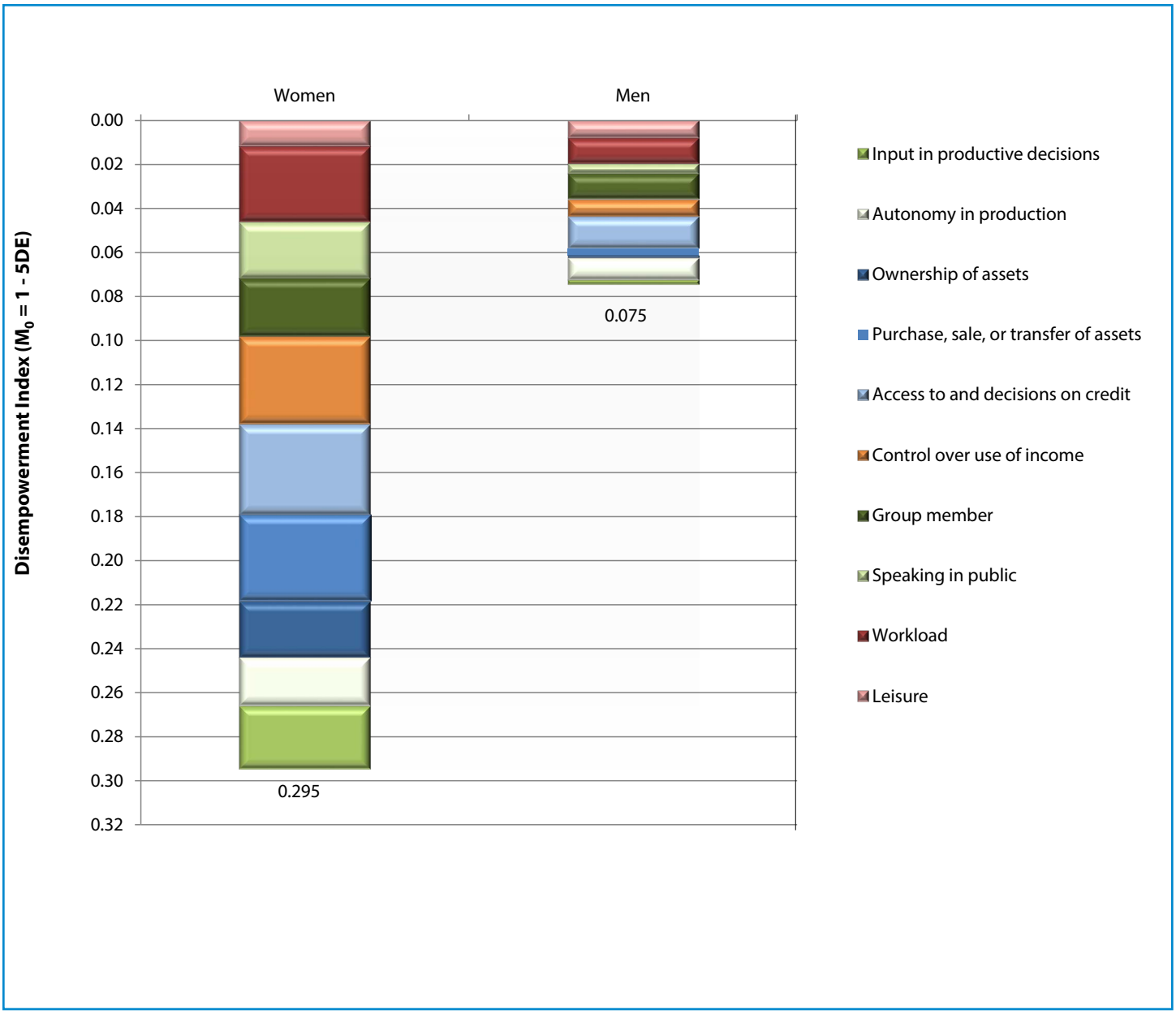
Indexes	Zone of Influence	
	Women	Men
Disempowered Headcount (H)	72.50%	26.90%
Average Inadequacy Score (A)	40.90%	32.30%
Disempowerment Index (M_o)	0.297	0.087
5DE Index ($1-M_o$)	0.703	0.913
Number of Observations	2,316	2,674
Percentage of Data Used	67.20%	73.40%
Percentage of Women with No Gender Parity (H_{GPI})	70.40%	
Average Empowerment (I_{GPI})	26.80%	
Gender Parity Index (GPI)	81.10%	
Number of Women in Dual Households	2,556	
Percentage of Data Used	63.00%	
WEAI	0.714	

* Indices are calculated based on weighted samples.

gender disparity and the average empowerment gap is 26.8 percent. Using the weight distribution above and the estimates of GPI and 5DE Index, the average WEAI for the sample is estimated at approximately 0.71.

Since the WEAI is multidimensional, interventions to empower women (or other groups) can be targeted in several areas. Many of the dimensions of the index are culturally defined or culturally influenced while others can be targeted through public policy. For example, if the workload of women is a large contributor to disempowerment, then labor saving innovations could alter this dynamic. Through the provision of public services such as electricity to reduce the burden of fuel wood collection or through the provision of water in the homes, women's workload in this sense may be reduced significantly to address some of the imbalance. Similarly, public policy interventions relating to asset ownership, titling, and access to credit could also be used to address empowerment gaps emanating from asset ownership, credit, and purchase and sale of assets. Figure 31 illustrates the multidimensionality of women empowerment and underscores the criticality of framing solutions using public and business policies that specifically seek to eliminate gaps that adversely affect the economic and social well-being of women.

Figure 31: Contribution of Each Indicator to Disempowerment in the ZOI



Summary of Indicators and Conclusions

The purpose of this report was to estimate and present the required indicators of the Feed the Future Initiative in Ghana, without a lot of commentary. The estimates are derived from a population-based survey conducted in the ZOI defined for USAID's interventions in Ghana, essentially the area above the 8th Parallel, covering 45 administrative districts in four regions: Brong Ahafo, Northern, Upper East and Upper West. The total population of the ZOI is estimated in the 2010 Ghana Census at 4.93 million, and this survey extrapolates to an estimated 5,161,755 people in 2012. The ZOI is important because despite Ghana's progress in all metrics of the HDI, various studies have shown that the gains are hardly uniform, and the populations in the ZOI tend to be the least affected by the progress that is being observed across the country.

The indicators of interest in this report emanate from the Country Strategy for Ghana, the focus of which may be organized into three intermediate results: (1) Increasing the competitiveness of food value chains for maize, rice, and soybeans; (2) Improving the resiliency of vulnerable households and communities; and (3) Improving the nutritional status of women and children. This report has provided the baseline estimates for the relevant indicators for each of these intermediate results to facilitate tracking the performance and evaluating the impacts of interventions that are currently being implemented or planned for implementation in the future. It has also provided these indicators, to the extent feasible by the data, for the different disaggregates – RING/Non-RING, Gendered Households, Locales, and etc.

The data used in the estimation of the results in this report were collected using a structured questionnaire in a population-based survey conducted in July and August of 2012. The number of households in the survey sample was 4,410 households, and there were a total of 24,860 individual respondents.

The demographic analysis showed that females accounted for 49.5 percent of the sample. However, this proportion was determined to be statistically different from the 50.5 percent of the population accounted for by males. The median age of sample population is 17 years and the average age is 22.9 years, with a standard deviation of 19.6 years. Although numerous ethnic groups are represented in the sample, 58.0 percent of respondents are Mole-Dagbanis, with the second largest group, the Gurma, accounting for only 18.0 percent. The sample's households are predominantly "Male and Female Adults" (92.0 percent) with an average household size of about six people. Eighty-five percent of the sample population has not received any formal education, although 52.0 percent of all respondents indicated being currently in school. Nearly 49.0 percent of respondents indicated being Muslims, with the remainder divided between Christianity and traditional religions. The principal crop planted in the ZOI is maize, however 25.0 percent of respondents did not cultivate any of the three target crops in the year before the survey.

Table 13 presents the summary of all the indicators, their disaggregate levels, and the weighted sample populations.[13] It shows that overall prevalence rate of poverty as measured by the proportion of the population living below $1.25 per day is 22.2 percent. However, more than one-quarter of "Male and Female Adults" households are living below $1.25/day. This contrasts with "Female Adult Only" and "Male Adult Only" households with 5.7 percent and 10.8 percent, respectively. The average daily per capita expenditure for "Male Adult Only" households is $9.58, about three times the value for "Male and Female Adults" households and about twice that of "Female Adult Only" households. The average per capita expenditure of the ZOI is $4.01.

The average number of food groups consumed by women of reproductive age is 4.0, with rural women consuming fewer number of food groups than their urban counterparts. Given their lower dietary diversity, this may be evidence that they have lower average nutritional status. The prevalence of underweight women in the child-bearing age group is about 12.0 percent in the ZOI. Given the weighted population of women of child-bearing age of about 1.08 million, this would imply that the estimated number of underweight women in the ZOI is approximately 130,000.

13 A set of tables providing summaries of the prevalence rates as well as the relative contributions of the different disaggregate variables to the different indicators is presented in Appendix C.

Table 13: Summary of the Prevalence Rates of Selected Indicators

Indicators	Disaggregate Level	Prevalence Rate	Standard Error*	Estimated Population
Prevalence of Poverty: Percent of people living on less than $1.25/day	Overall Prevalence	22.20%	0.02	5,161,715
	Male & Female Adult	25.41%	0.02	4,749,086
	Female Adult Only	10.79%	0.02	250,437
	Male Adult Only	5.74%	0.01	162,192
Per capita expenditures of USG targeted beneficiaries	Overall Prevalence	$4.01	0.18	5,161,715
	Male & Female Adults	$3.23	0.12	4,749,086
	Female Adult Only	$5.01	0.36	250,437
	Male Adult Only	$9.58	0.80	162,192
Prevalence of underweight women	Overall Prevalence	12.01%	0.01	1,083,155
Women's Dietary Diversity: Mean number of food groups consumed by women of reproductive age	Overall Mean	4.00	0.06	1,083,155
	Rural Mean	3.80	0.06	808,982
	Urban Mean	4.58	0.11	274,173
Prevalence of exclusive breastfeeding of children under six months of age	Overall Prevalence	60.52%	0.03	74,335
	Males	62.10%	0.05	38,222
	Females	58.89%	0.04	36,113
Prevalence of children 6-23 months receiving a minimum acceptable diet (MAD)	Overall Prevalence	15.54%	0.02	185,759
	Males	13.01%	0.02	96,049
	Females	18.18%	0.03	89,710
Prevalence of underweight children under five years of age	Overall Prevalence	18.41%	0.01	729,230
	Males	18.16%	0.01	362,133
	Females	18.65%	0.02	367,097
Prevalence of stunted children under five years of age	Overall Prevalence	36.08%	0.02	729,230
	Males	38.16%	0.02	362,133
	Females	34.03%	0.02	367,097
Prevalence of wasted children under five years of age	Overall Prevalence	10.99%	0.01	729,230
	Males	11.34%	0.01	362,133
	Females	10.65%	0.01	367,097
Prevalence of households with moderate or severe hunger	Overall Prevalence	39.43%	0.02	938,939
	Male & Female Adults	39.50%	0.02	765,531
	Female Adult Only	42.26%	0.04	81,761
	Male Adult Only	36.41%	0.03	91,647
Women's Empowerment in Agriculture Index (WEAI)	5DE	0.703	—	5,161,715
	GPI	0.811	—	5,161,715
	WEAI	0.714	—	5,161,715

* Standard Error of the prevalence rates. Appendix D contains the sampling error measures for all the indicators except WEAI.

More than 60.0 percent of children younger than six months of age are exclusively breastfed, and this is higher among male children. The prevalence of underweight children younger than 60 months of age is about the same between male and female children, but stunting and wasting are higher among males. A higher proportion of female children between the ages of 6 and 23 months of age are also estimated to be receiving the minimum acceptable diet compared to male children, but overall the prevalence of children aged 6-23 months who receive a minimum acceptable diet is only 15.5 percent.

Moderate to severe hunger is more prevalent in "Female Adult Only" households when compared to "Male Adult Only" households. The 5DE Index of the WEAI is 0.70; the GPI is 0.81. This yields a WEAI of 0.71.

The current and planned intervention initiatives should use the reported baseline indicators in this report as a frame of reference to assess and evaluate the impact of their outcomes and their contributions to achieving the stated objectives of the Feed the Future programs in Ghana. Providing these *raw* results also allow implementing partners to focus on discovering the factors that may contribute to these results and should contribute to effective execution of the planned and ongoing interventions. The results should contribute to effective evaluation of project performance in ongoing and planned interventions.

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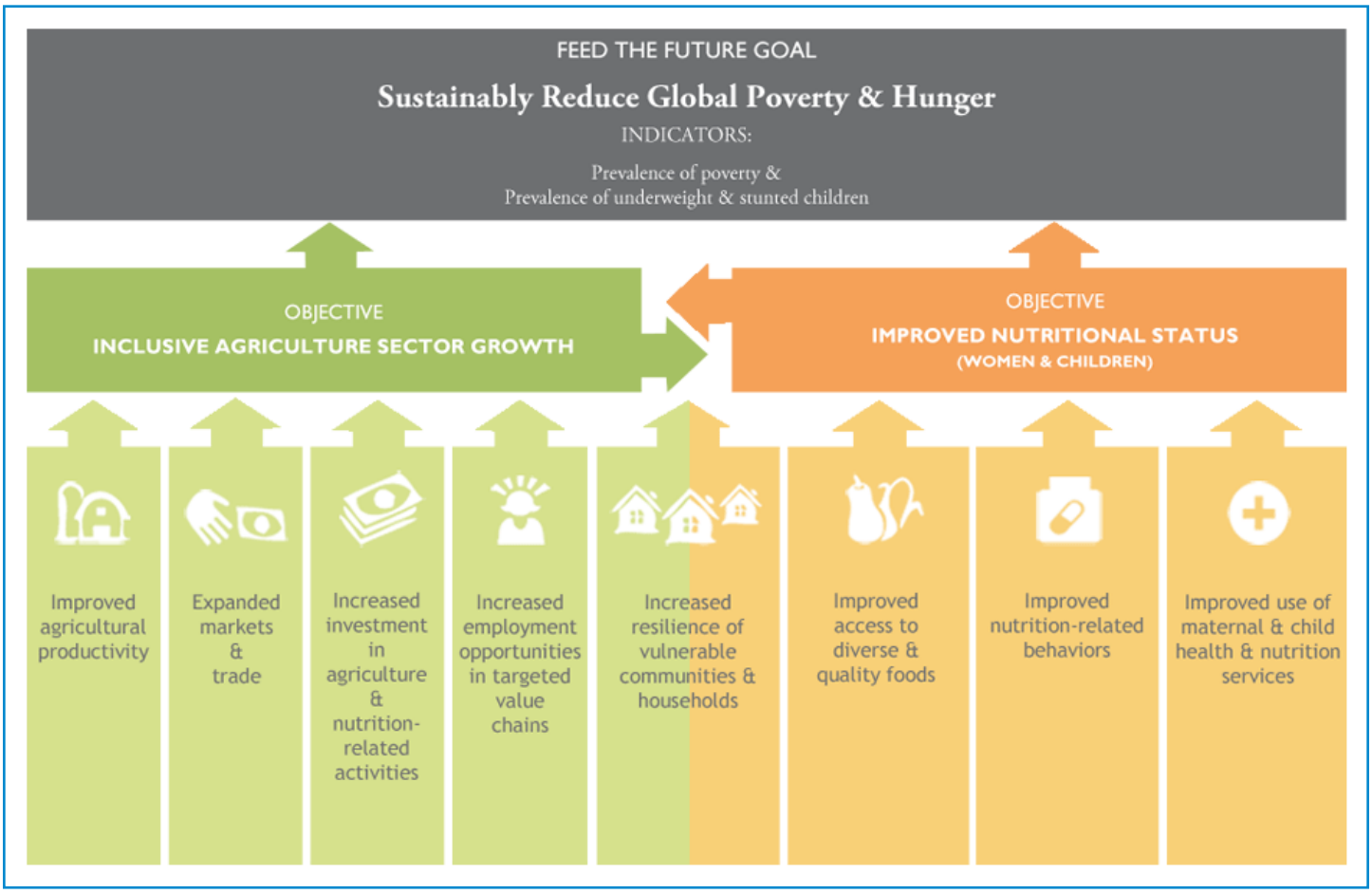
Appendix A: The Feed the Future Results Framework

The overall goal of the Feed the Future Initiative is to sustainably reduce global poverty and hunger by working closely with the focus-countries. There are two principal objectives underscoring this overall goal: (1) Inclusive agricultural sector growth; and (2) Improved nutritional status for women and children.

Figure A.1: Feed the Future Results Framework



Source: USAID, 2013

Appendix B: Outliers in the Women Anthropometry Analysis

Table B.1, below, presents the weight, height and BMI of respondents who were treated as outliers in the analysis of women's anthropometry. Observation 1 was treated as an error given that the weight of the individual was recorded as 12.5 kg and her height was 88 cm.

Table B.1: Excluded Observations from Women's Anthropometry Analysis

Number	Weight (kg)	Height (cm)	BMI (kg/m^2)
1	12.50	88.00	16.14
2	102.80	157.50	41.44
3	63.40	123.50	41.57
4	89.30	146.00	41.89
5	78.90	137.20	41.91
6	92.60	147.20	42.74
7	53.00	111.00	43.02
8	120.80	167.00	43.31
9	53.70	107.20	46.73
10	68.00	120.00	47.22
11	123.45	159.45	48.56
12	123.45	158.00	49.45
13	146.00	155.25	60.57
14	155.10	159.80	60.74
15	155.20	159.50	61.01
16	155.00	156.70	63.12
17	164.00	160.15	63.94
18	149.70	151.00	65.66
19	158.30	155.25	65.68
20	170.40	160.50	66.15
21	65.00	98.00	67.68
22	177.90	161.80	67.95
23	165.00	155.25	68.46

The summary statistics of these outliers are presented in Table B.2 for information and illumination on the potential effect of the excluded data on the underweight women indicator. Because the only data point that would have been considered underweight was the one that was treated as an error, the exclusion of these observations present no adverse effect on the prevalence of underweight women value. The projected excluded population is only an approximate 6,300 in an estimated population of 1.08 million.

Table B.2: Summary Statistics for Outlier Data

Variables	Mean	Standard Deviation	95% Confidence Interval	
			Lower	Upper
Weight (kg)	104.80	10.10	83.60	126.00
Height (cm)	142.10	6.80	127.70	156.50
BMI (kg/m^2)	49.70	2.40	44.70	54.70

Appendix C: Summary Results for All Indicators, Showing Disaggregated Results Presenting Statistically Significant Differences

Presented in the next several pages are the prevalence of all the indicators as well as the relative contributions of the disaggregated levels to each indicator. The estimated populations for each of the indicators are also presented. These estimates represent the projected number of people at each level of disaggregation characterized by the indicator in question. For example, in Table C.2, the total population of "Male and Female Adults" households is estimated at 4.75 million. The prevalence rate is 25.4 percent, resulting in the estimated population of people in "Male and Female Adults" households who are living below the poverty line of $1.25 per day as approximately 1.21 million.

Additionally, these tables show the indicators within each level of disaggregation that are significantly different from each other at the 5 percent or higher significance level. Please note that when two numbers within the same group of disaggregated variables have the same superscript, it means they are significantly different from each other. For example, in Table C.1, the daily per capita expenditures for all three disaggregated levels under Gendered Households are statistically different from each other.

Table C.1: Real Daily Expenditure per Capita by ZOI, Strata, Gendered Household Types, Locale, and Region in 2010 Constant US$

Disaggregating Variable	Disaggregated Level	Daily Per Capita Expenditure ($/Capita/Day)	Estimated Population
	ZOI	4.01	5,161,715
Strata	RING	3.54	1,957,201
	Non-RING	4.27	3,204,514
Gendered Households	Male & Female	3.23[a]	4,749,086
	Female Only	5.01[a]	250,437
	Male Only	9.58[a]	162,192
Locale	Rural	3.38[a]	4,018,705
	Urban	5.88[a]	1,143,010
Region	Brong Ahafo	6.39[a,b,c]	617,809
	Northern	3.71[a]	2,915,891
	Upper East	3.34[b]	933,614
	Upper West	3.36[c]	694,402

Table C.2: Poverty Indicator Prevalence and Relative Contributions to Poverty by ZOI, Strata, Gendered Households, Locale, and Region

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	22.20	100.00	1,537,309
Strata	RING	22.94	37.38	628,141
	Non-RING	21.77	62.62	909,168
Gendered Households	Male & Female	25.41[a]	93.21	1,474,356
	Female Only	10.79[a]	4.24	39,348
	Male Only	5.74[a]	2.54	23,605
Locale	Rural	25.94[a]	87.31	1,340,193
	Urban	11.14[a]	12.69	197,116
Region	Brong Ahafo	6.06[a]	4.24	44,988
	Northern	21.58[a,b]	50.47	854,883
	Upper East	28.07[a]	23.53	321,485
	Upper West	34.65[a,b]	21.76	315,953

Table C.3: Poverty Gap Index and Relative Contributions to Poverty Gap Index by ZOI, Strata, Gendered Households, Locale, and Region

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	6.72	100.00	1,537,309
Strata	RING	6.92	37.25	628,141
	Non-RING	6.60	62.75	909,168
Gendered Households	Male & Female	7.75[a,b]	93.94	1,474,356
	Female Only	2.97[a]	3.86	39,348
	Male Only	1.50[b]	2.19	23,605
Locale	Rural	8.03[a]	89.34	1,340,193
	Urban	2.83[a]	10.66	197,116
Region	Brong Ahafo	1.41[a,b,c]	3.27	44,988
	Northern	6.69[a]	51.69	854,883
	Upper East	9.17[b]	25.41	321,485
	Upper West	9.46[c]	19.63	315,953

Table C.4: Severity of Poverty and Relative Contributions to Severity of Poverty by ZOI, Strata, Gendered Households, Locale, and Region

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	3.00	100.00	1,537,309
Strata	RING	2.96	35.71	628,141
	Non-RING	3.02	64.29	909,168
Gendered Households	Male & Female	3.49[a,b]	94.83	1,474,356
	Female Only	1.14[a]	3.31	39,348
	Male Only	0.56[b]	1.86	23,605
Locale	Rural	3.64[a]	90.80	1,340,193
	Urban	1.09[a]	9.20	197,116
Region	Brong Ahafo	0.47[a,b,c]	2.44	44,988
	Northern	2.96[a]	51.25	854,883
	Upper East	4.40[b]	27.37	321,485
	Upper West	4.07[c]	18.94	315,953

Table C.5: Prevalence of Underweight Women and Relative Contributions to Underweight Women's Prevalence by ZOI, Strata, Gendered Households, Locale, and Region

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	12.01	100.00	130,087
Strata	RING	10.50	33.06	43,573
	Non-RING	12.93	66.94	86,382
Gendered Households	Male & Female	12.12	93.67	122,109
	Female Only	10.63	6.33	8,009
Locale	Rural	12.86[a]	80.10	104,015
	Urban	9.49[a]	19.90	26,024
Region	Brong Ahafo	8.03[a]	8.74	11,489
	Northern	10.04[b]	47.38	61,917
	Upper East	20.50[a,b]	29.48	37,912
	Upper West	13.24	14.32	18,341

Table C.6: Prevalence of Women with Low Dietary Diversity and Relative Contributions to the Prevalence of Women with Low Dietary Diversity by ZOI, Strata, Gendered Households, Locale, and Region

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	40.49	100.00	438,569
Strata	RING	39.10	37.29	162,216
	Non-RING	41.40	62.71	276,668
Gendered Households	Male & Female	40.29	92.68	406,047
	Female Only	43.28	7.32	32,609
Locale	Rural	45.80[a]	84.81	370,514
	Urban	24.60[a]	15.19	67,447
Region	Brong Ahafo	39.67[a]	12.51	56,733
	Northern	37.10[b]	53.03	228,784
	Upper East	51.14[a,b]	21.02	94,585
	Upper West	42.82	13.45	59,314

Table C.7: Prevalence of Exclusively Breastfed Children and Relative Contributions to Exclusively Breastfed Children's Prevalence by ZOI, Strata, Gendered Households, Locale, Region, Children's Gender and their Age

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	60.52	100.00	44,988
Strata	RING	66.46	40.44	18,606
	Non-RING	57.06	59.56	26,441
Gendered Households	Male & Female	61.55	94.99	43,025
	Female Only	45.98	5.01	2,039
Locale	Rural	58.62	78.49	34,855
	Urban	68.66	21.51	10,214
Region	Brong Ahafo	54.27	10.71	4,939
	Northern	67.02[a,b]	69.66	31,049
	Upper East	49.09[b]	12.15	5,391
	Upper West	44.52[a]	7.49	3,528
Child's Gender	Male	62.10	52.22	23,736
	Female	58.89	47.78	21,267
Child's Age (in Months)	0 to 1	75.48[a]	29.75	13,165
	2 to 3	66.47[b]	41.70	18,632
	4 to 5	45.25[a,b]	28.54	13,061

Table C.8: Prevalence of Children Receiving Minimum Acceptable Diet and Relative Contributions to the Prevalence of Children Receiving Minimum Acceptable Diet by ZOI, Strata, Gendered Households, Locale, Region, Children's Gender and their Age

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	15.54	100.00	28,867
Strata	RING	17.01	45.42	13,273
	Non-RING	14.49	54.58	15,610
Gendered Households	Male & Female	15.11	91.00	26,344
	Female Only	22.08	9.00	2,484
	Male Only	0.00	0.00	-
Locale	Rural	15.09	80.17	22,860
	Urban	17.64	19.83	6,045
Region	Brong Ahafo	16.44	16.70	4,815
	Northern	13.85	52.84	15,305
	Upper East	13.22	12.79	3,687
	Upper West	27.73	17.67	5,012
Child's Gender	Male	13.01	42.78	12,496
	Female	18.18	57.22	16,309
Child's Age (in Months)	6 to 11	8.51[a,b]	19.77	5,541
	12 to 17	19.71[a]	54.14	15,507
	18 to 23	19.11[b]	26.09	8,021

Table C.9: Prevalence of Underweight Children and Relative Contributions to the Prevalence of Underweight Children by ZOI, Strata, Gendered Households, Locale, Region, Children's Gender and their Age

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	18.41	100.00	134,251
Strata	RING	19.77	43.59	60,487
	Non-RING	17.48	56.41	73,989
Gendered Households	Male & Female	18.45	93.64	126,010
	Female Only	17.53	5.35	6,993
	Male Only	19.72	1.01	1,254
Locale	Rural	19.34[a]	84.71	113,401
	Urban	14.54[a]	15.29	20,774
Region	Brong Ahafo	9.61[a,c]	6.57	8,006
	Northern	21.98[a,b,d]	74.46	102,305
	Upper East	16.84[b,c]	13.05	17,717
	Upper West	10.10[d]	5.91	7,602
Child's Gender	Male	18.16	49.05	65,763
	Female	18.65	50.95	68,464
Child's Age (in Months)	0 to 5	9.83[a,b,c,d]	4.88	7,307
	6 to 11	16.19	7.63	10,542
	12 to 23	20.68[a]	20.20	24,949
	24 to 35	21.00[b]	18.36	22,199
	36 to 47	18.55[c]	25.43	34,281
	48 to 59	18.91[d]	23.50	33,778

Table C.10: Prevalence of Stunted Children and Relative Contributions to the Prevalence of Stunted Children by ZOI, Strata, Gendered Households, Locale, Region, Children's Gender and their Age

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	36.08	100.00	263,106
Strata	RING	38.20	42.97	116,873
	Non-RING	34.63	57.03	146,581
Gendered Households	Male & Female	35.82 [a]	92.76	244,644
	Female Only	34.99 [b]	5.45	13,958
	Male Only	68.42 [a,b]	1.79	4,350
Locale	Rural	38.14 [a]	85.25	223,636
	Urban	27.49 [a]	14.75	39,277
Region	Brong Ahafo	29.92 [a]	10.44	24,926
	Northern	39.22 [a,b]	67.78	182,548
	Upper East	36.15 [c]	14.30	38,033
	Upper West	25.05 [b,c]	7.48	18,854
Child's Gender	Male	38.16	52.58	138,190
	Female	34.03	47.43	124,923
Child's Age (in Months)	0 to 5	16.75 [a,b,c,d]	4.24	12,451
	6 to 11	19.39 [e,f,g,h]	4.66	12,626
	12 to 23	39.39 [a,e]	19.62	47,522
	24 to 35	35.37 [b,f,i]	15.78	37,390
	36 to 47	43.77 [c,g,i]	30.61	80,888
	48 to 59	39.56 [d,h]	25.08	70,663

Table C.11: Prevalence of Wasting Children and Relative Contributions to the Prevalence of Wasting Children by ZOI, Strata, Gendered Households, Locale, Region, Children's Gender and their Age

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	10.99	100.00	80,142
Strata	RING	11.69	43.17	35,766
	Non-RING	10.51	56.83	44,487
Gendered Households	Male & Female	11.22	95.34	76,630
	Female Only	9.13	4.66	3,642
	Male Only	0.00	0.00	-
Locale	Rural	10.76	78.90	63,092
	Urban	11.98	21.10	17,117
Region	Brong Ahafo	5.35[a,b]	6.13	4,457
	Northern	12.83[a,c]	72.80	59,717
	Upper East	11.88[b,d]	15.43	12,499
	Upper West	5.76[c,d]	5.64	4,335
Child's Gender	Male	11.34	51.29	41,066
	Female	10.65	48.71	39,096
Child's Age (in Months)	0 to 5	13.00[a]	10.81	9,664
	6 to 11	21.52[a,b,c,d]	16.99	14,013
	12 to 23	16.46[e,f,g]	26.91	19,858
	24 to 35	7.94[b,e]	11.63	8,393
	36 to 47	7.74[c,f]	17.76	14,304
	48 to 59	7.64[d,g]	15.90	13,647

Table C.12: Prevalence of Households with Moderate to Severe Hunger and Relative Contributions to Households with Moderate to Severe Hunger Prevalence by ZOI, Strata, Gendered Households, Locale, and Region

Disaggregating Variable	Disaggregated Level	Prevalence (%)	Relative Contribution (%)	Estimated Population
	ZOI	39.43	100.00	370,223
Strata	RING	28.50[a]	26.12	96,641
	Non-RING	45.60[a]	73.88	273,531
Gendered Households	Male & Female	39.50	81.75	302,385
	Female Only	42.26	9.21	34,552
	Male Only	36.41	9.05	33,369
Locale	Rural	43.30[a]	82.03	304,326
	Urban	28.10[a]	17.97	66,346
Region	Brong Ahafo	26.50[a,b]	10.38	38,325
	Northern	31.09[c,d]	40.91	151,330
	Upper East	59.74[a,c]	28.42	105,634
	Upper West	57.54[b,d]	20.29	75,230

Appendix D: Estimation of Sampling Errors

By nature, any sample drawn from a population is one of many that could have been drawn using the same design and size. The results produced from each sample could be slightly different from each other. This variability between the estimates from all possible samples is captured by sampling errors, and it can be estimated statistically from the survey data.

Sampling error measures are presented in Tables D.1 to D.10 for each of the Feed the Future indicators except for WEAI. The measures include standard error, relative error, design effect, and confidence limits. The tables also include weighted and unweighted number of cases for each indicator. These measures are calculated at the various selected levels of disaggregation such as strata, region, and locale. They are meant to provide readers with confidence in the reported results.

Table D.1: Sampling Errors: Real Daily Expenditure per Capita in 2010 Constant US$

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	4.0093	0.1752	4,365	4,360	1.9575	0.0437	3.6641	4.3545
Strata	RING	3.5450	0.1600	1,984	1,577	2.0172	0.0451	3.2297	3.8602
	Non-RING	4.2723	0.2599	2,381	2,783	1.7334	0.0608	3.7602	4.7845
Gendered House-holds	Male & Female	3.2286	0.1205	3,628	3,550	2.1383	0.0373	2.9913	3.4660
	Female Only	5.0054	0.3607	329	381	0.7798	0.0721	4.2946	5.7161
	Male Only	9.5844	0.7994	408	429	1.2143	0.0834	8.0092	11.1597
Locale	Rural	3.3762	0.1469	3,280	3,258	2.1643	0.0435	3.0868	3.6656
	Urban	5.8809	0.4198	1,085	1,102	1.4492	0.0714	5.0538	6.7080
Region	Brong Ahafo	6.3860	0.5470	552	678	1.1172	0.0857	5.3082	7.4638
	Northern	3.7114	0.1373	2,630	2,263	1.8803	0.0370	3.4409	3.9818
	Upper East	3.3413	0.3284	722	811	1.4324	0.0983	2.6943	3.9883
	Upper West	3.3612	0.6169	461	608	2.5938	0.1835	2.1456	4.5768

Table D.2: Sampling Errors: Poverty Prevalence

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.2220	0.0151	4,365	4,360	2.3700	0.0678	0.1923	0.2516
Strata	RING	0.2294	0.0239	1,984	1,577	2.5743	0.1042	0.1823	0.2766
	Non-RING	0.2177	0.0193	2,381	2,783	2.2165	0.0885	0.1798	0.2557
Gendered House-holds	Male & Female	0.2541	0.0171	3,628	3,550	2.3545	0.0674	0.2203	0.2879
	Female Only	0.1079	0.0231	329	381	1.3937	0.2143	0.0623	0.1534
	Male Only	0.0574	0.0136	408	429	1.2104	0.2362	0.0307	0.0841
Locale	Rural	0.2594	0.0180	3,280	3,258	2.3427	0.0693	0.2239	0.2948
	Urban	0.1114	0.0152	1,085	1,102	1.5096	0.1367	0.0814	0.1414
Region	Brong Ahafo	0.0606	0.0130	552	678	1.2484	0.214	0.0350	0.0861
	Northern	0.2158	0.0198	2,630	2,263	2.4025	0.0919	0.1767	0.2549
	Upper East	0.2807	0.0316	722	811	1.9735	0.1124	0.2185	0.3429
	Upper West	0.3465	0.0395	461	608	1.7547	0.1139	0.2687	0.4243

Table D.3: Sampling Errors: Women's Anthropometry

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.1201	0.0088	4,120	4,120	1.7680	0.0729	0.1028	0.1373
Strata	RING	0.1050	0.0106	1,940	1,560	1.6127	0.1014	0.0840	0.1258
	Non-RING	0.1293	0.0126	2,170	2,560	1.7351	0.0977	0.1044	0.1542
Gendered House-holds	Male & Female	0.1212	0.0094	3,850	3,820	1.8192	0.0772	0.1027	0.1396
	Female Only	0.1063	0.0209	271	295	1.1287	0.1970	0.0650	0.1474
Locale	Rural	0.1286	0.0111	3,080	3,080	1.8881	0.0860	0.1067	0.1503
	Urban	0.0949	0.0104	1,040	1,040	1.1373	0.1098	0.0744	0.1155
Region	Brong Ahafo	0.0803	0.0160	457	538	1.2823	0.1984	0.0490	0.1120
	Northern	0.1004	0.0090	2,620	2,330	1.5490	0.0891	0.0828	0.1181
	Upper East	0.2050	0.0308	629	711	1.8870	0.1502	0.1445	0.2660
	Upper West	0.1324	0.0236	409	535	1.5066	0.1783	0.0857	0.1786

Table D.4: Sampling Errors: Women's Dietary Diversity Score

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	3.9953	0.0618	4,320	4,330	2.5511	0.0155	3.8736	4.1170
Strata	RING	4.1154	0.0680	2,070	1,670	1.9999	0.0165	3.9815	4.2493
	Non-RING	3.9198	0.0926	2,250	2,660	2.7093	0.0236	3.7373	4.1022
Gendered House-holds	Male & Female	3.9998	0.0639	4,050	4,040	2.5460	0.0160	3.8739	4.1257
	Female Only	3.9350	0.1084	273	297	1.1852	0.0275	3.7215	4.1485
Locale	Rural	3.8017	0.0590	3,250	3,250	2.1599	0.0155	3.6855	3.9180
	Urban	4.5758	0.1104	1,080	1,080	2.3091	0.0241	4.3582	4.7933
Region	Brong Ahafo	3.9915	0.1123	469	553	1.9170	0.0281	3.7703	4.2127
	Northern	4.1255	0.0843	2,800	2,510	2.8216	0.0204	3.9594	4.2916
	Upper East	3.6604	0.1343	642	721	2.1221	0.0367	3.3959	3.9250
	Upper West	3.8450	0.1687	409	551	1.8165	0.0439	3.5125	4.1775

Table D.5: Sampling Errors: Exclusive Breastfeeding

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.6052	0.0304	333	339	1.1415	0.0502	0.5452	0.6652
Strata	RING	0.6646	0.0428	165	125	1.1577	0.0644	0.5801	0.7491
	Non-RING	0.5706	0.0415	168	214	1.0867	0.0727	0.4888	0.6525
Gendered House-holds	Male & Female	0.6155	0.0306	316	316	1.1279	0.0498	0.5550	0.6760
	Female Only	0.4598	0.1376	17	22	1.1180	0.2992	0.1883	0.7314
Locale	Rural	0.5862	0.0349	277	274	1.1957	0.0596	0.5172	0.6551
	Urban	0.6866	0.0525	56	64	0.8037	0.0764	0.5831	0.7902
Region	Brong Ahafo	0.5427	0.1256	31	40	1.3823	0.2314	0.2948	0.7907
	Northern	0.6702	0.0302	235	213	0.9768	0.0450	0.6106	0.7297
	Upper East	0.4909	0.0792	44	51	1.0404	0.1614	0.3344	0.6473
	Upper West	0.4452	0.0960	23	34	0.9085	0.2157	0.2556	0.6348
Child's Gender	Male	0.6210	0.0475	175	172	1.3103	0.0765	0.5272	0.7148
	Female	0.5889	0.0446	158	166	1.1391	0.0758	0.5008	0.6770
Child's Age (in Months)	0 to 1	0.7548	0.0622	82	81	1.3265	0.0824	0.6320	0.8776
	2 to 3	0.6647	0.0569	125	129	1.4379	0.0856	0.5524	0.7771
	4 to 5	0.4525	0.0467	126	129	1.0601	0.1032	0.3604	0.5447

Table D.6: Sampling Errors: Children Minimum Acceptable Diet

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.1554	0.0158	851	848	1.2220	0.1013	0.1245	0.1866
Strata	RING	0.1701	0.0192	431	351	1.0009	0.1126	0.1327	0.2084
	Non-RING	0.1449	0.0230	420	497	1.3441	0.1585	0.0996	0.1902
Gendered House-holds	Male & Female	0.1511	0.0158	807	793	1.1995	0.1042	0.1202	0.1824
	Female Only	0.2208	0.0773	43	54	1.1864	0.3503	0.0684	0.3732
	Male Only	0.0000	.	1	1	.	.	.	.
Locale	Rural	0.1509	0.0172	711	701	1.2350	0.1143	0.1169	0.1849
	Urban	0.1764	0.0379	140	147	1.1318	0.2134	0.1028	0.2521
Region	Brong Ahafo	0.1644	0.0435	100	134	1.1512	0.2644	0.0787	0.2501
	Northern	0.1385	0.0176	562	502	1.1084	0.1270	0.1040	0.1734
	Upper East	0.1322	0.0325	115	128	1.0306	0.2458	0.0682	0.1963
	Upper West	0.2773	0.0697	74	84	1.4152	0.2513	0.1399	0.4146
Child's Gender	Male	0.1301	0.0170	430	433	0.9966	0.1305	0.0968	0.1639
	Female	0.1818	0.0251	421	415	1.2985	0.1380	0.1324	0.2313
Child's Age (in Months)	6 to 11	0.0851	0.0168	315	306	1.0267	0.1968	0.0521	0.1181
	12 to 17	0.1971	0.0275	361	362	1.2736	0.1395	0.1429	0.2513
	18 to 23	0.1911	0.0332	175	179	1.0520	0.1728	0.1266	0.2575

Table D.7: Sampling Errors: Underweight Children

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.1841	0.0131	2,960	2,990	1.8467	0.0712	0.1583	0.2099
Strata	RING	0.1977	0.0135	1,500	1,210	1.3286	0.0683	0.1711	0.2243
	Non-RING	0.1748	0.0204	1,460	1,770	2.0587	0.1165	0.1347	0.2149
Gendered House-holds	Male & Female	0.1845	0.0137	2,800	2,790	1.8717	0.0740	0.1576	0.2114
	Female Only	0.1753	0.0361	134	168	1.1240	0.2060	0.1041	0.2464
	Male Only	0.1972	0.1067	19	28	1.1102	0.5409	-0.0130	0.4074
Locale	Rural	0.1934	0.0152	2,440	2,410	1.9189	0.0784	0.1635	0.2232
	Urban	0.1454	0.0178	513	578	1.1130	0.1221	0.1104	0.1804
Region	Brong Ahafo	0.0961	0.0159	296	376	0.9181	0.1654	0.0648	0.1274
	Northern	0.2198	0.0165	2,030	1,860	1.8426	0.0752	0.1872	0.2524
	Upper East	0.1684	0.0193	382	426	1.0143	0.1146	0.1304	0.2064
	Upper West	0.1010	0.0285	252	322	1.3924	0.2818	0.0449	0.1571
Child's Gender	Male	0.1816	0.0135	1,500	1,480	1.3576	0.0743	0.1550	0.2082
	Female	0.1865	0.0207	1,460	1,500	2.0467	0.1112	0.1456	0.2274
Child's Age (in Months)	0 to 5	0.0983	0.0267	272	273	1.6828	0.2714	0.0457	0.1509
	6 to 11	0.1619	0.0245	284	259	1.1104	0.1515	0.1136	0.2102
	12 to 23	0.2068	0.0245	539	537	1.4094	0.1184	0.1586	0.2551
	24 to 35	0.2100	0.0218	494	481	1.1607	0.1036	0.1671	0.2528
	36 to 47	0.1855	0.0211	728	754	1.4641	0.1138	0.1439	0.2271
	48 to 59	0.1891	0.0269	640	683	1.7626	0.1420	0.1362	0.2421

Table D.8: Sampling Errors: Stunted Children

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.3608	0.0160	2,960	2,990	1.8181	0.0443	0.3293	0.3923
Strata	RING	0.3820	0.0175	1,500	1,210	1.4028	0.0458	0.3476	0.4165
	Non-RING	0.3463	0.0243	1,460	1,770	1.9668	0.0703	0.2984	0.3943
Gendered House-holds	Male & Female	0.3582	0.0172	2,800	2,790	1.9038	0.0480	0.3244	0.3921
	Female Only	0.3499	0.0481	134	168	1.1962	0.1375	0.2551	0.4447
	Male Only	0.6842	0.1463	19	28	1.3352	0.2138	0.3960	0.9725
Locale	Rural	0.3814	0.0170	2,440	2,410	1.7433	0.0445	0.3480	0.4149
	Urban	0.2749	0.0287	513	578	1.4214	0.1043	0.2184	0.3314
Region	Brong Ahafo	0.2992	0.0224	296	376	0.8305	0.0748	0.2552	0.3433
	Northern	0.3922	0.0218	2,030	1,860	2.0243	0.0555	0.3493	0.4350
	Upper East	0.3615	0.0353	382	426	1.4443	0.0977	0.2919	0.4311
	Upper West	0.2505	0.0249	252	322	0.9308	0.0993	0.2014	0.2995
Child's Gender	Male	0.3816	0.0163	1,500	1,480	1.3085	0.0428	0.3494	0.4138
	Female	0.3403	0.0221	1,460	1,500	1.7936	0.0650	0.2967	0.3839
Child's Age (in Months)	0 to 5	0.1675	0.0343	272	273	1.6305	0.2049	0.0999	0.2352
	6 to 11	0.1939	0.0267	284	259	1.1081	0.1378	0.1412	0.2466
	12 to 23	0.3939	0.0331	539	537	1.5918	0.0839	0.3288	0.4590
	24 to 35	0.3537	0.0253	494	481	1.1591	0.0714	0.3039	0.4035
	36 to 47	0.4377	0.0274	728	754	1.4910	0.0625	0.3838	0.4916
	48 to 59	0.3956	0.0269	640	683	1.3938	0.0681	0.3425	0.4487

Table D.9: Sampling Errors: Wasted Children

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.1099	0.0081	0	2,990	1.4190	0.0737	0.0940	0.1259
Strata	RING	0.1169	0.0127	1,500	1,210	1.5370	0.1083	0.0920	0.1419
	Non-RING	0.1051	0.0107	1,460	1,770	1.3557	0.1017	0.0841	0.1262
Gendered House-holds	Male & Female	0.1122	0.0085	2,800	2,790	1.4380	0.0757	0.0954	0.1289
	Female Only	0.0913	0.0263	134	168	1.1037	0.2878	0.0395	0.1431
	Male Only	0.0000	.	19	28	.	.	.	.
Locale	Rural	0.1076	0.0093	2,440	2,410	1.4839	0.0862	0.0893	0.1258
	Urban	0.1198	0.0158	513	578	1.1286	0.1318	0.0887	0.1509
Region	Brong Ahafo	0.0535	0.0147	296	376	1.1868	0.2743	0.0246	0.0824
	Northern	0.1283	0.0099	2,030	1,860	1.3759	0.0774	0.1088	0.1479
	Upper East	0.1188	0.0201	382	426	1.2155	0.1690	0.0792	0.1584
	Upper West	0.0576	0.0194	252	322	1.2268	0.3371	0.0193	0.0959
Child's Gender	Male	0.1134	0.0101	1,500	1,480	1.2620	0.0894	0.0934	0.1334
	Female	0.1065	0.0107	1,460	1,500	1.3130	0.1000	0.0855	0.1274
Child's Age (in Months)	0 to 5	0.1300	0.0264	272	273	1.2953	0.2027	0.0781	0.1819
	6 to 11	0.2152	0.0291	284	259	1.1919	0.1352	0.1579	0.2725
	12 to 23	0.1646	0.0212	539	537	1.3438	0.1289	0.1228	0.2064
	24 to 35	0.0794	0.0138	494	481	1.0850	0.1735	0.0523	0.1066
	36 to 47	0.0774	0.0144	728	754	1.5378	0.1864	0.0490	0.1058
	48 to 59	0.0764	0.0153	640	683	1.5288	0.2003	0.0462	0.1066

Table D.10: Sampling Errors: Household Hunger Scale

		Value (R)	Standard Error (SE)	Number of Cases		Design Effect	Relative Error	Confidence Limits	
				Unweighted	Weighted			R-2SE	R+2SE
	ZOI	0.3943	0.0184	4,388	4,386	2.5048	0.0466	0.3581	0.4305
Strata	RING	0.2850	0.0212	1,995	1,586	2.1166	0.0745	0.2432	0.3268
	Non-RING	0.4560	0.0253	2,393	2,800	2.4787	0.0554	0.4064	0.5060
Gendered House-holds	Male & Female	0.3950	0.0188	3,653	3,580	2.3406	0.0476	0.3579	0.4321
	Female Only	0.4226	0.0390	327	377	1.4314	0.0923	0.3458	0.4994
	Male Only	0.3641	0.0299	408	430	1.2623	0.0820	0.3053	0.4229
Locale	Rural	0.4330	0.0223	3,298	3,280	2.5994	0.0516	0.3888	0.4767
	Urban	0.2810	0.0237	1,090	1,107	1.7511	0.0845	0.2338	0.3272
Region	Brong Ahafo	0.2650	0.0253	552	677	1.3399	0.0956	0.2150	0.3149
	Northern	0.3109	0.0192	2,641	2,277	2.1174	0.0616	0.2731	0.3486
	Upper East	0.5974	0.0305	731	823	1.6717	0.0511	0.5373	0.6575
	Upper West	0.5754	0.0517	464	610	2.2403	0.0898	0.4736	0.6772

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