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Mobile phones, nutrition, and agriculture in Ghana: Quantitative Baseline Report

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International Food Policy Research Institute

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Executive summary

The mNutrition intervention in Ghana

mNutrition is a global initiative supported by DFID, organised by GSMA, and implemented by in-country mobile network operators (MNOs) and third party providers to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. The potential to utilise mobile technology to change attitudes, knowledge, behaviours, and practices around health and agriculture for improved nutritional status has been recognised for some time, but to date there have been no rigorous evaluations of m-services at scale. mNutrition is implemented through existing mAgri and mHealth programmes in 12 countries throughout sub-Saharan Africa and South Asia. The nutrition content aims to promote behaviour change around key farming practices and around dietary and child feeding practices that are likely to result in improved nutritional health within a household. DFID has committed to conducting a rigorous independent impact evaluation of mNutrition. Given budgetary limitations, the decision was made to select two countries for inclusion in the evaluation: the mHealth programme in Tanzania and mAgri programme in Ghana. The mNutrition intervention that is the focus of the evaluation in Ghana and this report is the Vodafone Farmers' Club (VFC) service. The service is a 'bundled solution', offering agricultural and nutrition information through voice and SMS services in addition to free calls to other VFC members. The goal of adding mNutrition messages to VFC is to make the agriculture information platform more nutrition sensitive by providing relevant nutrition information about the crops farmers grow.

The main channels of content delivery are SMS (text messages) for weather and price information and voice messages for agriculture and nutrition information. While SMS is available only in English, voice messages are available in ten local languages. The content for all agricultural messages is provided by Esoko Ghana, a mobile phone-based rural information service. Esoko has worked with GAIN to develop nutrition-related messages around food preparation, food hygiene, safety and storage, and processing of 24 nutritious crops.

Evaluation design

The aim of the impact evaluation is to assess the impact, cost-effectiveness, and commercial viability of mNutrition. The evaluation is being conducted by a consortium of researchers from Gamos, the Institute of Development Studies (IDS), and the International Food Policy Research Institute (IFPRI). The team draws on a number of methods and interlinked components to gather evidence about the impact of the mNutrition intervention in Ghana, including a qualitative component, a quantitative component, and a business model and cost-effectiveness component.

This report focuses on the quantitative component that employs a randomized encouragement design to determine the causal effect of the programme on dietary diversity, agricultural income, and production. Households in study communities that were randomly assigned to the encouragement treatment arm will receive extra encouragement to increase take-up of VFC service; and households in communities that were randomly assigned to the control arm will not receive the extra encouragement activities but will still have access to the VFC service.

The additional marketing and promotion to encourage take-up and continued use was informed by the qualitative study and includes a combination of price discounts, and door-to-door marketing to farmers in selected communities throughout the evaluation period. During the door-to-door marketing, the product was promoted using a short advertisement script on the value added of the service. Households were randomly assigned to receive one of two scripts: (1) a script that focuses

on the agriculture value added of the product (Vodafone's current script), or (2) a script that augments the agriculture focus with additional information about the nutrition value added of the product. Comparing outcomes from the two scripts will inform whether emphasizing the nutrition component of the programme leads to larger changes in impact of the programme on outcomes such as household diets. Last, we randomly targeted either a male or female from each household to receive the advertisement scripts and free subscription to VFC. Comparing outcomes between male- and female-targeted households will inform whether the gender of the person receiving the messages affects the household's utilisation of the information provided.

The quantitative evaluation will answer the following research questions:

1. How effective is the Vodafone Farmers' Club service at increasing the knowledge and changing the behaviour of farmers?
2. What are the impacts of the Vodafone Farmers' Club service on households' dietary diversity, agricultural income, and production?
3. What is the demand for the Vodafone Farmers' Club service and can framing about the agriculture or nutrition objectives of the service affect household's willingness to pay for the service?
4. Does targeting women have differential impacts on knowledge, behaviour, and final outcomes than targeting men with the service?

Baseline data collection

The baseline data collection included two separate exercises: the community listing exercise (CLE) and the baseline household survey. The Institute of Statistical, Social, and Economic Research (ISSER) served as the in-country survey partner leading the CLE and baseline data collection in cooperation with the quantitative evaluation team from IFPRI.

The CLE data collection team interviewed 16,010 households in the 207 selected enumeration areas chosen for the study in the Upper West (UW) and Central regions of Ghana. Of these households, 62 percent were identified as being eligible to participate in the study. The inclusion criteria into the sample was that households must (1) be a farming household; (2) own a mobile phone; (3) not be a current member of VFC; and (4) have at least one female member age 15-60 years old. The baseline household survey was then conducted on a random sample of households eligible to participate. In total, 3,936 households across 207 communities were interviewed for the baseline household survey.

The study encouragement intervention was implemented at the time of the baseline household data collection. Study households in communities randomized to the treatment assignment were offered the opportunity to become VFC members at the completion of the household survey. The targeted individual was informed about the VFC service through either an agriculture script or agriculture+nutrition script, and were then asked to play a short game to determine the respondent's willingness to pay for the service. In total, 91.5 percent of the encouraged households in treatment communities agreed to be registered for the VFC service.

Baseline report and summary of key findings

The purpose of this baseline report is to introduce the context for this evaluation, describe the interventions and evaluation design, summarize the data from the baseline household survey, and test if the randomization successfully balanced baseline characteristics across encouraged and

comparison communities. The findings from the quantitative baseline will be combined and triangulated with the initial exploratory qualitative study and business model/cost-effectiveness study, and integrated into a mixed methods baseline report of the mNutrition impact evaluation in Ghana.

Key Highlights:

- Low literacy rates in the Central and UW region highlight the importance of using voice-over text to send mNutrition messages.
- Given the low access and use of mobile phones by females, reaching female farmers with the mNutrition messages could be challenging even if they are explicitly targeted through the study.
- Across both regions, only a small share of women consumes pulses, dairy, eggs, and nuts/seeds; thus, these food groups have the largest potential for improvement through mNutrition messages.
- Regional differences in agricultural production reveal the importance of profiling households for the VFC service and sending crop-specific agriculture messages.
- The portion of respondents that state automated text messages as the most important source of information is nearly zero for both crop production and nutrition, this highlights the importance of voice messages or call centres as a means of reaching farmers with agriculture and nutrition information as opposed to text messages.
- There are differences across men and women in their source of information and trust of information, with women trusting more than men agriculture information from their spouse, and nutrition information from other family members and friends/neighbours. This highlights that different approaches may be needed to target women and men.

Sample Characteristics and implications for mNutrition

- **Demographics, assets, and wealth:** There are large differences across the Central and UW regions in household demographics, assets, and wealth. In particular, households in the Central region, compared to the UW region, are smaller in size, more likely to have a female head and to have a head with some education that can read a phrase in English, and less likely to have a head that is polygamous, or engage in agriculture as the main activity. For both regions literacy is low, with only 31 percent of household heads and 17 percent of primary females[1] knowing how to read in English (literacy in the local language is even lower). Low literacy highlights the importance of using voice-over text to send mNutrition messages.
- **Access and use of mobile phones**: For both the primary male and female, access and usage of mobile phones is higher in the Central region than UW region. For both regions, while receiving and making calls is very common, less common is sending and receiving text messages, and even less common is sending or receiving mobile money. This again highlights

[1] In the majority of cases, household head is the husband of the primary female. In the 21 percent of cases where the household head is female, household head is the same as the primary female.

the importance of voice messages as a means of sending nutrition messages. There are also large differences in phone access and use between the primary male and female. Compared to the primary male, the primary female has less access to a mobile phone and uses it less to make and receive a call, send and receive a text message, and send and receive mobile money. Reaching female farmers with the mNutrition messages could be challenging even if they are explicitly targeted through the study.

- **Dietary diversity**: In terms of diets, households in the Central region compared to the UW region have a higher Household Dietary Diversity Score and Minimum Dietary Diversity - Women. In other words, households in the Central region have more economic access to food, and women have better diets in terms of nutritional adequacy compared to households and women in the UW region. Across both regions, only a small share of women consume pulses, dairy, eggs, and nuts/seeds; thus, these food groups have the largest potential for improvement through mNutrition messages.
- **Agriculture production**: There are large differences in terms of agriculture production across regions. While both the Central and UW regions cultivate, on average, three crops, the main crops cultivated for the Central region are cassava, maize, and cocoa, while the main crops for the UW region are maize and groundnut. These regional differences reveal the importance of profiling households for the VFC service and sending crop-specific agriculture and nutrition messages.
- **Nutrition knowledge and behaviour**: For both the primary male and primary female, nutrition knowledge and behaviour is low. Topics where less than half the respondents answered correctly are on cutting and drying mangoes for preservation, the health benefits of papaya, not cleaning tubers with water, and feeding avocados to babies when first introducing solid foods. Overall females answered 59 percent of questions correctly and males, 55 percent. Nutrition knowledge and behaviour scores are lower in the Central region compared to the UW region for both the primary male and female.
- **Farming knowledge**: Farming knowledge is also low for both the primary male and primary female, with females answering 54 percent of questions correctly and males, 58 percent. Scores on farming knowledge are lower in the Central region compared to the UW region for both the primary male and female. Topics with the lowest scores are on harvesting peppers and placement of pepper fields. However, information on peppers may not be relevant for most farmers and differences across regions in types of crops produced highlights the need for profiling messages to be crop-specific based on farmer's individual needs.
- **Source of information and trust**: Government extension workers are the most important source of information for crop production and community health worker for nutrition. Nearly all respondents agree they trust government extension workers for information on agriculture and community health workers for information on nutrition. In contrast, the portion of respondents that state automated text messages as the most important source of information is nearly zero for both crop production and nutrition. The proportion of respondents that agree they trust automated text messages is also lower compared to other sources. This again highlights the importance of voice messages or call centres as a means of reaching farmers with agriculture and nutrition information as opposed to text messages. There are also differences across men and women in their source of information and trust of information, with women trusting more than men agriculture information from their spouse, and nutrition information from other family members and friends/neighbours.

Baseline Balance in Observable Characteristics

Randomization successfully achieved baseline balance across the encouraged and comparison groups. Normalized differences between the encouraged and comparison groups are well below

the 0.25 cut-off that would indicate significant differences for baseline characteristics regarding demographics, wealth and assets, mobile phone access, dietary diversity, agriculture production, nutrition knowledge, farming knowledge, and source of information. Overall, from 208 tests of significant differences between the encouraged and comparison groups, only 8 are significant. This is a rejection rate of 3.8 percent, a little less than what we should expect to find by chance.

Balance in baseline characteristics was successfully achieved across the agriculture and agriculture and nutrition script. Normalized differences between these two groups are well below the 0.25 cut-off for baseline characteristics regarding demographics, wealth and assets, mobile phone access, dietary diversity, agriculture production, nutrition knowledge, and farming knowledge. Overall, only 3 of 208 tests of significant differences between the agriculture and agriculture and nutrition script group are significant.

Balance in baseline characteristics across male and female targeted groups was not as successful in the subsample of households with both a primary male and primary female. Although none of the 190 normalized differences between the male and female targeted groups were above the 0.25 cut-off, 22 of the 190 tests of differences are significant. This is a rejection rate of 11.6 percent, more than what we should expect to find by chance. The differences in baseline characteristics are concentrated in demographics, nutrition knowledge of males, and farming knowledge of females. This suggests that we need to take these differences into account when estimating the differential impact of targeting women.

Willingness-to-pay for VFC Service

Using Becker-DeGroot-Marschak method, we elicited a farmer's willingness-to-pay for the VFC service in encouraged households. Information on willingness-to-pay for the service was collected in order to learn about initial demand for the service at the time of its introduction, to determine whether consumers would be willing to pay a positive price for the service at the outset, before they had any exposure to using it. Our analysis also tests for heterogeneity in willingness-to-pay by gender and by whether the advertisement scripts emphasize the nutrition content.

As expected, the share of farmers willing to pay for VFC service decreases as the price increases. At 1.0 Ghanian Cedi (GHS) per month, the share of farmers willing to pay this price is 85 percent; at 2.0 GHS, the share is 50 percent; and at 3.0 GHS, the share is 19 percent. From the standpoint of pricing policy, these results suggest that small positive prices (between 0-1 GHS) for the VFC service do not substantially decrease demand, but after 1.0 GHS, demand drops dramatically. Farmer's demand for the VFC service depends on the targeting but not the advertisement scripts. Although farmers who heard the agriculture and nutrition script were willing to pay more for the service than farmers who only heard the agriculture script, differences were not statistically different. However, men were willing to pay significantly more for the service than women.

Challenges and Road ahead

Conducting an impact evaluation in the ICT sector has unique challenges. The ICT sector is fast-paced and dynamic, with changes to a product such as VFC consistently occurring in order to improve the service. During the study period, the VFC product changed its pricing, profiling system, and number of nutrition messages. All changes were to improve the user experience and increase the number of users. While improvements to a product has positive implications for the evaluation, it also means partners must be in constant communication with each other, and the evaluation flexible enough to adapt to the changes.

There are also practical challenges for mobile phones to be an effective means of improving nutrition knowledge, behaviours, or outcomes. In contrast with more typical in-person methods of conducting behaviour change communication whereby programme staff are physically available to deliver content to beneficiaries, to work, mobile phone-based information interventions need to ensure that targeted mobile phone numbers are activated, profiled, still in use, charged, and accessible, and that the user has the time and desire to read or listen to the delivered content. These issues have implications for the evaluation design, as take-up of the intervention in the treatment group will likely be far from perfect.

Lastly, while the rapid increase in access to and ownership of mobile phones across the developing world has generated a potentially low-cost opportunity for disseminating information to individuals and households, mobile phone ownership is still not universal in Ghana. The poorest households are less likely to own a mobile phone than others and women are less likely to own a mobile phone than men. Thus, reaching the most vulnerable populations through a mobile based platform still poses a challenge to the ICT sector.

We hope that the mNutrition evaluation, together with the qualitative component, quantitative component, and business model and cost-effectiveness component, will provide insights into the challenges and opportunities of using a mobile platform to deliver nutrition messages.

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Annex Tables

List of abbreviations

ANCOVA	Analysis of Covariance
ATE	Average Treatment Effect
BDM	Becker-DeGroot-Marschak
CAPI	Computer Assisted Personal Interviewing
CLE	Community Listing Exercise
CSPro	Census and Survey Processing System
DHS	Demographic and Health Survey
DFID	United Kingdom Department for International Development
EA	Enumeration Area
GAIN	Global Alliance for Improved Nutrition
GHS	Ghanian cedi
GSMA	GSM Association
HDDS	Household Dietary Diversity Score
HHIDs	Household Identifier
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
ISSER	Institute of Statistical, Social, and Economic Research
ITT	Intent to Treat
LATE	Local Average Treatment Effect
MNOs	Mobile Network Operators
OPM	Oxford Policy Management
PF	Primary female
PM	Primary male
PPI	Progress out of Poverty Index
PPs	Percentage points
RCT	Randomized control trial
SDs	Standard deviations
SIM	Subscriber Identity Module

SMS	Short Message Service
TOR	Terms of Reference
VFC	Vodafone Farmers' Club
USD	United States Dollar
UW	Upper West (region)
WHO	World Health Organization
WTP	Willingness-to-pay

1 Introduction

1.1 mNutrition

mNutrition is a global initiative supported by DFID, organised by GSMA, and implemented by in-country mobile network operators (MNOs) and third party providers to use mobile technology to improve the health and nutritional status of children and adults in the developing world. The potential to utilise mobile technology to change attitudes, knowledge, behaviours, and practices around health and agriculture for improved nutritional status has been recognised for some time, but to date there have been no rigorous evaluations of m-services at scale. A consortium of researchers from Gamos, the Institute of Development Studies (IDS), and the International Food Policy Research Institute (IFPRI) have been contracted to conduct a rigorous mixed-methods evaluation to estimate the impact of mNutrition on children and adults and to understand how the context and the components of the mNutrition intervention shape its impact.

mNutrition is being implemented through existing mAgri and mHealth programmes in 12 countries throughout sub-Saharan Africa and South Asia. The nutrition content aims to increase knowledge and promote behaviour change around key farming decisions and practices and around maternal and other household practices that are likely to result in improved nutritional health within a household. The mNutrition initiative aims to lead to the following changes in outcomes: (i) increased adoption of new nutrition-sensitive agriculture practices, improved agricultural productivity, and greater use of post-harvest technologies; (ii) improvements in nutrition practices around women during pregnancy, infant and young child feeding, and micronutrient supplementation of children at risk; and (iii) increased demand for nutrition and agriculture extension services. The evaluation design is expected to measure the impact, cost-effectiveness, and commercial viability of mNutrition, using a mixed methods evaluation design. The evaluations are being conducted on two programmes, Ghana mAgri (the focus of this report) and Tanzania mHealth. The period of DFID support to these studies is from 1 September 2014 to 31 December 2019. In order to satisfy the objectives of the TOR, the evaluation is composed of the following components (see annex B for timeline).

- A **quantitative impact evaluation**, employing a randomized encouragement design to determine the causal effect of the programme on dietary diversity, agricultural income, and production. Households in randomized encouraged communities will receive extra encouragement to increase take-up of VFC service in the form of additional door-to-door marketing and promotion and price discounts; and households in comparison communities will not receive the extra encouragement activities, but will still have access to the VFC service. A baseline survey will occur before the start of the extra encouragement activities, and an endline survey will occur one or two years later.
- A **qualitative impact evaluation**, which consists of three qualitative data collection rounds (i.e., an initial exploratory qualitative study, in-depth case studies at midline, and rapid explanatory qualitative work after the quantitative endline survey data collection) and aims to provide understanding of the context, underlying mechanisms of change and the implementation process of mNutrition.
- A **business model and cost-effectiveness evaluation** employing stakeholder interviews, commercial and end-user data, document analysis and evidence from the quantitative and qualitative evaluations to generate a business model framework and estimate the wider imputed benefits from the value-added service for the range of stakeholders involved.

The quantitative component of the evaluation is designed to contribute evidence to help answer the first two broad questions specified in the Terms of Reference (TOR, Annex A):

1. What are the impacts and cost-effectiveness of mobile phone-based nutrition and agriculture services on nutrition, health, and livelihood outcomes, especially among women, children, and the extreme poor?

2. How effective are mobile phone-based services in reaching, increasing the knowledge, and changing the behaviour of the specific target groups?
3. Has the process of adapting globally agreed messages to local contexts led to content that is relevant to the needs of children, women, and poor farmers in their specific context?
4. What factors make mobile phone-based services effective in promoting and achieving behaviour change (if observed), leading to improved nutrition and livelihood outcomes?
5. How commercially viable are the different business models being employed at country level?
6. What lessons can be learned about best practices in the design and implementation of mobile phone-based nutrition services to ensure (a) behaviour change and (b) continued private-sector engagement in different countries?

The quantitative component of the evaluation is designed primarily to contribute evidence to address the first two of these evaluation questions. In addition, the Ghana quantitative evaluation will also contribute to answering evaluation questions 4 and 5 on the factors shaping effectiveness of this approach and on the viability of the mNutrition business model applied in Ghana.

The primary target user of the evaluation results is DFID, along with other key stakeholders including GSMA and its national members (including local MNOs implementing mNutrition services), national governments (in particular, the Ministry of Health and Agriculture), international agencies and donors, as well as community-level health and agriculture extension workers. The reports from the evaluation will be publicly available on IFPRI's and IDS's websites.

1.2 Objectives of mNutrition in mAgri

mNutrition within the mAgri programme aims to promote behaviour change around key farming decisions and practices by delivering nutrition information to farmers.[2] The objective of mNutrition and mAgri is to create and scale commercially sustainable mobile services that enable smallholder farmers to improve the nutritional status of their household and increase their productivity (see annex C for GSMA's theory of change of mAgri). The stated GSMA targets are the following (GSMA M4D 2013):

- At least 20 percent of registered households that act on information and advice report consuming at least **four food groups** on a daily basis for at least nine months of the year as a result of more diverse agricultural output, increased income, and/or behaviour change in terms of nutrition.
- At least 50 percent of registered households that act on information and advice report a 25 percent increase in **agricultural productivity**.
- At least 50 percent of registered households that act on information and advice report increases in **agricultural income** of 20 percent.

In Ghana, mNutrition is being implemented as part of the Vodafone mAgri mobile extension service called Farmers' Club. The service is a bundled solution offering agricultural and nutrition information via voice and SMS services in addition to free calls to other Farmers' Club members (details on the service are provided in Section 2).

1.3 Research Questions

To determine whether the mNutrition programme in Ghana is meeting its stated objectives and targets, the quantitative impact evaluation will employ a randomized encouragement design to estimate the causal

[2] For a detailed landscape analysis on the context for implementing mNutrition and mAgriculture programmes see the report Barnett et al. 2016.

effect of the Vodafone Farmers' Club. The quantitative evaluation will answer the following two primary research questions:

1. How effective is the Vodafone Farmers' Club service at increasing the knowledge and changing the behaviour of farmers (intermediary or secondary outcomes)?
2. What are the impacts of the Vodafone Farmers' Club service on households' and women's dietary diversity, agricultural income, and production (final or primary outcomes)?

Primary research question 1 will provide evidence to inform evaluation question 2 for the overall mNutrition study by measuring the effectiveness of the Vodafone Farmers' Club at changing knowledge and behaviour in the target group. Primary research question 2 will provide evidence to inform evaluation question 1 for the overall mNutrition evaluation by estimating impacts on the main outcomes for the Ghana study. In addition to the two primary research questions, the impact evaluation will address two additional questions, which aim to build knowledge around appropriate programme targeting and to inform business models for future programmes:

3. What is the demand for the Vodafone Farmers' Club service and can framing about the agriculture or nutrition objectives of the service affect household's willingness to pay for the service?
4. Does targeting women have differential impacts on knowledge, behaviour, and final outcomes than targeting men with the service?

Research question 3 provides additional information to inform evaluation question 2 about effectiveness of the programme. The evidence about demand for the programme will also inform evaluation question 5 about the business model and commercial viability of Vodafone Farmers' Club. Research question 4 will contribute evidence to evaluation question 1 on impacts of the programme and also addresses evaluation question 4 on what factors contribute to the impact of the programme by examining the role of gender in programme targeting.

1.4 Objectives of the quantitative baseline report

The purpose of this baseline report is to introduce the context for this evaluation, describe the interventions and evaluation design, summarize the data from the baseline household survey, and test whether the randomization was successful at balancing baseline characteristics between encouraged and comparison communities. The findings from the quantitative baseline will be combined and triangulated with the initial exploratory qualitative study and business model/cost-effectiveness study, and integrated into a mixed methods baseline report of the mNutrition impact evaluation in Ghana. The baseline report is organized as follows. Section 2 describes the programme evaluated in this study and section 3 covers the evaluation design. The strategy for sampling and randomization is described in section 4 and section 5 covers details on the baseline data collection. Sections 6 through 8 present data from the baseline survey. Section 6 presents summary statistics on household characteristics, mobile usage, and the primary and secondary study outcomes for the Central and UW regions and across encouraged and comparison arms, showing balance across the EA-level randomization. Section 7 presents the same indicators for the encouraged group only, showing balance in baseline indicators across the household-level randomization. Section 8 presents statistics on households' willingness-to-pay for the Vodafone Farmers' Club service. The final section concludes with a summary of the baseline findings and any implications these could have on the overall study design.

2 The mNutrition Intervention in Ghana

2.1 Context

Nutrition: Child stunting is 19 percent nationally in Ghana and higher in the Northern (33 percent), Central (22 percent), and UW (22 percent) regions (GSS and GHS, 2015). Varied and high-quality diets are key to addressing child and maternal undernutrition. The percentage of children 6-23 months who consume the minimum diet diversity of four food groups is 46.8 percent and, on average, women consume four out of nine food groups (Kothari and Noureddine 2010).

In 2008 the number of community health workers per 1000 people was 0.19.[3] In 2016 Ghana launched "The Ghana Community Health Worker Programme" aimed to achieve universal health coverage. The program aimed to recruit, train, and deploy 20,000 CHWs and 500 eHealth technical assistants across the country over two years.

Mobile penetration in Ghana has risen dramatically in the past ten years, increasing from less than 20 subscriptions per 100 people in 2005 to 108 subscriptions per 100 people in 2013 (World Bank 2010). According to the Ghana Living and Standards Survey (GLSS Round 6), mobile phone penetration in 2013 was 80 percent in Ghana, with 70 percent of rural households reporting owning a phone and 88 percent of urban households reporting owning a phone (GLSS 2014). However, access to mobile phones in Ghana varies dramatically by region, socioeconomic status, and gender. In USAID's Feed the Future zone of influence (districts in Northern, UW, and Upper East regions), only 38 percent of males and 41 percent of females report having a mobile phone in the household (USAID 2012). Access to mobile phones in these regions is also lower among females, with only 14 percent saying they own most of the phones, while 57 percent of males say they own most of the phones. As of 2014, the largest mobile operator in Ghana was MTN followed by Vodafone, with 45 percent and 23 percent of the market share respectively.

Literacy in Ghana: According to the GLSS Round 6, adult literacy rates in rural areas are quite low, with only 41.7 percent of the adults knowing how to read or write in English or any Ghanaian language.[4] Among rural women, rates are even lower, at 31.4 percent. These low rates have implications on the design of the Vodafone Farmers' Club product and its ability to reach an illiterate population.

Agriculture in Ghana: A little over half (51.5 percent) of households in Ghana own or operate a farm. Farming is predominantly rural, with 82.5 percent of rural households involved compared to 26.6 percent of urban households.[5] The proportion of females involved in agriculture is 41.2 percent, and there is virtually no difference in urban and rural areas. The main crop harvested is maize, followed by cocoa and groundnut/peanut. The number of households harvesting crops and the types of crop grown vary extensively across ecological zones.

Agriculture extension services are decentralized, but provision remains poor due to low capacity and limited funds (WB 2017). In 2014 there were approximately 3,500 agriculture agents under the Ministry of Food and Agriculture (Dia et al 2017). Per the Ghana Socioeconomic Panel Survey baseline report (2011), 51.7 percent of all households surveyed received agricultural advice from other households and the proportion of households receiving agriculture extension advice through radio varies from 13.79 percent in the northern region to 0.26 percent in the Greater Accra region.

mAgri services: Other small scale mAgri programs in Ghana that provide information on weather, market price, and best practices include 399 Information Service (from Farmerline) and ADVANCE (from Esoko). However, their reach is small and they do not include nutrition messages. A potential competitor to VFC in terms of reach is the Farm Direct service provided by MTN (the largest network provider). More recently,

[3] WHO 2015
[4] GLSS Round 6, August 2014.
[5] *Ibid.*

large MNO companies are starting to rollout Business-to-Person services (B2P) where agribusinesses pay farmers via mobile money for the product or services rendered (Loukos, P. 2018).

2.2 Vodafone's Farmers' Club Service

The Vodafone Farmers' Club (VFC) service is a mobile agricultural extension service, offering agricultural and nutrition information via voice and SMS channels. The objective of Vodafone's mNutrition programme is to create and scale commercially sustainable mobile services that enable smallholder farmers to improve the nutritional status of their household and increase their productivity. Vodafone began offering the VFC service in May 2015. Smallholder farmers with access to mobile telecommunications are the primary target for VFC enrolment. Females and semi-literate or illiterate farmers are key targeted segments within this primary group. The service operates across 71 districts of Ghana, which were selected based on network access and crop cultivation patterns to ensure that farmers could receive messages and that content would be relevant to their location and crop choices. Promotion and active subscription of farmers via Vodafone Farmers Club agents varies between regions.

The value-added services components include:

- **Weather information**: Three SMS messages per week in English with local weather information.
- **Market price information**: One SMS message per week in English with local market price information for a selected crop and selected market.
- **Agri and nutrition tips**: One weekly recorded voice message in the selected local language with seasonal agricultural or nutrition tips (3 agri tips and 3 nutrition tip[6] per month) for the selected crop.
- **Call centre:** Free access to a call centre with advice available from an agricultural expert.
- Free calls and SMS messaging to other VFC members.
- Discounted SMS and calls to non-VFC members.

In total, 20 messages per month are sent to the subscriber. The mode of content are SMS text messages for weather and price information and voice messages for agricultural tips and nutrition information. While SMS are in English, voice messages are available in ten local languages. Esoko Ghana, a mobile phone-based rural information service, develops and curates the message content and operates the platform to send tailored SMS and recorded voice messages to member farmers. Esoko also operates the Farmer Helpline call centre.

Nutrition message content was developed by GAIN. GAIN created a large library of nutrition-sensitive agriculture messages and nutrition-specific tips designed to complement the agriculture messages provided by Esoko. GAIN created 312 crop-specific messages (13 messages per crop for 24 Esoko-supported crops) with nutrition information on topics including food preparation, food hygiene, safety and storage, and processing. GAIN also developed many general nutrition-specific tips as well as messages for 13 crops that were not originally part of the Esoko profile. Agri tips developed by Esoko cover recommended planting time and information on best practices for cultivation and harvest.

The VFC service is available through a dedicated Farmers' Club SIM and is activated upon subscribing monthly to the service. The subscription fee for the mNutrition packages was initially GHS 2 (USD 0.45) per month. At first members had to initiate monthly payments using airtime credit on their phone. As a result of very low rates of monthly membership activation, the programme was modified to automatically deduct GHS 2 from a member's airtime credit each month. If a member's credit fell below GHS 2, their membership status would become inactive until they loaded sufficient credit on their phone to cover the monthly subscription fee, which would be automatically deducted when the credit was loaded. From

[6] Initially the VFC service sent 1 nutrition message per month, but this was increased to 3 nutrition messages per month in July 2017. .

October 2016 to June 2017, the monthly fee was dropped in order to increase subscriptions. In June 2017 the monthly service fee was reinstated at GHS 0.5.

The VFC service is designed to offer customized information to farmers based on their selected preferences. Initially, each new member was profiled by a Vodafone agent at the time of registration, indicating their preference of location for weather and market price information, their preferred language for receiving recorded voice messages, and their preferred crop choice for agricultural tips and price information. It became apparent that much of the profiling data was not being collected by agents at the time of SIM registration. As a result, Esoko and Vodafone modified their strategy so that all profiling would be done through a follow-up call to new members by the Farmers Club call centre after the SIM registration process was completed. However, when Vodafone suspended the monthly service fee and initiated a large push to increase the programme member base, it became infeasible for Esoko to follow-up with each new VFC member individually. Instead, new members were given default profile options based on their district of residence, receiving agri and nutrition tips on the crops most widely grown in that district. Farmers were given the option to contact the call centre themselves to request customized profile options.

Vodafone Farmers' Club is available to farmers and people in the farming ecosystem, such as market women and input dealers in 71 districts of Ghana, although promotion and active subscription of farmers via Vodafone Farmers Club agents varies between regions.

3 Evaluation Design

3.1 Study Design

As stated in the inception report, given that the Vodafone Farmers' Club is available to all farmers in 71 districts of Ghana, an RCT within these districts where we randomly assign some individuals or communities to a true 'control' group that does not have access to the service was not an option. Moreover, comparison of farmers within the 71 districts to those outside the 71 districts would not lead to causal estimates because farmers within and outside the 71 districts are likely very different in terms of crop cultivation and mobile signal strength. Vodafone purposefully chose the 71 districts based on their access to a 3G cell tower and their crop cultivation to ensure that farmers would be able to receive the messages and that the Esoko price information was relevant to them. Consequently, farmers not in the 71 districts are likely to have less access to a 3G cell tower and engage in different farming activities. Thus, to estimate the causal impact of the Vodafone Farmers' Club product, we implemented a randomized encouragement design. The encouragement design does not restrict access to the Vodafone Farmers' Club product, but instead works by randomly assigning some communities to receive additional marketing and promotion of the programme.

A randomized encouragement design is one example of an experimental impact evaluation design, which makes it possible to interpret differences in outcomes between the encouragement treatment group and the control group as being a result of the interventions being implemented. Impact estimates have a causal interpretation in randomized field experiments because access to the programme cannot be correlated with local conditions or household behaviour, except by chance, in the way that is typical of targeted interventions and those in which household self-selection is a major determinant of participation. Heckman and Smith (2005) and Heckman, Ichimura, and Todd (1997) explain how randomly assigning access to an intervention eliminates selection bias and, in the absence of significant sampling error, makes it possible to identify causal impacts of the interventions.

The additional marketing and promotion to encourage take-up and continued use was informed by the qualitative study and includes a combination of price discounts, and door-to-door marketing to farmers in selected communities throughout the evaluation period. During the door-to-door marketing, the product was promoted using a short advertisement script on the value added of the service. Households were randomly assigned to receive one of two scripts: (1) a script that focuses on the agriculture value added of the product (Vodafone's current script), or (2) a script that augments the agriculture focus with additional information about the nutrition value added of the product. Comparing outcomes from the two scripts will inform whether emphasizing the nutrition component of the programme leads to larger impacts of the programme on outcomes such as household diets. Last, we randomly targeted either an adult male or female from each household to receive the advertisement scripts and free subscription to Farmers' Club. Comparing outcomes between male- and female-targeted households will inform whether the gender of the person receiving the messages affects the household's utilization of the information provided.

Thus the encouragement design is composed of the following five groups:

1. **Comparison group (Group 1)**—enumeration areas that are not receiving the extra marketing or promotion;
2. Encouraged group—enumeration areas that receive the extra marketing and promotion in the form of door-to-door marketing, blast SMS to farmers, and price discounts:
    - **Encouraged male, agri group (Group 2a)—**Households that receive marketing scripts that focus on the agriculture value added of the product and target a male household member;
    - **Encouraged male agri+nutrition (Group 2b)—**Households that receive marketing scripts that focus on the agriculture and nutrition value added of the product and target a male household member;

- **Encouraged female, agri group (Group 2c)—**Households that receive marketing scripts that focus on the agriculture value added of the product and target a female household member;
- **Encouraged female, agri+nutrition group (Group 2d)—**Households that receive marketing scripts that focus on the agriculture and nutrition value added of the product and target a female household member

Random assignment to the different intervention groups occurred in two stages. The first stage that randomly assigns communities to either the comparison group (Group 1) or encouraged group (Group 2a, Group 2b, Group 2c, Group 2d) occurred at the enumeration area (EA) level. We chose to randomize at the EA level as opposed to the household level because it is likely that individuals will discuss what they learn from the Vodafone Farmers' Club with other community members; thus, even individuals who do not directly use the service may be exposed to the information through their community members, and they cannot be considered "untreated". Urban areas that make up more than one EA were clustered together for the randomization to minimize the potential of spillovers. The second stage of randomization that assigns households to either Group 2a, 2b, 2c, or 2d occurred at the household level for households in the encouraged EAs.

The proposed design allows us to answer our specific research questions by making the following comparisons:

- Comparison of **combined encouraged group** (Groups 2a, 2b, 2c, 2d) with **comparison group** (Group 1): What is the absolute impact of the Vodafone Farmers' Club on primary and secondary outcomes and behaviour relative to comparison group (Research questions 1 and 2 in section 1.3)?
- Comparison of **encouraged male group** (Groups 2a and 2b) with **encouraged female group** (Groups 2c and 2d): What is the relative impact of targeting women on primary and secondary outcomes and behaviour (Research question 4 in section 1.3)?
- Comparison of **encouraged agri group** (Groups 2a and 2c) with **encouraged agri+nutrition group** (Groups 2b and 2d): Does framing the Vodafone Farmers' Club as an agriculture and nutrition programme lead to differences in a household's willingness to pay compared to framing as just an agriculture programme (Research question 3 in section 1.3)?

3.2 Estimation Strategy

The estimation methodology will compare differences in outcomes of interest across the encouraged and comparison groups using data collected in a baseline and an endline survey. Detailed information was collected at baseline and will be collected again at endline on (1) final (or primary) outcomes on which we expect to see impacts, (2) intermediate (or secondary) outcomes that may explain pathways of impact, such as changes in behaviour, knowledge, and practices, and (3) outputs such as take-up rates and factors that may affect take-up rates and use of the VFC service. The baseline survey was conducted in March-May 2017, before the extra encouragement was implemented. The endline survey will occur in November-December 2018. Although the endline survey will occur in a different season than the baseline survey, the timing is right after the harvest season which will ensure optimal recall of agriculture production, a primary outcome of interest. Moreover, given the randomized study design, we will still have comparable encouraged and comparison groups to estimate causal impacts using ANCOVA models (see section 3.2.1 for more details). The endline survey will collect data on the same households and individuals from the baseline survey. To minimize attrition across survey rounds detailed contact information was collected of households at baseline. The quantitative data collection and analysis strategy, as well as the interpretation of the analysis findings, will be informed by findings from the two qualitative data collection rounds.

Because the encouragement is randomly assigned, we will use the systematic variation in take-up of the product to measure the causal impact of the programme as the difference in outcomes between encouraged and comparison communities at endline. Random assignment ensures that baseline characteristics of children, households, and communities will be similar, on average, across encouraged

and comparison communities, minimising bias in impact estimates due to unobserved heterogeneity or selection.[7] Similarly, we expect that the presence of other agriculture and nutrition interventions as well as access to public services should be balanced across the encouraged and comparison communities as a result of randomization, which should limit the effect of confounding variables on the impact estimates. As a result, average differences in outcomes across the groups after intervention can be interpreted as being truly caused by, rather than simply correlated with, the interventions.

3.2.1 Empirical specification

To evaluate the impact of the Vodafone Farmers' Club product, we will use the baseline and endline data and conduct an analysis of covariance (ANCOVA) estimation. We will analyse our outcomes primarily with ANCOVA models, using difference-in-difference models and single difference models as robustness checks. ANCOVA specifications are more flexible than typical difference-in-difference models, allowing us to estimate rather than impose the autocorrelation in each outcome (McKenzie 2012) and creating a better fit of the data. Moreover, there are substantial power gains of using ANCOVA models over difference-in-difference when autocorrelation is low, which is likely to be the case with many of our outcome variables.[8] The ratio of the difference in differences variance to the ANCOVA variance is 2/(1+ρ). So when ρ=.25, with a single baseline and follow-up, the sample size needed to get the same power is 60 per cent larger with difference-in-differences than with ANCOVA.

Using the ANCOVA model, we will estimate the intent-to-treat (ITT) effect as the difference in average outcomes between the comparison group and those that were assigned to the randomized encouragement group regardless of whether they participated in VFC. The ITT is a clean experimental estimator that allows for imperfect compliance with the treatment assignment, as is typical in an encouragement design. Because compliance is not perfect, and not all who are encouraged will take up the service, we are measuring the ITT effect or the impact of treatment assignment (in this case encouragement to participate in VFC) on outcomes. In addition to the ITT estimate, we will estimate the effect of the Vodafone Farmers' Club service on farmers who take-up the service (treatment-on the-treated (TOT)) by estimating the local average treatment effect (LATE). We will use instrumental variable techniques to estimate LATE, and in particular use the random variation in encouragement as an instrument for take-up of the product.

For comparison of the **combined encouraged group** (Groups 2a, 2b, 2c, 2d) with the **comparison group** (Group 1), the exact empirical specification on the ANCOVA parametrisation in its simplest form is the following:

$$Y_{1hv} = \beta_0 + \beta_1 Encouraged_v + \beta_2 Y_{0hv} + \varepsilon_{hv},$$

where Y_{1hv} is the outcome of interest at endline for household *h* from enumeration area *v,* Y_{0hv} is the outcome of interest at baseline, and $Encouraged_v$ is an indicator for whether or not enumeration area *v* received the extra encouragement. β_1 measures the differences in outcomes of the encouraged versus comparison enumeration areas, and thus the impact of the Vodafone Farmers' Club product.

For comparison of the **encouraged-female group** (Groups 2c, 2d) with the **encouraged male group** (Groups 2a, 2b), the exact empirical specification on the ANCOVA parametrisation is the following:

$$Y_{1hv} = \beta_0 + \beta_1 Male_{vh} + \beta_2 Female_{hv} + \beta_3 Y_{0hv} + \varepsilon_{hv,}$$

where $Male_{hv}$ is an indicator for whether household *h* in enumeration area *v* targeted the Vodafone Farmers' Club service to a male and $Female_{hv}$ is an indicator for whether the Vodafone Farmers' Club service was targeted to a female. β_1 measures the impact of the Vodafone Farmers' Club product when it is targeted to males and β_2 the impact when it is targeted to females. To test whether the ITT estimators are

[7] A post-randomization test will be conducted to ensure that the intervention arms are balanced across key characteristics.
[8] The ratio of the difference in differences variance to the ANCOVA variance is 2/(1+ρ). So when ρ=.25, with a single baseline and follow-up, the sample size needed is 60 per cent higher with difference-in-differences than with ANCOVA to get the same power.

statistically different across male and female groups, we conduct Wald tests of equality of the two estimates.

The absolute and relative impacts measured for the VFC service may depend on baseline characteristics of the study sample. The two study regions chosen for the impact evaluation are very different in terms of seasons, agriculture, and nutrition. Consequently, we plan to measure heterogeneity of impact by region, following Bruhn and McKenzie (2009). For the first-stage randomization, we stratified the sample of EAs by region and assigned treatment within these two strata. This will help to assure even coverage of the intervention arms across regions, and will facilitate subgroup analysis. For the second stage household-level randomization, we stratified by whether the household was a two-person household (adult male and female) or female-only household.

3.3 Analysis of baseline data

In this baseline report, the baseline survey data will be used both to establish the pre-intervention situation of study households for context, and to empirically confirm that observable characteristics are well-balanced across the arms. For demonstrating balance, we will calculate average values in key characteristics for each intervention arm, then confirm that differences in these average values across arms are small and statistically insignificant. Demonstrating balance is important for establishing that households in each arm were similar prior to any household being encouraged to join the VFC service. With this established, significant differences found across the arms at follow-ups can be interpreted as caused by the VFC encouragement. In other words, if the baseline data show convincing balance across the arms, we can conclude that differences in outcomes at follow-ups are attributable to differences in programme benefits received rather than pre-existing differences.

4 Sample Design and Randomization

4.1 Sample design

4.1.1 Overview

The study takes place in 5 districts in the UW Region and 5 districts in the Central Region, for a total of 10 districts across two regions. The two regions were chosen based on differences across regions in nutritional status and agriculture production (see section 2.1). The 10 districts selected are based on (1) availability of Esoko market price information for crops, and (2) low FC subscription rates. From each selected district, we randomly selected 20-21 EAs from a list of EAs within a 10-mile radius of a Vodafone cell phone tower.[9] A total of 207 EAs (104 in the encouragement arm and 103 in the comparison arm) are part of the study. Figure 4.1 shows the distribution of EAs across the 10 study districts.

In each EA, we randomly sampled 19 farmer households, for a total planned sample of 3,933 households at baseline. The inclusion criteria into the sample are that households must (1) be a farming household, (2) own a mobile phone, (3) not be a current member of FC, and (4) have at least one female member age 15-60 years old. The last criterion ensures that we can measure woman's dietary diversity (a primary outcome) in all our sample households. In order to know which households met our sampling criteria, a Community Listing Exercise (CLE) that collected information on all households in the selected EAs was conducted.

4.1.2 Sample size calculations

Power calculations were conducted to estimate the necessary sample size required to measure a detectable effect of the VFC on 2 primary outcomes of interest: women's dietary diversity and agriculture production. The sample size estimation were based on the first-stage EA-level randomization of the pooled encouraged groups to the comparison group. Given that randomisation for this comparison is done at the EA level, sample sizes needed to detect impact are more demanding because the error term may not be independent across individuals in the same EA. In other words, outcomes of individuals in the same EA may be correlated. Although sample sizes are likely to be more demanding for the first comparison, we also estimated the power for the given sample size for the second comparison across encouragement arms, in order to ensure that we were powered for the second comparison, which is at the household level.

We used dietary diversity scores for women, one of the primary outcome indicators, to calculate the sample size needed to measure a detectable effect of VFC. This indicator has been validated by World Health Organization (WHO) as a good predictor of diet quality and micronutrient density (Ruel et al. 2013). We obtained means, standard deviations (SDs), and intracluster correlations[10] of women's dietary diversity index from the Demographic and Health Survey (DHS) 2008. We also designed the study to detect impacts on agricultural production, using yields of cocoa, which is the second largest crop in Ghana. We obtained mean yield, SDs, and intracluster correlations from the GLSS Round 6.

We used a minimum detectable effect size of 15 per cent increase for women's dietary diversity, in line with effect sizes of a homestead food production program in Burkina Faso (Olney et al 2016) and a 35 per cent increase for cocoa yields. Although 35 percent increase in yields is larger than the 25 per cent increase in agriculture production that GSMA targets (see section 1.2), a smaller MDE would require a sample size not possible within the budget.[11] We conducted the power calculations for ANCOVA models, and thus took into

[9] Urban areas that are made up of more than one enumeration area were clustered together for randomization.
[10] The intracluster correlation is the fraction of the total variance of an outcome that can be explained by the within cluster variance.
[11] Agriculture yields are noisy outcomes with high standard deviations, which require large samples for MDE. In the inception report, we show that a MDE of 25 percent increase on cocoa yields would require a sample of 7,455 households at baseline which is not possible with the given budget.

account the autocorrelation from baseline to endline. For women's dietary diversity index, we assumed an autocorrelation of .1, which is taken from data in Uganda, and for cocoa yields, we assumed an autocorrelation of .3, which is similar to autocorrelations in Ghana for food expenditures. We used conventional levels and set the power at 80 percent and the significance level at 0.05. We assumed 5 percent attrition from baseline to endline.[12]

Because we use an encouragement design, the standard sample size calculations for cluster randomized control trials needed to be amended to account for imperfect compliance (Glennerster and Takavarashi 2013). In a standard randomized controlled trial the minimal detectable effect is set assuming take-up of 100 percent in the treated group compared to 0 percent in the control group. In an encouragement design, some individuals assigned to the encouraged group may not take up the treatment, while some individuals assigned to the comparison group may take up the treatment. In our case, some individuals in our encouraged group may not sign-up for VFC or some individuals in the comparison group may sign-up for VFC. This, in essence, dilutes the difference in effect sizes between groups, which increases the required sample size. With an encouragement design, the minimal detectable effect should be set to (take up rate in encouraged group – take up rate in comparison group) x (expected effect on treated individual compared to untreated individual).[13] We conducted power calculations under two different assumptions about take-up rates in comparison and encouraged areas. In the first, we assume a 5 per cent take-up of mNutrition in comparison areas and a 75 per cent take-up in encouraged areas, leading to a 70 percentage point (pp) take-up gap, which is very optimistic. In the second scenario, we again assume a 5 per cent take up in comparison areas and a 50 per cent take-up in encouraged areas, resulting in a 45 pp take-up gap. Although these take-up rates are high, we assumed that our encouragement would be strong.

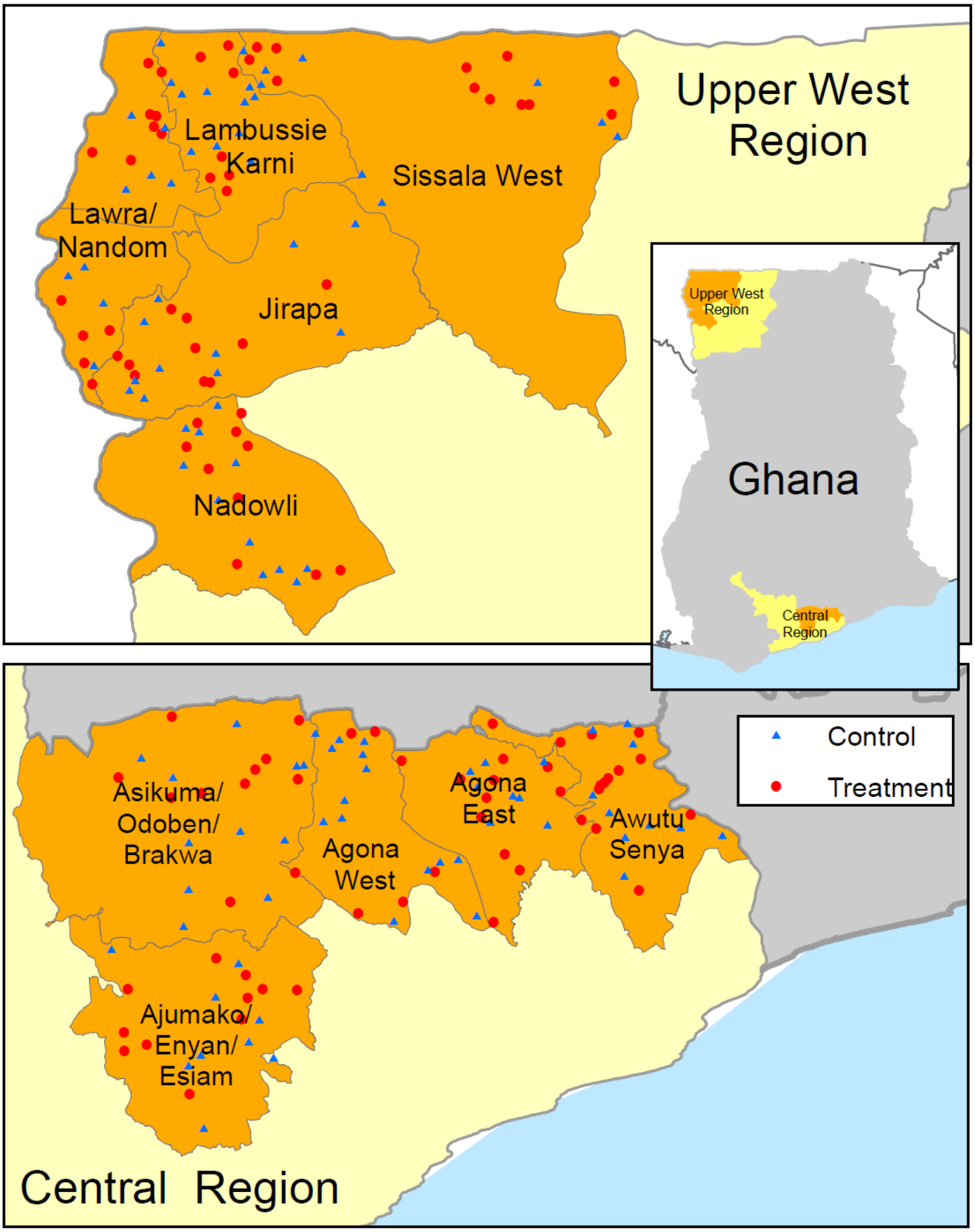
The inception report (Barnett et al 2017) provides more detail on the sample size needed under different assumptions in take-up rates. Assuming a 15-percent increase in women's dietary diversity and a take up gap of 45 pp between the encouraged group and the comparison group, the sample size needed was 3,898 households across 207 clusters. With 207 clusters, we needed to sample 19 households per cluster at baseline for a total sample of 3,933 households at baseline. This sample size also ensured that we could detect an impact on cocoa yields if the take-up gap was 70 pp and the effect size was 35 percent. We were also powered at 97.5 percent to detect impacts of 15 percent (assuming 45 pp take-up gap) on women's dietary diversity and we were powered at 81.5 percent to detect impacts of 35 percent (assuming 45 pp take-up gap) on cocoa yields when comparing male-targeted households to female-targeted households.

After the baseline data was collected, we recalculated the intra-cluster correlations (ICCs) for the two main outcomes used in the power calculation (dietary diversity and cocoa productivity). We found lower ICCs than assumed in the sample design, which means our study has more statistical power than originally expected. In particular, the ICC for dietary diversity was 0.166 in the inception report and 0.084 in the baseline data. In addition the ICC on cocoa yield was 0.23 in the inception report and 0.073 in the data. These lower ICCs imply less correlation between households in the same community and more power, so statistical power is at least as strong as in the original design.

[12] A review of attrition in recent IFPRI randomized controlled trials in Sub-Saharan Africa identified attrition rates (over 1.5-2 years) between 4% (Gilligan et al., 2015) and 16% (Olney et al., 2016). We opted to assume that attrition would be close to the bottom of this range because of the detailed mobile phone information we were collecting through the baseline survey. By recording all phone numbers used by each household in the data, we will be able to attempt to contact households via mobile phone in the event that we are unable to locate them when the fieldwork teams visit their village.

[13] For more information on power calculations, including the formula used, refer to the inception report (Barnett et al 2017).

Figure 4.1 Map of study area



4.1.3 EA sampling

IFPRI designed the study to include one region in the north and one region in the south of Ghana, targeting locations for inclusion where Farmers' Club has not yet been widely adopted and where Vodafone network coverage is reasonably strong. Based on membership data in late 2016, Vodafone recommended conducting the study in UW Region in the north and Central Region in the south, and identified five districts in each region where membership was quite low. In the Central region, the districts identified were Ajumako-Enyan-Esiam, Asikuman / Odoben / Brakwa, Agona West, Agona East, Ewutu Senya. In the UW Region, the districts were Sissala West, Nadowli, Lawra/Nandom[14], Jirapa, Lambussie-Karni.

In each of the selected study districts, a list of EAs within a 10-kilometer radius of Vodafone's cell towers was provided by the Ghana Statistical Service. From this list of EAs, IFPRI randomly selected 20-21 EAs per district for a total of 207 EAs. Additional EAs were drawn in each district and randomly ranked to serve as replacement EAs should any of the EAs in the primary sample fail validation. Urban areas that are made up of more than one EA were clustered together for randomization to minimize spillovers

To validate an EA, a team of enumerators for the CLE determined if Vodafone network coverage was sufficient in the location. Network coverage was assessed by asking 2-3 community members if the village and surrounding area had reception on the Vodafone network and the assessment of the quality of coverage. If network coverage was poor overall, then a replacement EA was used. EAs with less than 40 households were also replaced in order to ensure that an EA would have enough eligible households for the sampling. If a validated EA had more than 100 households, the team identified and demarcated a sub-enumeration area according to the protocol.

4.1.4 Community Listing Exercise and household sampling

In each selected and validated EA, a CLE was conducted to collect information on all households in the EA and determine whether the household met the inclusion criteria and thus formed part of the sampling frame. From this sample frame, 19 eligible households from each EA were randomly selected to be part of the primary baseline sample, for a total planned sample of 3,933 households. All other eligible households in each EA were randomly ranked for replacement if a household in the primary sample could not be surveyed (see section 5.6 for details). In addition, the CLE provided indicators to use to determine which randomized draw performed best in terms of balancing community-level characteristics across encouraged and comparison groups.

With a fixed number of households sampled in each EA, the household sampling probabilities vary with EA size. It is possible to generate sample weights to use in the analysis to generate means and other sample statistics that are representative of the underlying population in the sampled regions and districts. However, the main focus of the evaluation is to generate unbiased estimates of impact in the sample households in the experiment. Random assignment of village clusters to encouragement treatment groups assures that treatment assignment is uncorrelated with these sample weights, so estimated impacts should not be affected by using weights. As study locations are not statistically representative of the two regions, there is little motivation to include sampling weights to recover impact estimates that would be representative of the underlying population in the study areas.

[14] Nandom recently split off from the Lawra district.

4.2 Randomization

4.2.1 Implementation of EA-level randomization

Of the 207 study EAs, 104 were assigned to the encouragement arm (treatment) and 103 in the comparison arm (control). Treatment assignment was randomized stratified by region. Within each region, 1,000 potential treatment allocations were generated. For each allocation, balance tests were conducted by running separate regressions of four important contextual variables (distance to market, literacy of household head, number of eligible households per enumeration area, and single-headed households) on a constant term and a Treatment dummy variable. The random allocation chosen for assigning enumeration areas to the encouraged or comparison group was the draw whose largest t-statistic on the Treatment indicators in these four balancing regressions was the smallest of all random allocations (the minimum maximum t-statistic) (Bruhn and McKenzie 2009). The random allocation selected in this way is the one with the best balance on these variables—the smallest difference in means between the encouraged and comparison groups.

4.2.2 Implementation of household-level sub-randomization

Within the EAs assigned to the encouragement group, treatment households were stratified by two-person (male and female) and female-only households (male-only households were excluded from the sample). The sampled two-person households were randomized into the four arms for the encouragement treatment: (1) female targeted, agriculture script; (2) female targeted, agriculture+nutrition script, (3) male targeted, agriculture script, and (4) male targeted, agriculture+nutrition script. Female-only households were randomized into two groups, either agriculture scripts or agriculture+nutrition scripts.

5 Baseline data collection

The baseline data collection occurred in the first part of 2017 and included two separate exercises: the community listing exercise (CLE) and the baseline household survey. It was decided to conduct the community listing and baseline survey as close to the start of the year as feasible in order to facilitate recall from the agricultural season that ended in November 2016 for the UW region. Timing of the CLE was slightly delayed (from starting in January to February) due to issues in obtaining maps of EA within 10 km of a Vodafone cell tower. This then delayed slightly the timing of the baseline survey (from starting in February to March) Nevertheless, the baseline survey was successfully completed early in the project window ensuring that the extra encouragements could be implemented before any large rollout of the VFC service in the study districts.

The Institute of Statistical, Social, and Economic Research (ISSER) served as the in-country survey partner leading the CLE and baseline data collection in cooperation with the quantitative evaluation team from IFPRI. ISSER was selected on the basis that the institute has extensive experience conducting similar surveys in Ghana and a good understanding of local contextual issues, which may affect survey design and implementation.

5.1 Survey instruments

Both the CLE and baseline household questionnaires were designed by the IFPRI team based on the initial exploratory qualitative study (Barnett et al 2017), the landscaping review (Barnett et al 2016), and past experiences conducting quantitative evaluations of agriculture and nutrition interventions in sub-Saharan Africa. The CLE questionnaire was devised to quickly extract all the information necessary to identify whether households were eligible to participate in the evaluation as well as the geographic coordinates of the household and contact information for the household to facilitate a follow-up visit if the household was selected to be a part of the main sample. The CLE questionnaire can be found in Annex D.

The baseline household questionnaire collected information on primary and secondary outcomes, basic demographics, indicators that were likely to be predictive of the primary and secondary outcomes, and intermediate outcomes that are relevant for testing different causal mechanisms. GPS coordinates and multiple phone numbers were also collected for each household in order to easily track households over time for the endline survey. The full baseline questionnaire can be found in Annex E[15]. The baseline household interview took approximately two hours to complete and required an adult male (“primary male”) and adult female (“primary female”) of a sampled household to respond to different questionnaire modules. Primary female and male respondents were selected from the listing exercise.[16] In households with a single adult female and no adult male, the modules for the primary male respondent were skipped. Households with no adult female were not eligible for inclusion in the study. Table 5.1 provides the list of modules and the target respondent for each module. In households with both a target male and target female respondent, select modules were repeated for intrahousehold comparison.

The final module of the survey, which introduced the VFC service and included a game to determine the interviewee’s willingness to pay for the service using the Becker-DeGroot-Marschak mechanism, was administered to households in encouraged EAs only. The random assignment of the target household

[15] The Ghana Living Standards Survey Round 5, 2015 Northern Ghana Agricultural Survey, and the 2008 Demographic and Health Survey were the basis for the instrument used for this survey.

[16] If the head of household was a female (male), they were selected as the primary female (male) respondent. If the head of household was a male (female) and married, the spouse of the head of household would be selected as the primary female (male) respondent. If there were multiple spouses of the head of household, the primary female respondent was the highest order (earliest) wife. If the head of household was male (female) and unmarried, the primary female (male) respondent would be an adult female (male) who plays a role in decisionmaking on farming and household expenditure and is 15 years or older. 15 years was chosen as the limit to be consistent with the DHS Ghana and the minimum age for the Minimum Dietary Diversity Score for Women, a primary outcome in the study.

member for the intervention and random assignment of information were pre-assigned to sampled households (see section 3).

The CLE and baseline household survey questionnaires were administered by enumerators using Samsung tablets with a computer assisted personal interview (CAPI) programed in CSPro. The CAPI enabled enumerators to easily access pre-loaded data, follow interview skip patterns according to interviewee responses, and back-up survey data to a cloud server after each day of interviews.

Table 5.1: Baseline questionnaire modules

Module	Respondent
Module A: Household identification	Enumerator
Module B: Household composition	Household head or next most responsible *Male or female*
Module C: Housing and assets	Household head or next most responsible *Male or female*
Module D: Agriculture	Household member most responsible for farming and agriculture *Male or female*
Module E: Access to credit	Household head or next most responsible *Male or female*
Module F: Market information	Part 1: Primary male respondent Part 2: Primary female respondent
Module G: Mobile phone access and usage	Part 1: Primary male respondent Part 2: Primary female respondent
Module H: Nutrition knowledge	Part 1: Primary male respondent Part 2: Primary female respondent
Module I: Food security	Primary female respondent
Module J: Women's empowerment in agriculture	Primary female respondent
Module K: Farming knowledge and best practices	Part 1: Primary male respondent Part 2: Primary female respondent
Module L: Trust likelihood of nutrition and agriculture information	Randomized male OR female respondent
Module M: Willingness to pay	Randomized male OR female respondent *Treatment households only*

5.2 Implementation of encouragement

Randomized encouragement designs have been applied in a variety of settings (e.g., distribution of an influenza vaccine in Hirano et al. 2000; university retirement plans in Duflo and Saez 2003; online marketing in Aral and Walker 2011), and the methods of implementing the encouragement are also varied. Generally, a good encouragement intervention will have the features of an effective promotion campaign for a product or technology, except that the promotion campaign should only share information about the treatment and how to access it. To promote the use of mobile-phone-based services, sending information to potential customers through their phone is commonly done, but these contacts are better received if they are prefaced by some individual contact, including through local information sharing events. These lessons were considered when designing the encouragement promotion for VFC.

The study encouragement intervention was implemented at the time of the baseline household data collection. The limited study budget did not allow for a separate field exercise to visit individuals, so the study team decided that reaching encouragement households during the baseline survey would provide a cost-effective approach to prompting their use of VFC. In the encouragement, study households in EAs randomized to the treatment assignment were offered the opportunity to become VFC members at the completion of the household survey. The targeted individual was informed about the VFC service through either an agriculture script or agriculture+nutrition script (see baseline questionnaire in Annex E), and were

then asked to play a short game to determine the respondent's willingness to pay for the service (see section 8 for details on Willingness to Pay). The enumeration teams were instructed not to mention the mNutrition programme until after the full household survey had been completed, to reduce the likelihood that knowledge of the programme or an expectation of future benefits would affect the answers given by respondents.

If the targeted household member chose to join VFC, the enumerator attempted to complete the new member SIM registration and record information for profiling the new member to the service before leaving the household. If the targeted individual already had an existing Vodafone line, they could opt to migrate their existing number to the VFC service rather than receive a new SIM. In these cases, the migration requests were sent to Esoko in batches to complete the migration for existing Vodafone numbers that wished to become VFC members.

5.3 Ethics approval

As an overall guiding principle, the research team sought to conduct itself in a professional and ethical manner throughout the data collection and analysis phase, with strict respect for principles of integrity, honesty, confidentiality, voluntary participation, impartiality, and the avoidance of personal risk. These principles were informed by the OECD (2010) DAC Quality Standards for Development Evaluation and DFID's (2011) 'Ethics Principles for Research and Evaluation,' which will be followed for the duration of the evaluation.

The ethical implications of the study were reviewed by three independent committees. National-level ethics approval for both the quantitative and qualitative components of the study was obtained by the University of Ghana Ethics Committee for the Humanities on October 10, 2016 (prior to the start of data collection) (Annex F). In addition, ethics approval for the quantitative component was obtained from IFPRI's Institutional Review Board on October 16, 2016 (Annex G), and IDS Ethics Board provided approval for all components of the evaluation in September 2016.

The research was perceived as low risk by all ethic committees because the content generated was not sensitive and did not include particularly vulnerable groups (e.g., children) and it was not intrusive (e.g., no anthropometry or blood sample collection).

Informed consent was collected from all research participants prior to the start of the interview. Informed consent included consent to access information on phone usage from mobile network. The entire field team was trained on ethical data collection prior to the start of the data collection. Participants did not receive any reward or compensation for their participation in the interviews. We do not believe that the interviews were perceived as a burden by the participants that may have affected their responses.

All files with raw and analysed data are securely stored in password-protected databases. Access to the data with individual identifiers is restricted to the IFPRI/IDS/Gamos evaluation team. Phone numbers collected will only be used by the study team to locate households for follow-up work and to send information regarding VFC service.

5.4 Pilot testing and enumerator training

5.4.1 Pilot testing

A pilot test was conducted in January 2017 to finalize the protocol and script for the willingness-to-pay experiment and test the agricultural module of the household survey. Four enumerators were trained by members of the IFPRI research team and ISSER to conduct the willingness-to-pay experiment and the agricultural module on January 18, 2017. The enumerators were registered as Vodafone agents and

trained to register respondents as new Farmers' Club members after completing the willingness-to-pay module. A rural community outside of Accra was selected for pilot testing, in which enumerators conducted the willingness-to-pay experiment and Farmers' Club registration with 40 households and conducted the agricultural module with 10 households on January 19 and 20, 2017. 4 enumerators were enlisted for the pilot interviews, who on average conducted 10 interviews each. Members of the IFPRI research team observed interviews, collected feedback from the enumeration team, and reviewed data to finalize the survey instruments.

5.4.2 Enumeration Team and Trainings

ISSER, with close coordination from IFPRI, organized enumeration trainings for the CLE and the baseline survey in February 2017. At the CLE training, thirty enumerators were trained on February 9 and February 13, 2017 to conduct the CLE. The training consisted of how to validate an EA, administer the CLE on CAPI device, and ensure that enumerators reached all households within an EA. At the end of the training, enumerators were grouped into six teams, with each team comprising five members. Of the six teams, three were earmarked to work in the UW Region and the remaining three in the Central Region. The teams were formed considering the local languages proficiency, field experience, and gender balance, to bring efficiency.

The baseline survey training was conducted from February 15 to 25, 2017. Forty enumerators were trained to administer the baseline questionnaire on CAPI. Enumerators were chosen from the UW and Central regions and were tested to be proficient in the local language. In-depth training was provided on all modules, the encouragement and willingness-to-pay scripts, and Farmers' Club registration and profiling for households in treatment communities with ample opportunity for practice in local language. The training included one day for pre-testing on February 24, 2017, when enumerators practiced administering the survey and marketing scripts to farmers in a rural community outside of Accra. Given delays in the start of baseline data collection, a one-day refresher training was held for the baseline team to review the material before commencing fieldwork. The one-day refresher occurred on March 9, 2107 for the enumeration team in the Central region, and on March 12, 2017 for the enumeration team in the UW region. At the end of the training, enumerators were grouped into 8 teams of 4 enumerators and 1 supervisor. Four teams worked in the Central region and 4 in the UW region.

5.5 Fieldwork experience

5.5.1 Community Listing Exercise

The CLE was conducted from February 15 to March 3, 2017. Each study EA was validated by the enumeration team to ensure that study inclusion criteria were met and, if the EA had more than 100 households, a sub-EA was identified for the study and demarcated on a map. The CLE was completed in each EA by a pair of enumerators conducting brief interviews with all available households. Prior to beginning the CLE questionnaire, enumerators were instructed to ask for the consent of the respondent, who typically was the household head. If the household head was not available, enumerators asked the spouse of the head or the next most responsible household member over the age of 15. The enumerator only completed a CLE for the household if they received verbal consent to participate in the CLE study from the potential respondent.

Due to delays in the start of the CLE,[17] the CLE was completed after the training of baseline household enumerators. The CLE had to be completed before the baseline household data collection could begin in order to validate all study EAs, randomly allocate EAs to comparison and encouraged groups, identify all

[17] As detailed in the Quarterly Progress Report, G2 QUANT, the census was delayed slightly from the initial start date due to problems obtaining maps of enumeration areas within 10km of Vodafone's cell tower.

eligible households in an EA, randomly sample study households, and randomly assign encouraged households to the four encouraged groups.

The CLE data collection team interviewed 16,010 households in 207 selected enumeration areas chosen for the study in the UW and Central regions of Ghana. Of these households, 9,863 households (62 percent) were identified as being eligible to participate in the study (see section 4.1.1 for inclusion criteria). While approximately 91 percent of households operated a farm or had a primary female older than 15 years old, only 73 to 74 percent had access to a mobile phone or were not existing VFC members (Table 5.2).

Table 5.2: Descriptive statistics from the CLE

	Households
Total number of listing interviews	16,010
Household has access to a mobile phone	11,826
Household not an existing VFC member	11,707
Household member operates a farm	14,560
Household has a primary female older than 15 years	14,528
Household eligible for study	9,863

5.5.2 Baseline Household Data Collection

Data collection for the baseline household survey was conducted between March 11, 2017, and May 3, 2017. Before beginning a household survey, enumerators read the respondent a brief description of the study that was being conducted, informed them that their participation in the study was voluntary and that they could discontinue participating at any time, and asked whether they agreed to respond to the household interview questions. In encouraged EAs only, a primary male or female (over the age of 15 years) who was identified in the CLE was randomly selected to be informed of the VFC service, asked to participate in a willingness-to-pay game, offered the VFC service, and if accepted, registered and profiled for VFC.

Enumerators were also expected to follow certain procedures in replacing households. Replacement household rankings had been provided in the sample list, which was supposed to guide enumerators in replacing households that have been found ineligible or unavailable for the survey. If the targeted member of the household was unavailable for the interview, the entire household was replaced. However, if the primary male (PM) or primary female (PF) listed during the CLE—who was not the targeted person—was not available, but the targeted individual was available for the interview and there was no eligible household member to replace that PM or PF, enumerators were instructed to proceed with the interview and use code 96 to indicate unavailability of the PM or PF.

A total of 3,936 completed interviews were conducted—1,979 households in the central region and 1,957 in the UW region (Table 5.3). Of these, 616 surveys were sampled from the replacement list of households. The main reason for replacement was that the targeted individual was not available (411 cases did not have either the targeted primary female or male available). Of the 411 cases, 304 did not have a primary male available, and 107 did not have a primary female available. The rest of the replacement cases was due to households not fulfilling the eligibility criteria, either because of mistakes made during the CLE or changes in their circumstances between the CLE and the baseline survey.[18]

[18] Only one household refused to be interviewed.

Table 5.3: Summary of household surveys in both Central and Upper West Regions

	Central	Upper West	Total
Number of EAs completed	104	102	206
Completed household interviews	1,979	1,957	3,936
Intended household interviews	1,976	1,957	3,933
Replaced household	385	231	616
No targeted gender respondent available	183	228	411
Treatment group	991	988	1,979
Control group	988	969	1,957

Of the households in the final baseline sample, 1,957 were in the comparison group and 1,979 in the encouraged group. Across the encouraged group, 276 households were in the single female strata and 1703 in the two-person (male and female) strata. In the two-person strata, 392 households targeted the primary male and received the Agriculture script, 430 targeted the primary male and received the Agriculture+nutrition script; 438 targeted the primary female and received the agriculture script; and 443 targeted the primary female and received the agriculture+nutrition script (Table 5.4).

Table 5.4: Sample size across treatment groups

Group	Main treatment	Household-level sub-randomization				Total Number of households
		Gender targeting	Information	Single female household	Two person households	
1	Comparison	–	–			1,957
2a	Encouraged	Male	Agriculture		392	392
2b	Encouraged	Male	Agriculture + nutrition		430	430
2c	Encouraged	Female	Agriculture	138	438	576
2d	Encouraged	Female	Agriculture + nutrition	138	443	581

5.5.3 Consent for VFC service in Treatment Households

The evaluation design relies on a random offer of access to the VFC programme to drive differences in registration across encouraged and comparison EAs. At the end of the household survey all encouraged households were asked whether they wished to receive additional information on VFC and play a short game. If the household gave consent, then the targeted respondent was given a brief description of the VFC service and asked to participate in a willingness-to-pay exercise to sign up for the service. At the end of the second stage of the willingness-to-pay exercise, all respondents were offered the service free of charge and asked whether they were willing to be registered for the VFC.

Of the 1,979 households in the encouraged arm surveyed, 122 households did not consent to receive additional information on the Vodafone Farmers' Club service and to participate in the willingness-to-pay exercise to sign up for the service. An additional 14 households were unwilling to do the second stage of the willingness-to-pay exercise, which would guarantee them a zero price for the service. Of the remaining 1,843, 1,811 households agreed to be registered for the service. Thus, 91.5 percent of the 1,979 encouraged households agreed to be registered for the service and to receive the content on their mobile.

5.5.4 Registration, migration, and activation to VFC

Of the 1,811 households that agreed to be signed up for the VFC service, 370 asked to be migrated to the Vodafone Farmers' Club service using their existing Vodafone mobile number. Migration to the VFC service

could not be done by enumerators, and thus a list of households and phone numbers to be migrated was sent to Esoko to complete migration. The remaining 1,441 households were given new Vodafone Farmers' Club SIM cards, which were registered by enumerators. Enumerators were asked to try and register the new SIM cards while in the respondent's house, and if they were unable to do the registration on the spot (because of connectivity issues), make sure they gathered all the necessary information to do the registration remotely. Initially, the unsuccessful registrations were to be completed by Esoko. However, after the first week of fieldwork (and discussing with Esoko), it was deemed more efficient to have the enumerators complete the unsuccessful registrations in the evening when they were back in their places of residence. This way, any incorrect information could be quickly corrected by enumerators.

After the SIM was successfully registered, households were required to activate their new SIM cards by using the phone to check the balance or send a text message to start receiving VFC messages. On June 6, 2017, Vodafone shared the status of 1,798 of the 1,811 numbers that were to be registered or migrated to Vodafone Farmers' Club service. The 51 non-VFC active SIM cards were on other services on the Vodafone network (Table 5.5).

Table 5.5: VFC status for treatment households

SIM STATE	VFC	Non VFC	Total
Active	1,399	51	1,450
Pre-active	348	0	348
Total	1,747	51	1,798

5.5.5 Profiling households

After households had successfully registered or migrated to the VFC, they needed to be profiled to receive weather and market price information for their district and crop information for their chosen crop in their chosen language. Information for the profiling was collected right after the WTP exercise if the respondent consented to sign up for the VFC service. This information was sent to Esoko to complete the profiling. Since there is no system set up for batch profiling, the profiling must be done by hand, one at a time, which is time consuming. Given delays in the profiling, IFPRI has hired two interns to help Esoko complete the profiling.

Of the 923 treatment farmers in the Central region, 43.7 percent (403) asked to be profiled to receive farm and nutrition tips for cocoa, 33.8 percent (312) for cassava, and 14.4 percent (133) for maize (Figure 5.1). The remaining 75 households (8.1 percent) chose among the remaining 12 different commodities.

In the UW region, 49.8 percent (442) of the 888 treatment households asked to be profiled for maize, 36.2 percent (321) for groundnuts, and 7.2 percent (64) for millet (Figure 5.2). The remaining 6.8 percent of households chose among the remaining 10 commodities.

Figure 5.1: Type of crop registered to be profiled for VFC, Central Region

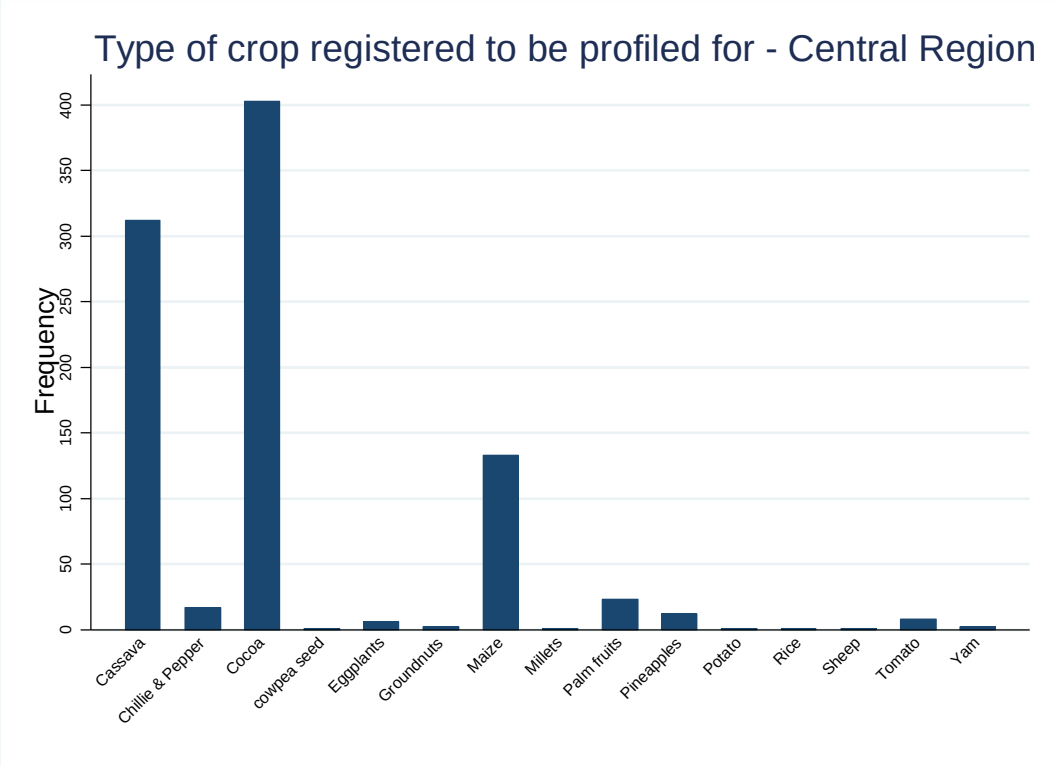
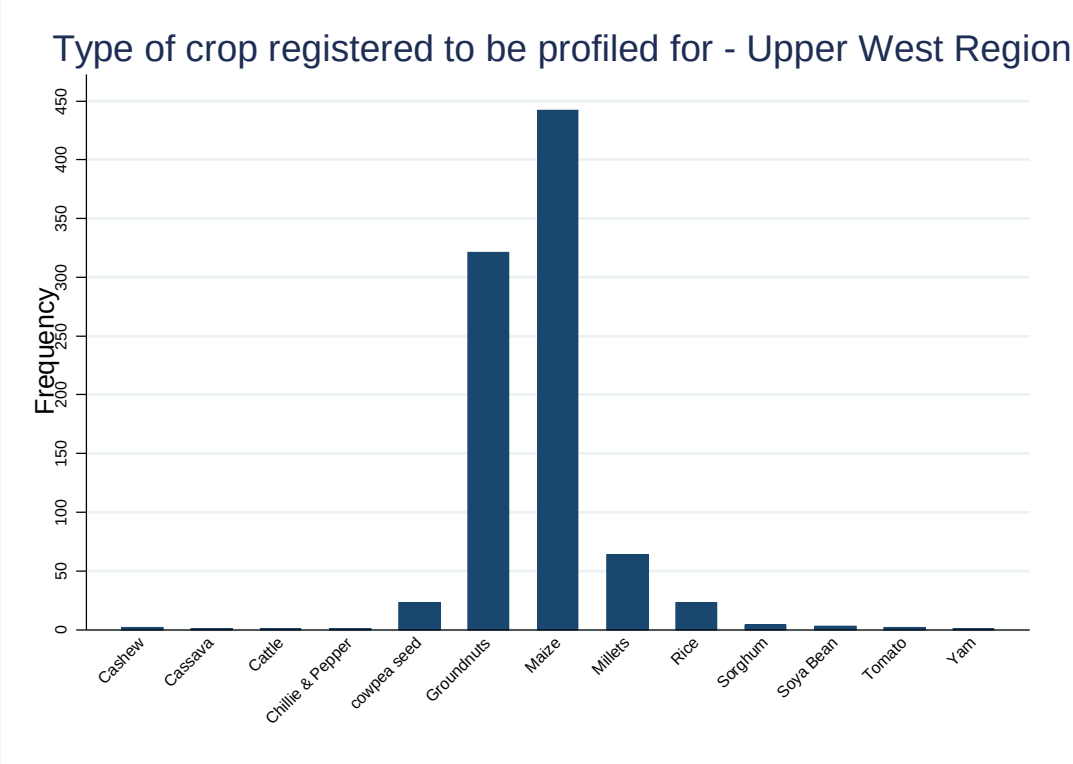


Figure 5.2: Type of crop registered to be profiled for VFC, Upper West Region



5.6 Data quality and cleaning

Data from the CLE and baseline household survey were collected using a CSPRO programme on Samsung tablets. All data were synched daily by enumerators (unless there were internet connectivity issues) to a remote server in Dropbox.

ISSER and IFPRI were careful to ensure the quality of the data collection. This was done primarily in six ways. First, team supervisors travelled with the enumeration teams, sat in on interviews, and reviewed the data being collected. Second, a fieldwork manager was present for the first week of household survey fieldwork, during which time he/she also sat in on household interviews, checked the data being recorded, and offered additional feedback to enumerators. Third, a fieldwork manager conducted EA revisits to address any issues that may have come up from the data collection teams. Fourth, ISSER concatenated and exported the baseline household data daily to Dropbox and checked for duplicate HHIDs and completeness of surveys. Fifth, ISSER kept detailed field notes and shared with IFPRI weekly. Any issues were discussed and solutions provided. Sixth, IFPRI conducted data validation checks 3-4 times a week on the exported data. To this end, a programme to perform data checks was developed by IFPRI staff to promptly validate question responses and identify incomplete information through a set of consistency checks. Incomplete or unsatisfactory questionnaires were returned to the relevant supervisors, and errors were corrected by enumerators during brief revisits to identified households. Main problems included duplicate HHIDs, missing household heads, missing targeted primary male respondents and targeted primary female respondents.

5.7 Limitations and challenges

5.7.1 Adapting to changes in the Vodafone Farmers' Club service

The recent changes to the VFC service and possibility for future changes through the course of the study intervention period presents a challenging environment for the impact evaluation. In October 2016, Vodafone decided to eliminate the monthly service fee for existing and new members of Farmers' Club to increase membership. As a result, IFPRI could no longer offer to farmers in the encouraged group price discounts on the service during baseline data collection as originally planned in the inception report. However, it was determined that door-to-door marketing of Farmers' Club that included scripts on the value added of the product would lead to significant take-up in the treatment group. Moreover, the willingness-to-pay experiment could still be included in the survey. After eliciting a respondent's willingness to pay, the respondent would be offered the service free of any charge (as any current new Farmers' Club member). In June 2017, Vodafone re-installed the service fee for VFC, again posing a challenge to the evaluation team who believed the service fee would lead to a large number of study farmers dropping from the service. To ensure the success of the evaluation, Vodafone worked with IFPRI to design a system in which study farmers were credited air-time to pay for the service fee in June 2017. In July 2017, Vodafone implemented a new platform only for study farmers where they received the VFC service at no charge.

5.7.2 Ensuring study farmers were registered, activated, and profiled for VFC

Another challenge faced by the evaluation team was ensuring that farmers in the encouraged group were registered and profiled for the Vodafone Farmers' Club service. Registration for VFC service could occur either through a VFC SIM or by migrating an existing Vodafone number to the service. Enumerators were instructed to try and register the new SIM cards while in the respondent's house, and if they were unable to do the registration on the spot (because of connectivity issues), make sure they gathered all the necessary information to do the registration remotely. Initially, the unsuccessful registrations were to be completed by Esoko. However, after the first week of fieldwork (and discussing with Esoko), it was deemed more efficient to have the enumerators complete the unsuccessful registrations in the evening when they were back in their places of residence. This way, any incorrect information could be quickly corrected by enumerators.

Although enumerators were successfully able to register farmers in the evenings, not all registered farmers had activated their SIM cards (see Table 5.5). Thus, it was deemed necessary by the study team to go back to households in the encouraged group, conduct more door-to-door encouragements of the product, and ensure farmers were successfully registered and activated. The follow-up occurred in July 2017.

After households had successfully registered or migrated to the VFC, they needed to be profiled to receive weather and market price information for their district and crop information for their chosen crop in their chosen language. Information for the profiling was collected during the baseline survey and sent to Esoko to complete the profiling. Since there is no system set up for batch profiling, the profiling needed to be done by hand, one at a time, which is time consuming. Given delays in the profiling, IFPRI hired two interns to help Esoko complete the profiling. Profiling of study households registered for the VFC service was completed at the end of June 2017.

6 Baseline Data: Sample Characteristics and Balance

Baseline data were successfully collected from 3,936 households. In this section, we discuss the data with two primary goals: (1) characterizing the observable attributes of the household sample, especially those relevant to the mobile-based information intervention being evaluated and (2) assessing balance in baseline characteristics across the encouraged and comparison EAs. We do this by presenting the means and standard deviations from baseline data for the full sample, as well as disaggregating by the Central and UW regions and by EA-level treatment assignment. Each table of baseline data is followed by a brief discussion of the statistics presented, and their implications for the quantitative evaluation.

Balance-in-baseline characteristics across the two treatment groups is central to the success of the randomized encouragement evaluation strategy. Imbalance in observable attributes at baseline, especially those thought to be strongly correlated with the outcomes of interest, typically casts doubt on the ability of the evaluation to identify the causal effect of the intervention being investigated. However, there is no clear consensus in the evaluation literature about how best to test for baseline balance, or overlap, in the distribution of a characteristic across the treatment and control group. In particular, while a comparison of means of a variable across the treatment and control groups can be informative, it is hard to draw any sound inference about whether the observed difference is meaningful because randomized assignment to treatment eliminates the basis for classical statistical inference in the usual t-test. We elect to present two sets of balance measures for each baseline characteristic: the p-value from a t-test of a null hypothesis that there is no difference in means between the two treatment groups and the normalized difference suggested by Imbens (2015).

6.1.1 P-Value from a Test of No Difference in Means

Most quantitative evaluations resort to statistical tests for the equality of means across treatment groups to determine balance in baseline characteristics. In effect, these test statistics capture how large the differences in means are relative to the typical variation in a variable observed in the data. We follow this practice by presenting, for each baseline characteristic, the probability (p-value) that the difference in means between the encouraged and comparison group is equal to zero. This p-value is computed based on a t-test of the null hypothesis that there is no difference between the two groups, using a regression of the characteristic on an indicator for whether each household resided in an encouraged EA at baseline with clustering standard errors at the EA level. A successful randomization should lead to few statistically significant differences in observable characteristics between the two groups.

Because we test for differences across the two treatment groups for many different baseline characteristics, even if the randomization was successful, we will observe some statistically significant differences. For example, interpreting characteristics based on the convention that a p-value below 0.05 is significant, we should expect to observe a significant difference for 1 out of every 20 tests simply by chance.[19] However, observing a significant difference for substantially more than 1 out of 20 tests would indicate that the randomization did not achieve balance, and suggest that any differences in outcomes at endline could be attributable to the baseline imbalance, rather than the mNutrition treatment.

The baseline report does not make any adjustments for multiple hypothesis testing—that is, adjusting for the fact that the likelihood of rejecting the null hypothesis at any level α when conducting multiple tests is typically increasing in the number of tests. Suggested corrections for this over rejection of the null due to multiple inference range from a Bonferroni correction that adjusts the required p-value for rejecting the null hypothesis by scaling the original significance level by the number of tests m ($\alpha_{Bonf} = \frac{\alpha}{m}$), reducing the

[19] The number of significant differences we should expect to observe by chance is actually greater than 1 out of 20. This is because, when testing multiple hypotheses simultaneously, the probability of observing at least one difference that is significant at the 5 percent level is actually greater than 5 percent. While methods have been developed to adjust for multiple hypothesis testing, we elect to present the unadjusted p-values and instead encourage readers to exert caution to avoid overinterpreting any significant differences.

number of tests by generating a summary index that combines the data from the individual indicators, or step-down methods for adjusting p-values to control for the familywise error rate (FWER)[20] using the actual data (Romano and Wolf, 2005; Kling et al., 2007; Anderson, 2008). While the endline impact analysis will use both the summary index and step-down p-value adjustment methods, we elect to make no formal adjustments for multiple hypothesis testing during the baseline analysis. Instead, we simply note that any adjustment for multiple hypothesis testing would reduce the number of tests with a p-value below our significance level of $\alpha = 0.05$.

6.1.2 Normalized Difference

Though assessing balance in observable characteristics by calculating p-values from a test of the null hypothesis of no difference between the encouraged and comparison group is useful, it is also sensitive to the sample size. Because the p-value is based on the t-statistic—the ratio of the difference in means between the two groups to the standard error for that difference—it increases quickly with the sample size. Therefore, particularly for large sample sizes, large t-statistics and the corresponding low p-values may be less informative about observable balance. We therefore follow Imbens (2015) and present the normalized difference for each characteristic. The normalized difference is the difference in means between the two groups scaled by the average of the within group standard deviations. Specifically, for characteristic x, the normalized difference is given by

$$\Delta_x = \frac{\mu_T - \mu_C}{\sqrt{(\sigma_T^2 + \sigma_C^2)/2}},$$

where μ_T and μ_C are the sample means for households in the encouraged and comparison group and σ_T^2 and σ_C^2 are the conditional within-group sample variances for characteristic x, respectively. Like the p-value from a t-test of no difference between the two treatment groups, the normalized difference is scale free (i.e., the difference is calculated relative to the "normal" variation in the variable as measured by the variance). However, the normalized difference is also substantially less sensitive to the sample size: the t-statistic is approximately equal to the normalized difference multiplied by the square root of the total sample size. We therefore use the normalized differences as our preferred measures of balance, and follow Imbens (2015) in interpreting normalized differences below 0.25 as being indicative of baseline balance. Nonetheless, we report both normalized differences and p-values for differences in means across treatment arms in the balancing tests for comparison.

The remainder of this section describes the baseline data and balance in observable characteristics between the encouraged and comparison groups. We begin with a table for basic household demographics including the age, sex, marital status, and educational attainment of household members and a table for household wealth and assets. Next, we present information on mobile phone access and usage for the primary male and female in each household. We then present a table with the primary outcomes, including household and women's dietary diversity, crop yields, and the value of crop production. Next, we present secondary outcomes on nutrition and farming knowledge and practices, followed by sources and trust in nutrition and agriculture information. In all tables we present the normalized difference between the encouraged and comparison group and the p-value from a t-test of a null hypothesis that there is no difference in means between the two groups.

[20] The FWER is defined as the probability of rejecting at least one true null hypothesis.

6.2 Household demographics, assets, and wealth

6.2.1 Household demographics

Table 6.1 presents sample characteristics for household demographics, the household head, and the primary female. On average, households have 5.1 members, with the UW region having a larger household size (5.5 members) compared to the Central region (4.7 members). Twenty-one percent of households are female-headed, with the UW region having less female-headed households (15.4 percent) than the central region (26.8 percent). Household heads[21] are, on average, 47 years old, 31.3 percent can read a phrase in English and 23.9 percent in the local language, 51.8 percent have had some education, 68.6 percent are in a monogamous marriage, 13 percent are in a polygamous marriage, and 86.7 percent have crop production as their main activity. The main differences in household head characteristics across the UW and Central regions are being able to read in English (42 percent in the Central region and 20.5 percent in the UW region), having some education (73.9 percent in the Central region and 29.3 percent in the UW region), being in a polygamous marriage (6.9 percent in the Central region and 19.1 percent in the UW region), and having crop production as their main activity (83.3 percent in the Central region and 90.2 percent in the UW region). The primary females[22] in sample households are, on average, 42 years old, 16.5 percent can read a phrase in English and 9.8 percent in the local language, 41.4 percent have some education, 72 percent are in a monogamous marriage, 8.5 percent are in a polygamous marriage, and 74.8 percent have crop production as their main activity. Similar to the household head, the main differences in primary female characteristics across the UW and central region are being able to read in English (20.3 percent in the Central region and 12.6 percent in the UW region), having some education (60.3 percent in the Central region and 22.5 percent in the UW region), being in a polygamous marriage (2.9 percent in the Central region and 14.1 percent in the UW region), and having crop production as their main activity (68.3 percent in the Central region and 81.3 percent in the UW region).

In terms of differences across the encouraged and comparison groups, only 1 out of 18 variables are significant at the 5 percent level. In particular, encouragement households have significantly larger households than comparison households (5.2 members versus 4.9 members). Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 threshold and only one (household size) of 18 has a normalized difference above 0.10. Based on household demographic characteristics, the randomization appears to have been successful at selecting observably similar households.

[21] Definition of Household head: the individual who plays a leading role in household decision-making, particularly concerning farming, household economic activity and expenditures. Generally, the person identified by the household as the household head is accepted in this role for the survey.
[22] Definition of Primary female respondent: see section 5.1

Table 6.1: Household demographics, by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (E) and (C)	P-value
Household size	3,936	5.131	4.731	5.534	5.262	4.998	-0.111	0.026
		(2.377)	(2.184)	(2.495)	(2.420)	(2.326)		
Female-Headed Household	3,935	0.211	0.268	0.154	0.199	0.224	0.063	0.196
		(0.408)	(0.443)	(0.361)	(0.399)	(0.417)		
Age of Household Head	3,935	47.920	48.206	47.630	47.667	48.175	0.034	0.423
		(14.932)	(14.253)	(15.588)	(14.913)	(14.951)		
Household Head can read a phrase in English	3,935	0.313	0.420	0.205	0.312	0.314	0.004	0.946
		(0.464)	(0.494)	(0.404)	(0.464)	(0.464)		
Household Head can read a phrase in the local language	3,935	0.239	0.345	0.132	0.243	0.236	-0.015	0.785
		(0.427)	(0.476)	(0.339)	(0.429)	(0.425)		
Household Head has some education	3,935	0.518	0.739	0.293	0.523	0.512	-0.021	0.774
		(0.500)	(0.439)	(0.455)	(0.500)	(0.500)		
Household Head: Not Married, Divorced, Widowed, Separated	3,934	0.185	0.225	0.144	0.181	0.189	0.020	0.640
		(0.388)	(0.418)	(0.351)	(0.385)	(0.391)		
Household Head: Married, Monogamous	3,934	0.686	0.706	0.664	0.692	0.679	-0.026	0.511
		(0.464)	(0.456)	(0.472)	(0.462)	(0.467)		
Household Head: Married, Polygamous	3,934	0.130	0.069	0.191	0.127	0.132	0.013	0.790
		(0.336)	(0.253)	(0.393)	(0.334)	(0.338)		
Household Head's main activity is crop production	3,931	0.867	0.833	0.902	0.867	0.868	0.004	0.937
		(0.339)	(0.373)	(0.298)	(0.340)	(0.339)		
Age of the Primary Female	3,828	42.295	42.851	41.738	42.212	42.380	0.012	0.793
		(14.252)	(13.748)	(14.723)	(14.300)	(14.206)		
Primary Female can read a phrase in English	3,827	0.165	0.203	0.126	0.171	0.158	-0.034	0.412
		(0.371)	(0.402)	(0.332)	(0.377)	(0.365)		
Primary Female can read a phrase in the local language	3,827	0.098	0.133	0.064	0.098	0.099	0.003	0.954
		(0.298)	(0.339)	(0.245)	(0.297)	(0.298)		
Primary Female has some education	3,827	0.414	0.603	0.225	0.415	0.414	-0.003	0.970
		(0.493)	(0.489)	(0.418)	(0.493)	(0.493)		
Primary Female: Not Married, Divorced, Widowed, Separated	3,828	0.195	0.231	0.159	0.188	0.201	0.033	0.443
		(0.396)	(0.422)	(0.365)	(0.391)	(0.401)		
Primary Female: Married, Monogamous	3,828	0.720	0.740	0.701	0.730	0.710	-0.043	0.303

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (E) and (C)	P-value
		(0.449)	(0.439)	(0.458)	(0.444)	(0.454)		
Primary Female: Married, Polygamous	3,828	0.085	0.029	0.141	0.082	0.088	0.023	0.695
		(0.279)	(0.168)	(0.348)	(0.274)	(0.283)		
Primary Female's main activity is crop production	3,814	0.748	0.683	0.813	0.763	0.733	-0.068	0.211
		(0.434)	(0.465)	(0.390)	(0.426)	(0.442)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. The normalized difference is the difference in means between the two groups scaled by the average of the within group standard deviations. P-value is from the test of difference of means between encouraged and comparison groups. Statistics on the primary female are only for the subset of households that had a primary female.

6.2.2 Household assets and wealth

To measure household wealth, we rely on a poverty index. The progress out of poverty index (PPI) uses a country- and year-specific set of ten questions to calculate the likelihood that a household is living below different national and international poverty lines.[23] A higher PPI score corresponds to a lower likelihood of the household living below the poverty line. In Ghana, the ten questions used to generate the PPI include the number of household members, school enrolment of children in the household, whether the male head or spouse could read a phrase in English, building materials for the walls, type of toilet facility, fuel used for cooking, and ownership of a working box or electric iron, a working TV, video player, VCD player, or satellite dish, the number of working mobile phones owned by the household, and ownership of a working bicycle, motorcycle, or car. The latest index was created in 2015 using Ghana's 2012/13 Living Standards Survey.

We also produce household asset indices for consumer durables,[24] agriculture production,[25] livestock,[26] and a total asset index. For the asset indices, we generate dichotomous indicators for whether the household owned at least one of each asset in that class (e.g., sheep and goats would be included in the livestock index). Principal component analysis is then used to identify the first orthogonal component—the linearly independent component that explains the highest fraction of the total variance in the class—and that component is used as the index for that asset category. The first component of the total asset index explains 15.02 percent of the variation in asset ownership.

Table 6.2 reveals that the average PPI score for households in our sample is 60.5, with households in the Central region having a higher score than those in the UW region (63.9 versus 57.1). A PPI score of 60 corresponds to a household having a 10.6 percent chance of being below 150 percent of the national poverty line in Ghana, and a 1 percent chance of living on less than $2.00 per day in 2005 US dollars. For poverty lines considered by the Progress out of Poverty group in Ghana, converting the PPI score for each household into a poverty likelihood and averaging the poverty likelihood across all households in the sample yields an estimate for the percent of households in our sample below that poverty line. We calculate that 19 percent of sample households are below 150 percent of the national poverty line in Ghana and 3 percent are living on less than $2.00 per day in 2005 US dollars.

In terms of consumer durables, the only item owned by more than half the sample is a working mobile phone (89.4 percent). Given that our sample inclusion criteria required a mobile phone, it is surprising that 11 percent of households do not own a working mobile phone. The discrepancy could be due to a different person responding to the question between the census and baseline survey, or that a working phone during the census no longer worked during the baseline. Other consumer durables owned by at least a third of the sample are a bicycle (42.5 percent), a television (36.5 percent), and an iron (34.2 percent). For three of the four more commonly owned items, households in the Central region are more likely to own the item than households in the UW region (92.6 percent versus 86.2 percent for mobile phone, 50.3 percent versus 22.6 percent for television, and 43.8 percent versus 24.6 percent for iron). However, households in the UW region are more likely to own a bicycle than households in the Central region (13.5 percent in the Central region versus 71.8 percent in the UW region). In terms of the overall consumer durable index, households in the Central region have a higher index than households in the UW region.

[23] See http://www.progressoutofpoverty.org/ for a more detailed description of the methods.
[24] The assets included in the household consumer durable asset index are iron (box or electric), video player/VCD/DVD/MP3/MP4 player/ iPod, television (B/W or colour), satellite dish, bicycle, motorcycle, car, and working mobile phone.
[25] The assets included in the household production asset index are plough and yoke of animals, wheelbarrow/hauling carts, other non-mechanized farm equipment (hoe, rake, shovel), and mechanized farm equipment (tractor-plough, power tiller, treadle pump).
[26] The assets included in the household livestock asset index are bulls/oxen/cattle, buffalo, sheep, goats, chicken, other poultry, pigs, horses, and donkeys.

Table 6.2: Housing characteristics, asset ownership, and poverty index, by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (E) and (C)	P-value
Total PPI score	3,936	60.506	63.887	57.086	60.160	60.856	0.050	0.448
		(14.017)	(13.621)	(13.577)	(13.941)	(14.088)		
Consumer Durable Asset Index	3,936	-0.000	0.371	-0.376	0.016	-0.017	-0.022	0.756
		(1.503)	(1.548)	(1.357)	(1.522)	(1.485)		
Household owns a box/electric iron	3,936	0.342	0.438	0.246	0.341	0.344	0.006	0.918
		(0.475)	(0.496)	(0.431)	(0.474)	(0.475)		
Household owns video players/iPods	3,936	0.187	0.276	0.096	0.188	0.185	-0.006	0.915
		(0.390)	(0.447)	(0.295)	(0.391)	(0.389)		
Household owns a television	3,936	0.365	0.503	0.226	0.361	0.370	0.019	0.799
		(0.482)	(0.500)	(0.418)	(0.480)	(0.483)		
Household owns a satellite dish	3,936	0.122	0.138	0.105	0.125	0.118	-0.022	0.707
		(0.327)	(0.345)	(0.307)	(0.331)	(0.323)		
Household owns a bicycle	3,936	0.425	0.135	0.718	0.424	0.426	0.003	0.970
		(0.494)	(0.342)	(0.450)	(0.494)	(0.495)		
Household owns a motorcycle	3,936	0.178	0.040	0.317	0.189	0.166	-0.063	0.330
		(0.382)	(0.196)	(0.465)	(0.392)	(0.372)		
Household owns a car	3,936	0.018	0.025	0.010	0.022	0.014	-0.060	0.072
		(0.132)	(0.157)	(0.101)	(0.146)	(0.117)		
Household owns a working mobile phone	3,936	0.894	0.926	0.862	0.901	0.887	-0.048	0.338
		(0.308)	(0.261)	(0.345)	(0.298)	(0.317)		
Household Agriculture Asset Index	3,936	0.000	-0.155	0.156	0.031	-0.032	-0.058	0.261
		(1.083)	(0.584)	(1.403)	(1.141)	(1.020)		
Household owns plough/yokes	3,936	0.015	0.000	0.031	0.017	0.014	-0.023	0.595
		(0.123)	(0.000)	(0.172)	(0.128)	(0.117)		
Household owns a wheelbarrow	3,936	0.067	0.038	0.096	0.074	0.060	-0.056	0.368
		(0.250)	(0.191)	(0.295)	(0.261)	(0.237)		
Household owns other non-mechanized farm equipment	3,936	0.976	0.988	0.964	0.983	0.969	-0.095	0.040
		(0.153)	(0.109)	(0.186)	(0.128)	(0.174)		
Household owns mechanized farm equipment	3,936	0.011	0.015	0.006	0.012	0.010	-0.019	0.643
		(0.103)	(0.122)	(0.078)	(0.107)	(0.098)		

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (E) and (C)	P-value
Household Livestock Asset Index	3,936	-0.000	-0.642	0.649	0.077	-0.078	-0.106	0.191
		(1.462)	(0.737)	(1.706)	(1.510)	(1.407)		
Household owns cattle/bull/oxen	3,936	0.059	0.001	0.118	0.074	0.044	-0.127	0.029
		(0.236)	(0.032)	(0.322)	(0.261)	(0.205)		
Household owns goat	3,936	0.470	0.351	0.590	0.473	0.467	-0.012	0.848
		(0.499)	(0.477)	(0.492)	(0.499)	(0.499)		
Household owns sheep	3,936	0.173	0.111	0.236	0.176	0.169	-0.019	0.749
		(0.378)	(0.314)	(0.424)	(0.381)	(0.375)		
Household owns pigs	3,936	0.169	0.008	0.331	0.188	0.149	-0.104	0.207
		(0.375)	(0.090)	(0.471)	(0.391)	(0.356)		
Household owns chicken	3,936	0.644	0.661	0.625	0.647	0.640	-0.014	0.796
		(0.479)	(0.473)	(0.484)	(0.478)	(0.480)		
Household owns other poultry	3,936	0.129	0.010	0.248	0.138	0.119	-0.059	0.387
		(0.335)	(0.100)	(0.432)	(0.345)	(0.323)		
Household owns donkeys	3,936	0.053	0.000	0.107	0.066	0.040	-0.113	0.152
		(0.224)	(0.000)	(0.309)	(0.248)	(0.197)		
Household Total Asset Index	3,936	0.000	-0.901	0.911	0.093	-0.094	-0.111	0.192
		(1.689)	(0.738)	(1.882)	(1.748)	(1.623)		
Household owns or operates a parcel of agricultural land	3,936	0.984	0.987	0.981	0.991	0.977	-0.116	0.013
		(0.125)	(0.112)	(0.136)	(0.092)	(0.150)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. The normalized difference is the difference in means between the two groups scaled by the average of the within group standard deviations. P-value is from the test of difference of means between encouraged and comparison groups.

For agriculture assets, most households own non-mechanized farm equipment (97.6 percent) while very few own mechanized farm equipment (1.1 percent). Although households in the Central region are more likely than those in the UW region to own non-mechanized and mechanized farm equipment, they are less likely to own a wheelbarrow and plough. As a result, households in the Central region have a lower agriculture asset index than households in the UW region. For livestock, most households own a chicken (64.4 percent) and almost half own a goat (47.0 percent). Households in the Central region are more likely to own a chicken (66.1 percent versus 62.5 percent) and less likely to own a goat (35.1 percent versus 59.0 percent). Overall, households in the Central region own less livestock than households in the UW region and have a lower livestock index score. Although households in the Central region have a higher consumer durables index, they have a lower agriculture and livestock index, and thus they have a lower total asset index.

In terms of differences across the encouraged and comparison groups, only 3 out of 25 variables are significant at the 5 percent level. In particular, encouragement households are significantly more likely than comparison households to own non-mechanized farm equipment (98.3 percent versus 96.9 percent), cattle, bull, or oxen (7.4 percent versus 4.4 percent), and agriculture land (99.1 percent versus 97.7 percent). Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 threshold and only 6 of 25 have a normalized difference above 0.10. Based on assets and wealth, the randomization appears to have been successful at selecting observably similar households.

6.3 Mobile phone access and usage

Tables 6.3 and 6.4 present baseline information on mobile phone access and usage as reported by the primary female and primary male, respectively. Below we discuss the indicators separately by respondent sex, first for females and then for males, before briefly discussing gendered differences in the responses at the end of this subsection.

6.3.1 Primary female

Table 6.3 reveals that mobile phone ownership by the primary female is moderate at 46.8 percent; however, most primary females have access to a mobile phone (81.9 percent). Access to a mobile phone for this study was defined as the respondent either owning a working mobile phone or someone in their household owning a working mobile phone. There are large differences in ownership and access by region with ownership and access in the central region being 56.5 percent and 88.2 percent, respectively, compared to 37.1 percent and 75.6 percent in the UW region. A small percentage of females (31.4 percent) use Vodafone network as the main network, with the Central region having a lower percentage (12.8 percent) compared to the UW region (53.2 percent). On average, the primary female spends 9.1 GHS a month on airtime, with females in the Central region spending 12.5 GHS a month and females in the UW region spending 5.1 GHS a month. Most primary females charge their phones at home (73.7 percent), 77.9 percent in the Central region and 68.1 percent in the UW region.

Of the primary females who have access to a mobile phone, 6.3 percent did not use it in the last 14 days. Of those that did use it in the last 14 days, 82.4 percent made calls, 87.1 percent received calls, only 4.2 percent sent text messages, 23.1 percent received text messages, only 5.2 percent sent mobile money, and 11.9 percent received mobile money. Differences across regions are large, with females in the Central region being more likely than the UW region to make calls (90.6 percent versus 72.5 percent, respectively), receive calls (92.5 percent versus 80.8 percent, respectively), receive text messages (27.7 percent versus 17.7 percent, respectively), send mobile money (6.5 percent versus 3.6 percent, respectively), and receive mobile money (16.2 percent versus 6.7 percent, respectively). However, females in the Central region are less likely than those in the UW region to send text messages in the last 14 days (2.8 percent versus 5.7 percent, respectively). Very few females have ever used their mobile phone to receive agriculture advice (1.5 percent) or received text messages on agriculture and nutrition information (1.0 percent), although more than half (57.5 percent) report that they would find it useful. Differences appear across regions with

females in the Central region being less likely to have ever used their mobile phone to receive agriculture advice (1.1 percent versus 2 percent, respectively) but more likely to report finding it useful to receive agriculture and nutrition information (64.9 percent versus 47.9 percent, respectively).

In terms of differences across the encouraged and comparison groups, 2 out of 15 variables are significant at the 5 percent level. In particular, encouragement households are significantly less likely than comparison households to send (4.2 percent versus 6.2 percent) and receive (9.6 percent versus 14.2 percent) mobile money. Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 threshold and only 3 of 15 have a normalized difference above 0.10.

Based on the primary female's mobile phone access and usage, the randomization appears to have been successful at selecting observably similar households.

6.3.2 Primary male

Table 6.4 reveals that mobile phone ownership by the primary male is high at 79.6 percent, and most primary males have access to a mobile phone (89.7 percent). There are large differences in ownership and access by region with ownership and access being higher in the Central region (85.9 percent and 93.8 percent, respectively) compared to the UW region (74.1 percent and 86.1 percent, respectively). A small percentage of males (35.2 percent) use Vodafone network as the main network, with the Central region having a lower percentage (14.3 percent) compared to the UW region (55.3 percent). On average, the primary male spends 22.7 GHS a month on airtime, with males in the Central region spending 31.8 GHS a month and those in the UW region spending 13.9 GHS a month. Most primary males charge their phones at home (72.7 percent), 77.7 percent in the Central region and 67.8 percent in the UW region.

Of the primary males who have access to a mobile phone, only 3.3 percent did not use it in the last 14 days. Of those that did use it in the last 14 days, 94.2 percent made calls, 95.8 percent received calls, only 13.2 percent sent text messages, 46.9 percent received text messages, 15.6 percent sent mobile money, and 23.2 percent received mobile money. Differences across regions are moderate, with males in the Central region being more likely than the UW region to make calls (96.9 percent versus 91.5 percent), receive calls (97.4 percent versus 94.4 percent), receive text messages (52.3 percent versus 41.6 percent), send mobile money (19.9 percent versus 11.5 percent), and receive mobile money (29.0 percent versus 17.6 percent). However, males in the Central region are slightly less likely than those in the UW region to send text messages in the last 14 days (12.8 percent versus 13.6 percent). Very few males have ever used their mobile phone to receive agriculture advice (5.2 percent) or received text messages on agriculture and nutrition information (4.1 percent), although more than half (63.2 percent) report that they would find it useful. Differences appear across regions with males in the Central region being less likely to have ever used their mobile phone to receive agriculture advice (4.0 percent versus 6.5 percent) but more likely to report finding it useful to receive agriculture and nutrition information (69.9 percent versus 56.1 percent).

In terms of differences across the encouraged and comparison groups, only 1 out of 15 variables is significant at the 5 percent level. In particular, encouragement households are significantly more likely than comparison households to receive a call (96.7 percent versus 94.9 percent). Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 threshold and only 2 of 15 have a normalized difference above 0.10. Based on the primary male's mobile phone access and usage, the randomization appears to have been successful at selecting observably similar households.

Table 6.3: Mobile phone access and usage (female), by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Owns a mobile phone	3,827	0.468	0.565	0.371	0.447	0.490	0.086	0.113
		(0.499)	(0.496)	(0.483)	(0.497)	(0.500)		
Has access to a mobile phone	3,827	0.819	0.882	0.756	0.823	0.815	-0.023	0.699
		(0.385)	(0.323)	(0.430)	(0.381)	(0.389)		
Main phone number uses a Vodafone SIM card	3,138	0.314	0.128	0.532	0.344	0.283	-0.131	0.183
		(0.464)	(0.334)	(0.499)	(0.475)	(0.451)		
No mobile phone use in the last 14 days	3,136	0.063	0.056	0.071	0.063	0.062	-0.005	0.900
		(0.243)	(0.229)	(0.257)	(0.244)	(0.242)		
Used mobile phone in the last 14 days to make calls	2,944	0.824	0.906	0.725	0.825	0.822	-0.008	0.887
		(0.381)	(0.291)	(0.447)	(0.380)	(0.383)		
Used mobile phone in the last 14 days to receive calls	2,939	0.871	0.925	0.808	0.870	0.873	0.010	0.860
		(0.335)	(0.264)	(0.394)	(0.337)	(0.333)		
Used mobile phone in the last 14 days to send text messages	2,939	0.042	0.028	0.057	0.038	0.046	0.040	0.449
		(0.200)	(0.165)	(0.233)	(0.190)	(0.209)		
Used mobile phone in the last 14 days to receive text messages	2,938	0.231	0.277	0.177	0.223	0.240	0.042	0.485
		(0.422)	(0.448)	(0.382)	(0.416)	(0.427)		
Used mobile phone in the last 14 days to send mobile money	2,938	0.052	0.065	0.036	0.042	0.062	0.093	0.025
		(0.222)	(0.247)	(0.186)	(0.200)	(0.242)		
Used mobile phone in the last 14 days to receive mobile money	2,938	0.119	0.162	0.067	0.096	0.142	0.143	0.003
		(0.324)	(0.369)	(0.250)	(0.295)	(0.349)		
Used mobile phone to receive agriculture advice ever	2,773	0.015	0.011	0.020	0.014	0.015	0.008	0.850
		(0.121)	(0.104)	(0.139)	(0.119)	(0.123)		
Received agriculture and nutrition information via text message ever	2,695	0.010	0.005	0.017	0.010	0.011	0.010	0.806
		(0.100)	(0.067)	(0.130)	(0.097)	(0.102)		
Would find it useful to receive agriculture and nutrition information via text messages	2,724	0.575	0.649	0.479	0.585	0.564	-0.041	0.507
		(0.494)	(0.477)	(0.500)	(0.493)	(0.496)		
Amount spent on airtime on all phones in an average month (GhC)	3,127	9.110	12.507	5.131	9.018	9.205	0.016	0.798
		(11.734)	(13.761)	(6.918)	(12.232)	(11.199)		
Charges phone at home	2,756	0.737	0.779	0.681	0.711	0.765	0.124	0.239
		(0.440)	(0.415)	(0.466)	(0.454)	(0.424)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. The normalized difference is the difference in means between the two groups scaled by the average of the within group standard deviations. P-value is from the test of difference of means between encouraged and comparison groups. Main SIM card service provider question is only asked to those who have access to a mobile phone. Questions on the details of use of a mobile phone in the last 14 days are only asked of the subset of households who said they used their mobile phone in the last 14 days.

Table 6.4: Mobile phone access and usage (male), by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Owns a mobile phone	3,185	0.796	0.859	0.741	0.803	0.789	-0.035	0.479
		(0.403)	(0.348)	(0.438)	(0.398)	(0.408)		
Has access to a mobile phone	3,185	0.897	0.938	0.861	0.906	0.889	-0.055	0.337
		(0.304)	(0.240)	(0.346)	(0.292)	(0.314)		
Main phone number uses a Vodafone SIM card	2,860	0.352	0.143	0.553	0.382	0.320	-0.129	0.211
		(0.478)	(0.350)	(0.497)	(0.486)	(0.467)		
No mobile phone use in the last 14 days	2,859	0.033	0.028	0.037	0.035	0.030	-0.028	0.486
		(0.177)	(0.164)	(0.189)	(0.184)	(0.171)		
Used mobile phone in the last 14 days to make calls	2,771	0.942	0.969	0.915	0.946	0.937	-0.040	0.411
		(0.235)	(0.175)	(0.279)	(0.226)	(0.243)		
Used mobile phone in the last 14 days to receive calls	2,770	0.958	0.974	0.944	0.967	0.949	-0.090	0.043
		(0.200)	(0.160)	(0.230)	(0.178)	(0.219)		
Used mobile phone in the last 14 days to send text messages	2,769	0.132	0.128	0.136	0.133	0.132	-0.003	0.944
		(0.339)	(0.334)	(0.343)	(0.339)	(0.338)		
Used mobile phone in the last 14 days to receive text messages	2,769	0.469	0.523	0.416	0.491	0.446	-0.091	0.083
		(0.499)	(0.500)	(0.493)	(0.500)	(0.497)		
Used mobile phone in the last 14 days to send mobile money	2,768	0.156	0.199	0.115	0.157	0.156	-0.002	0.960
		(0.363)	(0.399)	(0.320)	(0.364)	(0.363)		
Used mobile phone in the last 14 days to receive mobile money	2,768	0.232	0.290	0.176	0.219	0.246	0.064	0.199
		(0.422)	(0.454)	(0.381)	(0.413)	(0.431)		
Used mobile phone to receive agriculture advice ever	2,633	0.052	0.040	0.065	0.050	0.054	0.019	0.682
		(0.222)	(0.196)	(0.246)	(0.218)	(0.226)		
Received agriculture and nutrition information via text message ever	2,563	0.041	0.020	0.063	0.040	0.041	0.009	0.860
		(0.197)	(0.141)	(0.243)	(0.195)	(0.199)		
Would find it useful to receive agriculture and nutrition information via text messages	2,551	0.632	0.699	0.561	0.624	0.641	0.037	0.577
		(0.482)	(0.459)	(0.497)	(0.485)	(0.480)		
Amount spent on airtime on all phones in an average month (GhC)	2,859	22.717	31.844	13.922	22.682	22.753	0.003	0.965
		(23.256)	(27.403)	(13.455)	(23.771)	(22.716)		
Charges phone at home	2,787	0.727	0.777	0.678	0.685	0.771	0.194	0.072
		(0.445)	(0.416)	(0.467)	(0.465)	(0.420)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. The normalized difference is the difference in means between the two groups scaled by the average of the within group standard deviations. P-value is from the test of difference of means between encouraged and comparison groups. Main SIM card service provider question is only asked to those who have access to a mobile phone. Questions on the details of use of a mobile phone in the last 14 days are only asked of the subset of households who said they used their mobile phone in the last 14 days.

6.3.3 Differences across primary male and female mobile phone access and usage

There are large differences across primary male and female mobile phone access and usage. Only 46.8 percent of primary females own a phone compared to 79.6 percent of males. Nearly all males have made (94.2 percent) or received (95.8 percent) a call in the last 14 days compared to 82.4 percent and 87.1 percent of females, respectively. Primary males are also more likely than primary females to send (13.2 percent versus 4.2 percent) and receive (46.9 percent versus 23.1 percent) text messages and send (15.6 percent versus 5.2 percent) and receive (23.2 percent versus 11.9) mobile money. Differences in usage is also reflected in the amount of money spent on airtime, with males spending, on average, 22.7 GHS per month compared to females spending, on average, 9.1 GHS. However, primary males and females are similar in that the majority would find it useful to receive agriculture and nutrition information via text messages (63.2 and 57.5 percent, respectively).

6.4 Primary outcomes

The primary outcomes of the study are household and women's dietary diversity, agriculture yields, and agriculture income. In this subsection, we first present and discuss the dietary diversity indicators before turning to the agriculture yields and income indicators.

6.4.1 Household dietary diversity

We construct a household dietary diversity index using information collected on food the household consumed in the last 24 hours prior to the survey. For 21 different food items, respondents were asked "Yesterday (during the day or the night) did anyone in your **household** eat or drink any [food item]?" (see Annex E for more details on the food items). This information is used to construct a Household Dietary Diversity Score (HDDS), which combines responses to the 21 food items consumed into the following 12 food group indicators: cereals, roots/tubers, vegetables, fruits, meat/poultry/offal, eggs, fish/seafood, pulses/legumes/nuts, milk/milk products, oils/fats, sweets, spices/condiments/beverages. The HDDS indicates a household's economic access to food, thus items are included in the score that require household resources to obtain, such as condiments, sugar and sugary foods, and beverages (Kennedy, Ballard et al. 2011).

Table 6.5 reveals that households, on average, consumed 5.8 out of 12 food groups in the last 24 hours, with households in the Central region consuming 6.29 groups compared to 5.38 food groups in the UW. Condiments, cereals, and fruits are the most commonly consumed groups (91.3 percent, 90.7 percent, 82.1 percent, respectively), while the least common are meat and organ meats, dairy, and eggs (19.5 percent, 13.9 percent, 8.6 percent, respectively). There are large differences across regions in the food groups consumed, especially with respect to roots and tubers (87.0 percent in the Central region versus 7.0 percent in the UW region), oils and fats (20.9 percent in the Central region versus 61.6 percent in the UW region), and eggs (14.4 percent in the Central region versus 2.8 percent in the UW region).

In terms of differences across the encouraged and comparison groups, there are no differences in means that are significant at the 5 or 10 percent level. Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 or .10 threshold. Based on household food consumption, the randomization appears to have been very successful at selecting observably similar households.

Table 6.5: Primary outcomes, household dietary diversity, by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Household Dietary Diversity Score (1-12)	3,721	5.841	6.293	5.381	5.868	5.814	-0.032	0.616
		(1.711)	(1.618)	(1.680)	(1.693)	(1.729)		
Household consumed cereals	3,807	0.907	0.877	0.937	0.907	0.907	0.001	0.988
		(0.290)	(0.329)	(0.243)	(0.291)	(0.290)		
Household consumed roots and tubers	3,809	0.470	0.870	0.070	0.487	0.454	-0.066	0.569
		(0.499)	(0.336)	(0.256)	(0.500)	(0.498)		
Household consumed vegetables	3,811	0.629	0.550	0.708	0.636	0.622	-0.028	0.580
		(0.483)	(0.498)	(0.455)	(0.481)	(0.485)		
Household consumed fruit	3,809	0.821	0.843	0.799	0.816	0.827	0.028	0.639
		(0.383)	(0.364)	(0.401)	(0.388)	(0.379)		
Household consumed meat and organ meat	3,805	0.195	0.199	0.191	0.196	0.194	-0.006	0.905
		(0.396)	(0.399)	(0.393)	(0.397)	(0.395)		
Household consumed eggs	3,787	0.086	0.144	0.028	0.091	0.081	-0.035	0.441
		(0.281)	(0.352)	(0.164)	(0.288)	(0.273)		
Household consumed seafood	3,810	0.816	0.931	0.702	0.817	0.816	-0.004	0.950
		(0.387)	(0.254)	(0.458)	(0.387)	(0.388)		
Household consumed legumes, pulses, nuts, and seeds	3,804	0.254	0.248	0.260	0.260	0.247	-0.031	0.490
		(0.435)	(0.432)	(0.439)	(0.439)	(0.431)		
Household consumed dairy	3,815	0.139	0.173	0.106	0.133	0.145	0.034	0.476
		(0.346)	(0.378)	(0.308)	(0.340)	(0.352)		
Household consumed oils and fats	3,797	0.412	0.209	0.616	0.404	0.421	0.034	0.654
		(0.492)	(0.407)	(0.487)	(0.491)	(0.494)		
Household consumed sweets	3,760	0.200	0.280	0.119	0.206	0.194	-0.028	0.566
		(0.400)	(0.449)	(0.324)	(0.404)	(0.396)		
Household consumed condiments	3,808	0.913	0.968	0.858	0.915	0.911	-0.012	0.830
		(0.282)	(0.176)	(0.349)	(0.279)	(0.284)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups. Household dietary diversity excludes foods purchased and eaten outside the home. HDDS is calculated for households who report on all food groups, ie, for those households who have non-missing responses to all 12 food groups.

6.4.2 Women's dietary diversity

Individual food consumption of the primary female was also collected and used to construct the Minimum Dietary Diversity-Women (MDD-W), which is an updated version of the Women's Dietary Diversity Score (WDDS).[27] The main difference between the WDDS and the MDD-W is that the MDD-W has identified 5 out of 10 food groups as indicating the minimum dietary diversity across contexts. In particular, the MDD-W is a dichotomous indicator that reflects the greater likelihood of women meeting their micronutrient needs than women consuming foods from fewer food groups (FAO and FHI 360, 2016). Similar to the HDDS, the survey instrument collected information on 21 different food items consumed by the primary female in the last 24 hours. For each food item the primary female was asked, "Did you, (name of primary female respondent), eat or drink any [FOOD ITEM] yesterday (during the day or night)"? (see Annex E for the full module).[28] Responses from the consumption of the 21 food items were used to create indicators on the primary female's consumption of the following 10 food groups: grains/white roots/tubers, pulses, nuts and seeds, dairy, meat/poultry/fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, other fruit.[29] In contrast to the HDDS, the MDD-W does not include oils/fats, sweets, and spices/condiments/beverages, but instead is only composed of 10 food groups intended to reflect the micronutrient adequacy of the diet (Kennedy, Ballard et al. 2011).

Table 6.6 reveals that the primary female, on average, consumed 4.5 food groups out of 10, with little differences across regions (4.55 in the Central region and 4.41 in the UW region). This is slightly higher than the mean number of food groups of 3.8 for women 15-49 years old in the Upper West Region reported in the Feed the Future Population based Survey (Zereyesus, Y. A et al 2014).[30] Only 51.9 percent of females met the minimum dietary diversity for women and consumed at least 5 out of the 10 food groups. The percentage of females meeting the MDD-W is slightly higher in the Central region compared to the UW region (53.7 percent versus 50.1 percent). The most commonly consumed food is grains/white roots/tubers (96 percent), followed by meat, fish and poultry (84.1 percent). The least consumed food group is eggs (7.1 percent) followed by nuts and seeds (9.6 percent). Similar to the HDDS, there are large differences across regions. Females in the Central region are more likely than those in the UW region to consume eggs and other fruits and vegetables, and less likely to consume pulses, green leafy vegetables, and vitamin A-rich fruits and vegetables.

In terms of differences across the encouraged and comparison groups, there are no differences in means that are significant at the 5 or 10 percent level, and the normalized differences are extremely small in magnitude: none are above the 0.25 or .10 threshold. Based on the primary female's food consumption, the randomization appears to have been very successful at selecting observably similar households.

6.4.3 Agriculture production and income

For agriculture production and income, we analyse crop diversity, yields, value of production, input costs, and profits from the last major season. For value of production, input costs, and profits, we construct indicators for the aggregate across all crops and for the main two crops in each region that were reported for profiling for the VFC. In the Central region, the main two crops were cocoa and cassava, and in the UW

[27] The differences between the two indicators are: 1) in the 9-food group WDDS indicator, non-vitamin A-rich vegetables and fruits were combined and they are now separated (vegetables and fruits are now 2 different categories) in the MDD-W; similarly, beans/peas and nuts and seeds were combined in the WDDS indicator and they are now separated in the MDD-W; and organ meats were separated from other flesh food in the WDDS index, whereas they are now combined in the MDD-W.
[28] Guidelines for the MDD-W (FAO and FHI 360, 2016) state two methods for collecting food group indicators: open recall and list-based. While open recall is recommended the guidelines acknowledge the advantages and disadvantages to each method. We chose the list-method because it was logistically more feasible to implement in terms of CAPI programming and enumerator training.
[29] Unfortunately, the survey instrument did not separate out the categories "other vegetables" and "other fruit" and instead combined these into one question. We deal with this problem by considering anyone who answered yes to "other fruits and vegetables" in the survey to have consumed both "other fruits" and "other vegetables".
[30] Differences in means could be attributed to different inclusion criteria and time of survey. PBS survey was fielded July-August.

region, the main two crops were maize and groundnut. For yields, we also construct indicators for the main two crops in each region that were reported for profiling for the VFC. Below we provide more detail on how each indicator was constructed.

Table 6.6: Primary outcomes, women's dietary diversity, by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Women's Dietary Diversity Score (1-10)	3,770	4.476	4.545	4.405	4.489	4.463	-0.016	0.756
		(1.662)	(1.353)	(1.926)	(1.634)	(1.691)		
Met Minimum Dietary Diversity for Women (MDD-W)	3,770	0.519	0.537	0.501	0.528	0.510	-0.035	0.469
		(0.500)	(0.499)	(0.500)	(0.499)	(0.500)		
Primary female consumed grains, white roots, tubers	3,821	0.960	0.988	0.932	0.960	0.960	0.001	0.974
		(0.195)	(0.109)	(0.251)	(0.196)	(0.195)		
Primary female consumed pulses	3,816	0.140	0.095	0.184	0.145	0.135	-0.029	0.566
		(0.347)	(0.293)	(0.388)	(0.352)	(0.341)		
Primary female consumed dairy	3,824	0.100	0.114	0.085	0.092	0.107	0.050	0.236
		(0.300)	(0.318)	(0.280)	(0.289)	(0.309)		
Primary female consumed meat, fish, poultry	3,821	0.841	0.952	0.729	0.843	0.839	-0.011	0.846
		(0.366)	(0.213)	(0.445)	(0.364)	(0.368)		
Primary female consumed eggs	3,797	0.071	0.107	0.033	0.071	0.070	-0.002	0.955
		(0.256)	(0.309)	(0.180)	(0.257)	(0.256)		
Primary female consumed green leafy vegetables	3,817	0.598	0.520	0.676	0.603	0.593	-0.021	0.656
		(0.490)	(0.500)	(0.468)	(0.489)	(0.491)		
Primary female consumed vitamin A rich fruits and vegetables	3,821	0.370	0.110	0.632	0.354	0.387	0.068	0.441
		(0.483)	(0.313)	(0.482)	(0.478)	(0.487)		
Primary female consumed other vegetables	3,818	0.642	0.781	0.502	0.656	0.628	-0.059	0.374
		(0.480)	(0.414)	(0.500)	(0.475)	(0.484)		
Primary female consumed other fruits	3,818	0.642	0.781	0.502	0.656	0.628	-0.059	0.374
		(0.480)	(0.414)	(0.500)	(0.475)	(0.484)		
Primary female consumed nuts and seeds	3,804	0.096	0.098	0.095	0.091	0.102	0.040	0.356
		(0.295)	(0.297)	(0.294)	(0.287)	(0.303)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups. The food groups “other vegetables” and “other fruits” come from the same question on whether the primary female consumed “other fruits or vegetables” in the last 24 hours. If she answered “yes” to the question then she was coded as consuming both other fruit and other vegetables. WDDS is calculated for women who report on all food groups, ie, for those women who have non-missing responses to all 10 food groups used for the index.

Crop diversity: Crop diversity is measured by the number of crops grown by each household out of a list of 42. Categories of other grain, other vegetable, other fruit, etc., were counted as a separate crop.

Yields: Yield was generated for cocoa, cassava, maize, and groundnut by calculating the quantity harvested per unit area in the last major season. All units of amount harvested were converted to kilograms and units of land area were converted to acres to obtain the quantity harvested in kilograms per acre. Distributional outliers were identified as being in the bottom and top 1 percent of the tail, and were dropped from the sample.

Value of production: The value of production for each crop is calculated as the amount harvested times the price at which the crop was sold. If any portion of the crop harvested was sold by the household, we use that price (unit value) to value the entire harvest. If the household did not sell any of the harvest, we use the median price for that crop in that EA. If no one in the EA sold that crop, we use the median price for that district, then for that region, then for the sample. Distributional outliers were identified as being in the bottom and top 1 percent of the tail, and were dropped from the sample.

Input costs: Input costs are the total incurred costs on fertilizer, pesticides, herbicides, spraying services, tractor hire, and labour costs for each crop. Labour costs were calculated as the number of person-days of hired labour times the average cash daily wage paid to the hired labour. For households that report using some days of hired labour but with zero wage, we assumed that this is exchange labour. We then use the average daily wage for each EA to come up with the cost of exchange labour for that household. Distributional outliers were identified as being in the bottom and top 1 percent of the tail, and were dropped from the sample.

Profits: Profits were calculated by subtracting the input cost of each crop from the value of production of that crop.

Table 6.7 reveals that households, on average, cultivate three crops, with minor differences across regions in the number of crops cultivated. Maize is grown in both the Central and UW regions, with the percentage of households growing maize being 67.5 percent and 74.6 percent, respectively. Cocoa and cassava are only grown in the Central region (53.9 percent and 85.3 percent of households, respectively); while groundnut is only grown in the UW region (73.6 percent of households). On average, 344.9 kg per acre of maize was harvested in the last major season. Differences across regions are small, with the Central region harvesting 341.9 kg per acre and the UW region harvesting 347.6 kg per acre. Harvest yields in the Central region for cocoa is 65 kg/acre and, for cassava, it is 1,063 kg/acre. Harvest yields for groundnut in the UW region is 339 kg/acre.

The average total value of production across all crops harvested by a household in the last major season is 3,526 GHS (approximately $800 USD or 620 GBP), with the value in the Central region being larger than the value in the UW region (4,353 GHS versus 2,691 GHS). Across the four main crops, the value of production for cocoa in the Central region is the largest at 3,012 GHS followed by groundnut in the UW region at 844 GHS. The value of production for maize is the smallest at 684 GHS, with the value being smaller for the Central region (595 GHS) than the UW region (765 GHS). The average input costs across all crops cultivated by a household in the last major season is 1,167 GHS, with the Central region having smaller input costs (1,057 GHS) than the UW region (1,278 GHS). The input costs of cocoa are the largest (949 GHS), followed by maize (500 GHS) and groundnut (365 GHS). There are large differences in input costs across regions for maize, with the Central region incurring smaller costs than the UW region (230 GHS versus 747 GHS). Average profits across all crops cultivated by a household in the last major season is 2,323 GHS, with profits being larger in the Central region (at 3,262 GHS) than in the UW region (at 1,374 GHS). The large difference in profits across regions is mainly due to large profits from cultivating cocoa in the Central region (at 2,009 GHS). The crop with the smallest profit is maize, at 182 GHS, with large regional differences due to higher input costs in the UW region.

In terms of differences across the encouraged and comparison groups, there are no differences in means that are significant at the 5 or 10 percent level, and the normalized differences are extremely small in

magnitude: none are above the 0.25 and only two are above the .10 threshold (the total value of production for cocoa and profits from cocoa). Based on agriculture production, the randomization appears to have been very successful at selecting observably similar households.

Table 6.7: Primary outcomes, yields, and profit, by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Number of crops cultivated	3,846	2.970	2.963	2.976	3.016	2.923	-0.075	0.207
		(1.239)	(1.220)	(1.258)	(1.229)	(1.247)		
Farmer grows maize	3,839	0.711	0.675	0.746	0.729	0.693	-0.079	0.173
		(0.453)	(0.468)	(0.435)	(0.445)	(0.462)		
Farmer grows cocoa	3,839	0.271	0.539	0.000	0.261	0.281	0.046	0.692
		(0.444)	(0.499)	(0.000)	(0.439)	(0.450)		
Farmer grows cassava	3,839	0.430	0.853	0.004	0.433	0.426	-0.013	0.915
		(0.495)	(0.354)	(0.060)	(0.496)	(0.495)		
Farmer grows groundnut	3,839	0.369	0.004	0.736	0.381	0.357	-0.049	0.663
		(0.483)	(0.064)	(0.441)	(0.486)	(0.479)		
Yield of maize (kg/acre)	2,675	344.949	341.935	347.645	347.177	342.557	-0.013	0.889
		(355.208)	(357.473)	(353.274)	(343.771)	(367.209)		
Yield of cocoa (kg/acre)	1,028	65.342	65.342		61.583	68.914	0.071	0.446
		(103.817)	(103.817)		(102.628)	(104.907)		
Yield of cassava (kg/acre)	1,626	1,063.414	1,063.414		1,011.149	1,117.778	0.061	0.481
		(1,752.829)	(1,752.829)		(1,734.044)	(1,771.610)		
Yield of groundnut (kg/acre)	1,380	339.748		339.748	336.606	343.226	0.025	0.863
		(264.265)		(264.265)	(243.366)	(285.769)		
Total value of production (GhC)	3,811	3,526.251	4,353.121	2,691.971	3,478.794	3,574.638	0.013	0.788
		(7,287.393)	(8,007.737)	(6,374.243)	(7,431.403)	(7,139.214)		
Total value of maize produced (GhC)	2,697	684.565	595.549	765.095	687.380	681.532	-0.005	0.957
		(1,158.405)	(904.993)	(1,342.457)	(1,167.424)	(1,149.047)		
Total value of cocoa produced (GhC)	1,029	3,012.345	3,012.345		2,793.975	3,219.548	0.102	0.259
		(4,175.796)	(4,175.796)		(3,819.869)	(4,481.304)		
Total value of cassava produced (GhC)	1,627	768.637	768.637		716.939	822.080	0.076	0.393
		(1,381.713)	(1,381.713)		(1,344.883)	(1,417.642)		
Total value of groundnut produced (GhC)	1,384	844.607		844.607	856.197	831.708	-0.024	0.774
		(1,012.660)		(1,012.660)	(967.954)	(1,060.801)		
Total input costs (GhC)	3,817	1,167.417	1,057.168	1,278.770	1,219.424	1,114.114	-0.048	0.401
		(2,215.552)	(2,071.971)	(2,346.985)	(2,254.584)	(2,174.127)		

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Input cost of maize (GhC)	2,708	500.278	230.806	747.612	518.406	480.818	-0.040	0.654
		(940.386)	(491.507)	(1,160.579)	(905.620)	(976.305)		
Input cost of cocoa (GhC)	1,035	949.308	949.308		984.779	915.510	-0.037	0.603
		(1,860.098)	(1,860.098)		(2,086.216)	(1,616.786)		
Input cost of cassava (GhC)	1,628	177.681	177.681		191.939	162.816	-0.089	0.344
		(327.801)	(327.801)		(350.716)	(301.567)		
Input cost of groundnut (GhC)	1,391	365.115		365.115	357.177	373.757	0.023	0.789
		(730.198)		(730.198)	(735.139)	(725.235)		
Total profit (GhC)	3,783	2,323.356	3,262.412	1,374.820	2,251.159	2,397.058	0.021	0.680
		(7,030.364)	(7,718.790)	(6,115.932)	(7,290.154)	(6,756.019)		
Profit from maize (GhC)	2,680	182.765	366.998	15.329	158.709	208.687	0.048	0.504
		(1,042.728)	(979.230)	(1,070.424)	(1,023.210)	(1,063.146)		
Profit from cocoa (GhC)	1,020	2,009.409	2,009.409		1,799.519	2,208.865	0.106	0.252
		(3,874.865)	(3,874.865)		(3,608.419)	(4,105.620)		
Profit from cassava (GhC)	1,614	597.432	597.432		536.400	660.619	0.091	0.303
		(1,364.756)	(1,364.756)		(1,332.029)	(1,395.862)		
Profit from groundnut (GhC)	1,369	474.266		474.266	491.084	455.663	-0.031	0.731
		(1,141.807)		(1,141.807)	(1,087.168)	(1,199.920)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups. Yield, value, and profit are only calculated for those households that grow each crop.

6.5 Secondary Outcomes

6.5.1 Nutrition knowledge and behaviour

Tables 6.8 and 6.9 summarize indicators of the primary female and primary male's nutrition knowledge and behaviour. The set of questions on nutrition knowledge and behaviour were developed based on the list of nutrition messages to be sent to farmers as part of VFC. We construct three different summary measures of knowledge and behaviour, all of which are constructed from the 16 questions contained in Module H parts 1 and 2: a count of the number of correct answers the respondent gave, the percent of correct answers that the respondent gave, and a standardized measure of the number of correct answers that is generated by demeaning the number of correct answers using the mean number of correct answers in the full sample and dividing by the standard deviation among individuals in control EAs. The 16 questions on nutrition were created from the repository of nutrition messages created for VFC. All farmers were administered the same 16 questions regardless of their region or main crop.

6.5.1.1 Primary female

Nearly all female respondents washed their hands on the day of the interview (97.5 percent), but only 57.3 percent knew when one should wash their hands. This knowledge is greater in the UW (70.2 percent) compared to the Central region (44.5 percent). The data also reveal high baseline levels of knowledge on keeping perishable foods in refrigerators or in a cold place (81.5 percent); and that it's not safe to consume cereals with aflatoxin (81.5 percent). However, only 1.6 percent of female respondents knew that cutting and drying mangoes can preserve them for later use, and 43.5 percent of females knew that water should not be used to clean tubers because of increased susceptibility of infection from germs. There were large differences across regions in knowledge of the nutritional value of certain types of food. While only 21.7 percent of respondents in the Central region knew that cassava leaves were more nutritious than the roots, 84.1 percent of respondents in the UW had knowledge of this. Females in the Central region were also less likely than those in the UW region to know the health benefits of papaya (18.7 percent versus 55.2 percent) or foods that were a rich source of vitamin A (45.7 percent versus 72.3 percent). Females could correctly answer 59.3 percent of the questions (9.48 of 16 questions). This was slightly higher in the UW region (63.8 percent) compared to the Central region (54.8 percent).

In terms of differences across the encouraged and comparison groups, there are no differences in means that are significant at the 5 percent level. Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 threshold. The randomization appears to have balanced baseline levels of nutrition knowledge and behaviour across the two treatment groups.

6.5.1.2 Primary male

As reported in the baseline survey, male respondents engage in near universal hand washing (93.9 percent) but are equally unfamiliar as female respondents about when one must wash their hands (55.4 percent). There were large differences across regions in nutrition knowledge. While 25.0 percent of respondents in the Central region knew about cassava leaves nutritional value versus the roots, 78.4 percent of respondents in the UW had knowledge of this. Again, 18.3 percent of respondents in the Central region could list the health benefits of papaya, versus 56.1 percent in the UW region; and only 48.8 percent of males in the Central region could name foods rich in vitamin A compared to 70.2 percent in the UW region. Knowledge on storage methods were more consistent between the two regions: 79.2 percent had knowledge that perishable foods are stored in refrigerators or in a cold place; and 81.8 percent knew that it's not safe to consume cereals with aflatoxin. Respondents could correctly answer 55.1 percent of the questions (8.81 of 16 questions). This was slightly higher in the UW region (58.0 percent) compared to the Central region (51.7 percent).

Table 6.8: Secondary outcomes, nutrition knowledge and behaviour (female), by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Washed hands on the day of the interview	3,826	0.975	0.968	0.982	0.975	0.975	0.000	0.993
		(0.156)	(0.176)	(0.132)	(0.156)	(0.156)		
Perishable foods should be kept in the refrigerator/cold place	3,826	0.815	0.783	0.847	0.814	0.816	0.006	0.895
		(0.388)	(0.412)	(0.360)	(0.389)	(0.387)		
Washes crops under water to remove pesticide and debris	3,826	0.700	0.707	0.693	0.711	0.689	-0.048	0.224
		(0.458)	(0.455)	(0.461)	(0.454)	(0.463)		
Knows when one should wash hands	3,826	0.573	0.445	0.702	0.576	0.570	-0.012	0.855
		(0.495)	(0.497)	(0.458)	(0.494)	(0.495)		
Water must not be used to clean tubers because of increased susceptibility of infection	3,825	0.435	0.468	0.401	0.434	0.435	0.002	0.957
		(0.496)	(0.499)	(0.490)	(0.496)	(0.496)		
Cassava leaves are more nutritious than the roots	3,825	0.529	0.217	0.841	0.533	0.525	-0.017	0.853
		(0.499)	(0.413)	(0.366)	(0.499)	(0.500)		
Cook potatoes immediately after peeling or keep them covered in a bowl of water	3,825	0.738	0.770	0.705	0.727	0.748	0.049	0.246
		(0.440)	(0.421)	(0.456)	(0.446)	(0.434)		
Knows the health properties of ripe tomatoes	3,825	0.539	0.417	0.660	0.542	0.536	-0.013	0.830
		(0.499)	(0.493)	(0.474)	(0.498)	(0.499)		
Knows food rich in vitamin A	3,826	0.590	0.457	0.723	0.610	0.569	-0.085	0.175
		(0.492)	(0.498)	(0.448)	(0.488)	(0.495)		
Knows the health benefits of papaya	3,826	0.369	0.187	0.552	0.371	0.367	-0.008	0.925
		(0.483)	(0.390)	(0.497)	(0.483)	(0.482)		
Cutting and drying mangoes can preserve and store them for later use	3,826	0.016	0.007	0.026	0.015	0.018	0.023	0.657
		(0.127)	(0.085)	(0.158)	(0.122)	(0.133)		
Avocados are an appropriate food to feed babies when first introducing solid food	3,826	0.484	0.651	0.317	0.493	0.475	-0.035	0.621
		(0.500)	(0.477)	(0.465)	(0.500)	(0.500)		
Knows the benefits of consuming beans	3,826	0.551	0.457	0.646	0.563	0.540	-0.045	0.507
		(0.497)	(0.498)	(0.478)	(0.496)	(0.499)		
Removed stones, damaged beans, and dry soybean to avoid the bean from getting moldy	3,827	0.615	0.595	0.635	0.620	0.610	-0.021	0.605
		(0.487)	(0.491)	(0.481)	(0.485)	(0.488)		
Adding pulse flour to porridge increases the protein content	3,826	0.739	0.835	0.644	0.724	0.755	0.069	0.292
		(0.439)	(0.371)	(0.479)	(0.447)	(0.430)		

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Not safe to consume cereals that have been affected by aflatoxin	3,826	0.815	0.801	0.829	0.819	0.810	-0.023	0.625
		(0.389)	(0.400)	(0.377)	(0.385)	(0.392)		
Percentage of correct answers (female)	3,828	59.264	54.783	63.759	59.558	58.965	-0.038	0.595
		(15.522)	(13.427)	(16.172)	(15.455)	(15.588)		
Number of correct answers (female)	3,828	9.478	8.757	10.201	9.525	9.431	-0.038	0.599
		(2.485)	(2.148)	(2.587)	(2.477)	(2.493)		
Number of correct answers, standardized (female)	3,828	-0.000	-0.289	0.290	0.019	-0.019	-0.038	0.599
		(0.997)	(0.862)	(1.038)	(0.994)	(1.000)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups.

Table 6.9: Secondary outcomes, nutrition knowledge and behaviour (male), by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Washed hands on the day of the interview	3,184	0.939	0.936	0.941	0.942	0.935	-0.029	0.505
		(0.240)	(0.245)	(0.235)	(0.233)	(0.246)		
Perishable foods should be kept in the refrigerator/cold place	3,184	0.792	0.781	0.801	0.789	0.794	0.012	0.813
		(0.406)	(0.414)	(0.399)	(0.408)	(0.404)		
Washes crops under water to remove pesticide and debris	3,184	0.581	0.689	0.486	0.588	0.573	-0.031	0.568
		(0.494)	(0.463)	(0.500)	(0.492)	(0.495)		
Knows when one should wash hands	3,184	0.554	0.440	0.654	0.564	0.543	-0.042	0.499
		(0.497)	(0.497)	(0.476)	(0.496)	(0.498)		
Water must not be used to clean tubers because of increased susceptibility of infection	3,184	0.198	0.140	0.250	0.199	0.198	-0.001	0.975
		(0.399)	(0.347)	(0.433)	(0.399)	(0.399)		
Cassava leaves are more nutritious than the roots	3,184	0.534	0.250	0.784	0.550	0.517	-0.068	0.421
		(0.499)	(0.433)	(0.412)	(0.498)	(0.500)		
Cook potatoes immediately after peeling or keep them covered in a bowl of water	3,184	0.701	0.766	0.643	0.696	0.706	0.024	0.631
		(0.458)	(0.423)	(0.479)	(0.460)	(0.456)		
Knows the health properties of ripe tomatoes	3,184	0.522	0.412	0.619	0.524	0.520	-0.007	0.916
		(0.500)	(0.492)	(0.486)	(0.500)	(0.500)		
Knows food rich in vitamin A	3,185	0.602	0.488	0.702	0.610	0.593	-0.035	0.580
		(0.490)	(0.500)	(0.457)	(0.488)	(0.491)		
Knows the health benefits of papaya	3,185	0.384	0.183	0.561	0.380	0.388	0.016	0.855
		(0.486)	(0.387)	(0.496)	(0.486)	(0.487)		
Cutting and drying mangoes can preserve and store them for later use	3,184	0.014	0.009	0.018	0.010	0.018	0.067	0.303
		(0.117)	(0.093)	(0.134)	(0.099)	(0.132)		
Avocados are an appropriate food to feed babies when first introducing solid food	3,184	0.430	0.602	0.279	0.422	0.438	0.032	0.653
		(0.495)	(0.490)	(0.448)	(0.494)	(0.496)		
Knows the benefits of consuming beans	3,184	0.557	0.451	0.650	0.569	0.544	-0.049	0.478
		(0.497)	(0.498)	(0.477)	(0.495)	(0.498)		
Removed stones, damaged beans, and dry soybean to avoid the bean from getting moldy	3,184	0.535	0.561	0.511	0.538	0.531	-0.014	0.763
		(0.499)	(0.496)	(0.500)	(0.499)	(0.499)		
Adding pulse flour to porridge increases the protein content	3,184	0.655	0.757	0.564	0.648	0.661	0.026	0.699

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
		(0.476)	(0.429)	(0.496)	(0.478)	(0.474)		
Not safe to consume cereals that have been affected by aflatoxin	3,184	0.818	0.808	0.827	0.822	0.814	-0.019	0.724
		(0.386)	(0.394)	(0.378)	(0.383)	(0.389)		
Percentage of correct answers (male)	3,186	55.051	51.669	58.038	55.288	54.810	-0.029	0.693
		(16.763)	(13.380)	(18.766)	(16.106)	(17.411)		
Number of correct answers (male)	3,186	8.808	8.267	9.286	8.846	8.770	-0.029	0.693
		(2.682)	(2.141)	(3.003)	(2.577)	(2.786)		
Number of correct answers, standardized (male)	3,186	-0.000	-0.194	0.172	0.014	-0.014	-0.029	0.693
		(0.963)	(0.768)	(1.078)	(0.925)	(1.000)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups.

As with the prior table, the randomization appears to have balanced baseline levels of nutrition knowledge and behaviour across the two treatment groups: the largest normalized difference is below 0.10 and none of the differences are significant at the 5 percent level.

6.5.1.3 Difference between female and male

Overall, women and men seem to have similar levels of nutrition knowledge and behaviours—on average, women correctly answered 59.2 percent of the questions correctly compared to 55.1 percent among males. The largest difference in knowledge across men and women is that water must not be used to clean tubers because of increased susceptibility to infection (43.5 percent of females answered correctly versus 19.8 percent of males). The low rates of correct answers (where less than half of men and women answer correctly) for specific questions reveal that there are substantial gaps in knowledge for most adults in the sample on topics related to feeding avocados to babies, cleaning tubers, the health benefits of papaya, and preserving mangos. Consequently, the information offered by the Vodafone Farmer's Club service may be able to improve the nutrition related knowledge of adults who may then select to engage in better behaviours.

6.5.2 Farming Knowledge

Tables 6.10 and 6.11 summarize indicators of the primary female and primary male's farming knowledge. The set of questions on farming knowledge was developed based on the list of crop production messages to be sent to farmers as part of VFC. Questions in the survey were not profiled to the respondent's primary crop, but instead tried to capture a range of food crops. Again, we display three different summary measures of knowledge, all of which are constructed from 12 questions contained in Module K parts 1 and 2: a count of the number of correct answers the respondent gave, the percent of correct answers that the respondent gave, and a standardized measure of the number of correct answers that is generated by demeaning the number of correct answers using the mean number of correct answers in the full sample and dividing by the standard deviation among individuals in control EAs. The 12 questions on farming knowledge were created from the repository of agri messages created for VFC. All farmers were administered the same 12 questions regardless of their region or main crop.

6.5.2.1 Primary female

Table 6.10 reveals that there is near universal knowledge of what causes post-harvest loss (88.9 percent) and of oil palm fruits being red when ripe (92.1 percent). Less than half the sample of primary females (41.6 percent) know what to top-dress maize with a month after planting. However, this knowledge is much higher in the UW region (59.2 percent) compared to the Central region (24.0 percent), even though both regions grow maize. Similar differences are found between women in the Central and UW regions on their knowledge of burning groundnut fields after harvest (13.3 percent in the Central region versus 82.7 percent in the UW region), although this difference is likely explained by the fact groundnut is only grown in the UW region. Overall, females in the sample answered 6.4 out of the 12 questions correctly (or 53.8 percent), with females in the Central region scoring lower (49.8 percent) than females in the UW region (57.7 percent).

In terms of differences across the encouraged and comparison groups, there are no differences in means that are significant at the 5 percent level. Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 threshold or above 0.10. The randomization appears to have balanced baseline levels of farming knowledge across the two treatment groups.

6.5.2.2 Primary male

Similar to female respondents, Table 6.11 reveals that there is near universal knowledge of what causes post-harvest loss (88.5 percent) and that oil palm fruits are red when ripe (91.6 percent). Only 57.8 percent of males in the sample know what to top-dress maize with a month after planting. However, this knowledge is much higher in the UW region (70.5 percent) compared to the Central region (43.3 percent). Large differences are also found on knowledge that burning groundnut fields decreases post-harvest, with 19.4 percent of males in the Central region being aware of this compared to 86.3 percent of males in the UW region. Overall, males in the sample answered 6.9 out of the 12 questions correctly (or 57.9 percent), with males in the Central region scoring lower (53.7 percent) than males in the UW region (61.6 percent).

The randomization appears to have balanced baseline levels of farming knowledge across the two treatment groups: the largest normalized difference is below 0.10 and none of the differences are significant at the 5 percent level.

6.5.2.3 Difference between female and male

Overall women and men seem to have similar levels of knowledge on farming practices—on average, men correctly answered 6.93 of the 12 questions correctly compared to 6.43 among females. The largest difference in knowledge is with respect to knowing what to top-dress maize with one month after planting (41.6 percent for females versus 57.8 percent for males). The low rates of correct answers for males and females in specific topics indicate gaps in knowledge for most adults in the sample. Consequently, information offered by the Vodafone Farmer's Club service, if profiled to farmer's specific needs, may be able to improve the farming knowledge of adults who may then select to engage in better behaviours that lead to higher yields.

6.5.3 Source of information on agriculture and nutrition

Figures 6.1 and 6.2 reveal the most important source of information on crop production and nutrition for the randomly selected primary male or female respondent. As Figure 6.1 reveals, the most important source of information on crop production for the Central region is spouse followed by government extension worker (24.7 percent and 18.8 percent, respectively) and for the UW region, it is government extension worker followed by other family (27.9 percent and 17.7 percent, respectively). For nutrition information, the most important source for the Central region is community health worker followed by newspaper/TV/radio/poster (35.5 percent and 30.8 percent, respectively) and for the UW region the most important source of information is community health worker followed by spouse (52.8 percent and 14.2 percent, respectively).

For each source of information, we ask the primary female or male respondent whether they agree or disagree on a 5-point scale with the statement: If I were to receive any agricultural advice or information from [source], I would feel confident and trust it completely." A similar statement is asked about sources of nutrition information. In general, respondents agree that they would trust information on agriculture from all sources (Table 6.12). However, the highest percentage agree that they would trust sources from newspaper/TV/radio/poster followed by government extension workers (93.0 percent and 91.7 percent, respectively); and the lowest percentage of agreement is on sources from community health workers, cooperative staff, and automated text messages (50.2 percent, 72.2 percent, and 78.1 percent, respectively). Similarly, respondents in general agree that they would trust information on nutrition from all sources. However, the highest percentage agree that they would trust sources from community health workers followed by newspaper/TV/radio/poster (95.7 percent and 94.2 percent, respectively); and the lowest percentage of agreement is on sources from cooperative staff and automated text messages (69.3 percent and 78.1 percent, respectively). While a high share of women self-report that they would hypothetically trust automated text messages with information on agriculture or nutrition, rates are not universal especially compared to more common and trusted sources of information, such as

newspaper/TV/radio/poster, or government extension workers for agriculture and community health workers for nutrition,

In terms of differences across the encouraged and comparison groups, only 1 of 18 differences in means is significant at the 5 percent level. Even more reassuring, the normalized differences are extremely small in magnitude: none are above the 0.25 threshold or above 0.10. The randomization appears to have balanced baseline levels of information sources and trust across the two treatment groups.

Table 6.10: Secondary outcomes, farming knowledge (female), by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Knows what to top-dress maize within one month after planting	3,827	0.416	0.240	0.592	0.438	0.393	-0.091	0.171
		(0.493)	(0.427)	(0.492)	(0.496)	(0.489)		
Knows what is used to weed onion fields at regular intervals	3,827	0.487	0.493	0.481	0.497	0.477	-0.040	0.402
		(0.500)	(0.500)	(0.500)	(0.500)	(0.500)		
Knows maize can be stored longer when the chaff is removed	3,827	0.642	0.530	0.755	0.619	0.665	0.095	0.084
		(0.479)	(0.499)	(0.430)	(0.486)	(0.472)		
Burning groundnut fields after harvest decreases crop yield	3,827	0.479	0.133	0.827	0.491	0.468	-0.046	0.654
		(0.500)	(0.340)	(0.379)	(0.500)	(0.499)		
Knows how plants should be spaced to make full use of all available sun	3,827	0.440	0.445	0.435	0.430	0.450	0.041	0.511
		(0.496)	(0.497)	(0.496)	(0.495)	(0.498)		
Oil palm fruits are red when ripe	3,827	0.921	0.972	0.869	0.926	0.915	-0.044	0.373
		(0.270)	(0.164)	(0.338)	(0.261)	(0.280)		
Peppers should be harvested again after a 2-week interval for maximum yield	3,827	0.340	0.353	0.327	0.332	0.348	0.032	0.595
		(0.474)	(0.478)	(0.469)	(0.471)	(0.476)		
Cassava is ready for harvesting 9-18 months after planting	3,827	0.637	0.889	0.384	0.640	0.633	-0.015	0.869
		(0.481)	(0.314)	(0.486)	(0.480)	(0.482)		
Knows when the plantain fruit is considered mature	3,827	0.535	0.662	0.408	0.535	0.535	0.001	0.991
		(0.499)	(0.473)	(0.492)	(0.499)	(0.499)		
Knows the signs of a matured soybean	3,652	0.583	0.351	0.802	0.598	0.568	-0.062	0.459
		(0.493)	(0.477)	(0.398)	(0.490)	(0.496)		
Pepper fields should be located far away from tobacco plantations to avoid spread of viruses	3,827	0.092	0.022	0.162	0.104	0.080	-0.081	0.268
		(0.289)	(0.146)	(0.369)	(0.305)	(0.272)		
Knows what can cause post-harvest loss when storing grain crops	3,827	0.889	0.883	0.895	0.892	0.886	-0.020	0.637
		(0.314)	(0.321)	(0.306)	(0.310)	(0.318)		
Percentage of correct answers (female)	3,827	53.820	49.890	57.761	54.163	53.471	-0.040	0.577
		(17.451)	(14.793)	(18.964)	(17.416)	(17.485)		
Number of correct answers (female)	3,827	6.434	5.947	6.923	6.476	6.391	-0.041	0.565
		(2.092)	(1.758)	(2.278)	(2.089)	(2.094)		
Number of correct answers, standardized (female)	3,827	-0.000	-0.233	0.233	0.020	-0.021	-0.041	0.565
		(0.999)	(0.840)	(1.088)	(0.998)	(1.000)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups.

Table 6.11: Secondary outcomes, farming knowledge (male), by region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Knows what to top-dress maize within one month after planting	3,184	0.578	0.433	0.705	0.599	0.556	-0.088	0.129
		(0.494)	(0.496)	(0.456)	(0.490)	(0.497)		
Knows what is used to weed onion fields at regular intervals	3,185	0.549	0.535	0.561	0.549	0.549	-0.001	0.985
		(0.498)	(0.499)	(0.496)	(0.498)	(0.498)		
Knows maize can be stored longer when the chaff is removed	3,184	0.663	0.555	0.758	0.658	0.668	0.021	0.707
		(0.473)	(0.497)	(0.429)	(0.475)	(0.471)		
Burning groundnut fields after harvest decreases crop yield	3,184	0.549	0.194	0.863	0.563	0.535	-0.057	0.578
		(0.498)	(0.396)	(0.344)	(0.496)	(0.499)		
Knows how plants should be spaced to make full use of all available sun	3,184	0.508	0.542	0.478	0.501	0.516	0.031	0.622
		(0.500)	(0.498)	(0.500)	(0.500)	(0.500)		
Oil palm fruits are red when ripe	3,184	0.916	0.960	0.876	0.917	0.914	-0.011	0.812
		(0.278)	(0.195)	(0.329)	(0.275)	(0.280)		
Peppers should be harvested again after a 2-week interval for maximum yield	3,184	0.361	0.385	0.339	0.358	0.363	0.010	0.863
		(0.480)	(0.487)	(0.474)	(0.480)	(0.481)		
Cassava is ready for harvesting 9-18 months after planting	3,184	0.646	0.871	0.447	0.645	0.646	0.002	0.985
		(0.478)	(0.336)	(0.497)	(0.479)	(0.478)		
Knows when the plantain fruit is considered mature	3,184	0.556	0.657	0.466	0.558	0.553	-0.011	0.857
		(0.497)	(0.475)	(0.499)	(0.497)	(0.497)		
Knows the signs of a matured soybean	3,076	0.619	0.388	0.813	0.634	0.604	-0.061	0.446
		(0.486)	(0.487)	(0.390)	(0.482)	(0.489)		
Pepper fields should be located far away from tobacco plantations to avoid spread of viruses	3,184	0.125	0.040	0.200	0.117	0.132	0.045	0.559
		(0.330)	(0.195)	(0.400)	(0.322)	(0.339)		
Knows what can cause post-harvest loss when storing grain crops	3,184	0.885	0.875	0.893	0.887	0.882	-0.014	0.779
		(0.319)	(0.330)	(0.309)	(0.317)	(0.322)		
Percentage of correct answers (male)	3,185	57.911	53.725	61.605	58.211	57.606	-0.035	0.606
		(17.333)	(15.017)	(18.373)	(17.306)	(17.360)		
Number of correct answers (male)	3,185	6.930	6.413	7.387	6.966	6.893	-0.035	0.604
		(2.079)	(1.789)	(2.207)	(2.077)	(2.082)		
Number of correct answers, standardized (male)	3,185	-0.000	-0.249	0.219	0.017	-0.018	-0.035	0.604
		(0.999)	(0.859)	(1.060)	(0.998)	(1.000)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups.

Figure 6.1 Source of information on crop production, by region

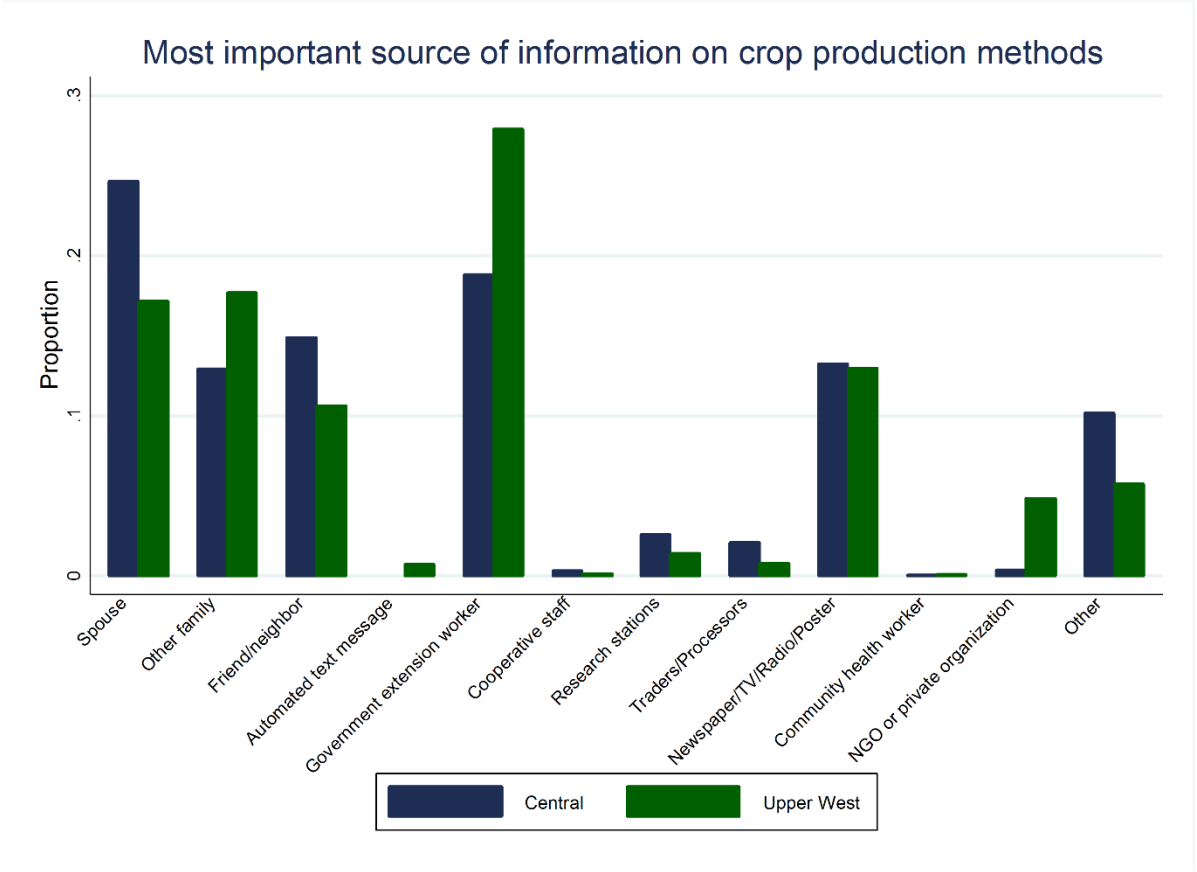


Figure 6.2 Source of information on nutrition, by region

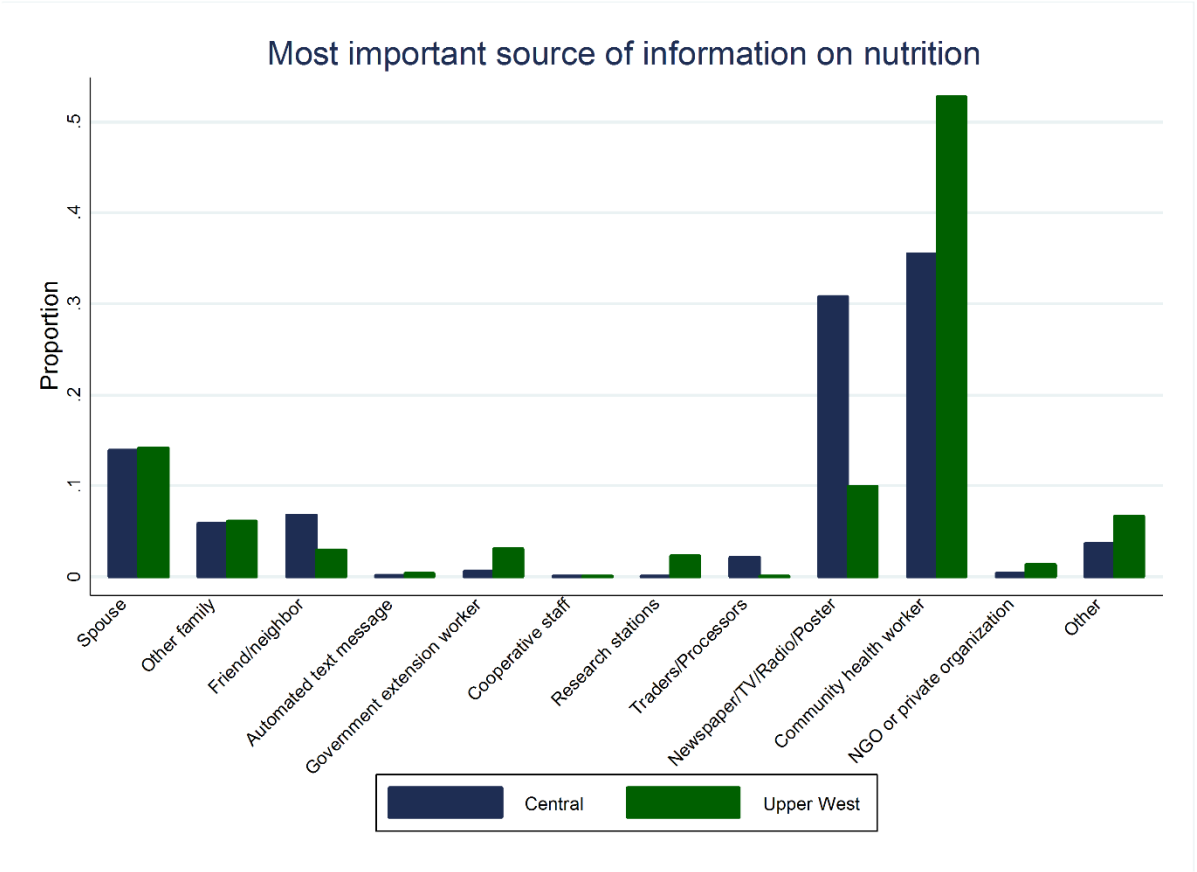


Table 6.12: Trust and Sources of Agriculture and Nutrition Information, by Region and mNutrition beneficiary status

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Government extension workers are the most important source of information about crop production	3,936	0.233	0.188	0.279	0.244	0.223	-0.049	0.230
		(0.423)	(0.391)	(0.449)	(0.429)	(0.416)		
Community health workers are the most important source of information on nutrition	3,936	0.441	0.355	0.528	0.438	0.444	0.013	0.807
		(0.497)	(0.479)	(0.499)	(0.496)	(0.497)		
Agree they would trust agricultural information from their spouse	3,410	0.867	0.857	0.875	0.869	0.865	-0.013	0.805
		(0.340)	(0.350)	(0.330)	(0.337)	(0.342)		
Agree they would trust agricultural information from their other family	3,890	0.876	0.858	0.894	0.874	0.878	0.013	0.779
		(0.330)	(0.349)	(0.308)	(0.332)	(0.327)		
Agree they would trust agricultural information from their friends/neighbors	3,895	0.854	0.826	0.882	0.849	0.859	0.029	0.553
		(0.353)	(0.379)	(0.323)	(0.358)	(0.348)		
Agree they would trust agricultural information from newspaper/TV/radio/posters	3,817	0.930	0.955	0.904	0.919	0.942	0.089	0.048
		(0.255)	(0.206)	(0.295)	(0.273)	(0.234)		
Agree they would trust agricultural information from automated text messages	3,618	0.781	0.783	0.778	0.765	0.796	0.075	0.126
		(0.414)	(0.413)	(0.415)	(0.424)	(0.403)		
Agree they would trust agricultural information from cooperative staff	3,646	0.722	0.801	0.639	0.716	0.728	0.026	0.685
		(0.448)	(0.400)	(0.480)	(0.451)	(0.445)		
Agree they would trust agricultural information from government extension worker	3,765	0.917	0.924	0.909	0.913	0.920	0.027	0.505
		(0.277)	(0.265)	(0.288)	(0.282)	(0.271)		
Agree they would trust agricultural information from the community health worker	3,749	0.502	0.494	0.511	0.499	0.506	0.013	0.804
		(0.500)	(0.500)	(0.500)	(0.500)	(0.500)		
Agree they would trust nutrition information from their spouse	3,443	0.884	0.877	0.890	0.889	0.879	-0.032	0.539
		(0.320)	(0.328)	(0.313)	(0.314)	(0.327)		
Agree they would trust nutrition information from their other family	3,890	0.826	0.828	0.824	0.829	0.822	-0.018	0.698
		(0.379)	(0.377)	(0.381)	(0.376)	(0.382)		
Agree they would trust nutrition information from their friends/neighbours	3,891	0.816	0.806	0.825	0.811	0.820	0.022	0.652
		(0.388)	(0.395)	(0.380)	(0.391)	(0.384)		
Agree they would trust nutrition information from newspaper/TV/radio/posters	3,817	0.942	0.969	0.914	0.932	0.953	0.089	0.064
		(0.233)	(0.172)	(0.280)	(0.252)	(0.212)		
Agree they would trust nutrition information from automated text messages	3,624	0.781	0.792	0.771	0.766	0.797	0.074	0.126
		(0.413)	(0.406)	(0.421)	(0.423)	(0.402)		

	N	All	Central	Upper West	Encouraged (E)	Comparison (C)	Normalized Difference between (C) and (E)	P-value
Agree they would trust nutrition information from cooperative staff	3,642	0.693	0.770	0.613	0.682	0.705	0.050	0.418
		(0.461)	(0.421)	(0.487)	(0.466)	(0.456)		
Agree they would trust nutrition information from government extension worker	3,708	0.809	0.874	0.742	0.803	0.814	0.027	0.624
		(0.394)	(0.332)	(0.438)	(0.398)	(0.389)		
Agree they would trust nutrition information from the community health worker	3,890	0.957	0.960	0.953	0.955	0.959	0.017	0.703
		(0.203)	(0.195)	(0.211)	(0.207)	(0.199)		

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between encouraged and comparison groups. Respondents who answered ‘don’t know’, ‘not applicable’ or who refused to answer the questions are counted as missing leading to different Ns for each of the questions.

7 Baseline Data: The Household-Level Randomization

To investigate whether the encouragement scripts and targeting affect the uptake and use of the VFC, and consequently, our primary and secondary outcomes, we conducted a household-level randomization in our encouraged EAs. In particular, each household with an eligible primary male and female were randomized into one of the following four groups: (1) agriculture script, targeted to primary male; (2) agriculture script targeted to primary female; (3) agriculture and nutrition script, targeted to primary male; and (4) agriculture and nutrition script targeted to primary female. If a household only had a primary female and no primary male, then the household was randomized to either the agriculture script or the agriculture and nutrition script.

To explore whether the household randomization was successful, we follow the same procedures as in Section 6, calculating both the p-value from a test of the null hypothesis of no difference in means, and compute the normalized difference. We test differences in means across the agriculture and agriculture and nutrition scripts, and then across the male-targeted and female-targeted households. For the first comparison (across agriculture and agriculture and nutrition scripts), we pool together all households that were randomized to an agriculture script and compare them to all households randomized to an agriculture and nutrition script. For the second comparison, we restrict the sample to only those that have both a primary male and female member, and then compare means across male- and female-targeted households. We also provide a joint test of significance for the subsample of households with both a primary male and female, across the four randomized groups. The p-value on the joint test of significance tests the null hypothesis that the coefficients on all four treatment groups are equal to zero. Given that we discussed baseline mean characteristics for the whole sample in Section 6, here we only discuss any differences in means across the different encouraged groups. All tables can be found in Annex H.

7.1 Household demographics, assets, and wealth

7.1.1 Household demographics

Annex H,Table 7.1a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of demographic characteristics. There are no differences in means that are significant at the 5 percent level, and the normalized differences are all well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, there are a few differences in means that are significant at the 5 percent level across the targeted male and targeted female groups. In particular, female-targeted households are more likely than male-targeted households to be female-headed, the head is more likely to have never married, be divorced, widowed, or separated, and less likely to be monogamous, and the primary female is older and less likely to be in a monogamous marriage and more likely to be in a polygamous marriage. The likely reason for the differences is due to rules on how to replace households for sampling if a primary male or female was not available to be surveyed. In particular, female targeted households were not required to have a primary male respondent to be surveyed, while male targeted households were required to have a primary male and female. Hence the likely reason that female targeted households are more likely to be female-headed and household heads are more likely to have never been married. Although there are quite of few differences at the 5 percent level, the normalized differences are small and all are below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, two are significant at the 5 percent level: the household head being monogamous and the primary female being monogamous (Annex H, Table 7.1b).

7.1.2 Household assets and wealth

Annex H, Table 7.2a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of assets and wealth. Only 1 out of 25 variables is significant at the 5 percent level: households randomized to the agriculture script are significantly less likely than those randomized to an agriculture and nutrition script to own an iron. This significance is likely due to chance. In terms of the normalized differences, all are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, there are no differences across the targeted male and targeted female groups, and the normalized differences are all below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, none are significant at the 5 percent level (Annex H, Table 7.2b). Overall, the household-level randomization seems to have successfully created similar groups in terms of assets and wealth.

7.2 Mobile phone access and usage

7.2.1 Primary female

Annex H, Table 7.3a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of mobile phone access and usage of the primary female. There are no differences in means that are significant at the 5 percent level and the normalized means are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, only 1 out of 15 variables are significantly different at the 5 percent level across the targeted male and female groups: households randomized to target a female are significantly more likely to receive mobile money than those randomized to target a male. Normalized differences, however, are all below the .25 threshold. Similarly, the joint significant test for the four encouraged groups in the subsample of households with a primary male and female shows that receiving mobile money is significant at the 5 percent level (Annex H, Table 7.3b). Overall, the household-level randomization seems to have successfully created similar groups in terms of mobile phone access and usage of the primary female.

7.2.2 Primary male

Annex H, Table 7.4a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of mobile phone access and usage of the primary male. There are no differences in means that are significant at the 5 percent level and the normalized means are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, only 1 out of 15 variables are significantly different at the 5 percent level across the targeted male and female groups: households randomized to target a female are significantly less likely to find it useful to receive agriculture and nutrition information via text messages than those randomized to target a male. Normalized differences, however, are all below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, none are significant at the 5 percent level (Annex H, Table 7.4b). Overall, the household-level randomization seems to have successfully created similar groups in terms of mobile phone access and usage of the primary male.

7.3 Primary outcomes

7.3.1 Household dietary diversity

Annex H, Table 7.5a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of household dietary diversity. There are no differences in means that are significant at the 5 percent level, and the normalized means are well below the .25 threshold. For the subsample of

encouraged households with both a primary male and primary female, none of the 13 variables are significantly different at the 5 percent level across the targeted male and female groups. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, the meat and organ meat food group is significant at the 5 percent level (Annex H, Table 7.5b). Overall, the household-level randomization seems to have successfully created similar groups in terms of household dietary diversity across agriculture scripts and agriculture and nutrition scripts but was less successful across male- and female-targeted subgroups.

7.3.2 Women's dietary diversity

Women's dietary diversity reveals similar results as household dietary diversity in terms of balance across the different subgroups in encouraged households (Annex H, Table 7.6a). Across the agriculture script group and the agriculture and nutrition script group, there are no differences in means that are significant at the 5 percent level, and the normalized means are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, no differences in means are significant at the 5 percent level, and the normalized means are also well below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, no variable is significant at the 5 percent level (Annex H, Table 7.6b). Overall, the household-level randomization seems to have successfully created similar groups in terms of women's dietary diversity across agriculture scripts and agriculture and nutrition scripts, and male and female targeted subgroups.

7.3.3 Agriculture production and income

Annex H, Table 7.7a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of agriculture production and income. There are no differences in means that are significant at the 5 percent level, and the normalized differences are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, there are also no differences in means that are significant at the 5 percent level across the targeted male and targeted female groups, and the normalized differences are below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, only groundnut yields is significant at the 5 percent level (Annex H, Table 7.7b). Overall, the household-level randomization seems to have successfully created similar groups in terms of agriculture production and income.

7.4 Secondary outcomes

7.4.1 Nutrition knowledge and behaviour

7.4.1.1 Primary female

Annex H, Table 7.8a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of nutrition knowledge and behaviour of the primary female. There are no differences in means that are significant at the 5 percent level and the normalized means are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, only 1 out of 19 variables is significantly different at the 5 percent level across the targeted male and female groups: females in households randomized to target a female are significantly more likely to know the health properties of a ripe tomato than those randomized to target a male. Normalized differences, however, are all below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, none are significant at the 5 percent level (Annex H, Table 7.8b). Overall, the household-level randomization seems to have successfully created similar groups in terms of nutrition knowledge and behaviours of the primary female.

7.4.1.2 Primary male

Annex H, Table 7.9a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of nutrition knowledge and behaviour of the primary male. There are no differences in means that are significant at the 5 percent level, and the normalized differences are all well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, there are a few differences in means that are significant at the 5 percent level across the targeted male and targeted female groups. In particular, males in female-targeted households are more likely than males in male-targeted households to know the health properties of ripe tomatoes, the health benefits of papaya, the benefits of consuming beans, and have a higher overall knowledge score. Although there are quite of few differences at the 5 percent level, the normalized differences are small and all are below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, there are significant differences at the 5 percent level for certain knowledge indicators and the overall nutrition knowledge score (Annex H, Table 7.9b).

7.4.2 Farming knowledge

7.4.2.1 Primary female

Annex H, Table 7.10a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of farming knowledge of the primary female. There are no differences in means that are significant at the 5 percent level and the normalized means are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, there are a few differences in means that are significant at the 5 percent level across the targeted male and targeted female groups. In particular, females in female-targeted households are less likely than females in male-targeted households to know that maize can be stored longer if the chaff is removed, but more likely to know how plants should be spaced to make full use of the sun, when plantain fruit is considered mature, and have a higher overall farming knowledge score. Although there are quite of few differences at the 5 percent level, the normalized differences are small and all are below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, there are significant differences at the 5 percent level for certain knowledge indicators and the overall farming knowledge score (Annex H, Table 7.10b).

7.4.2.2 Primary male

Annex H, Table 7.11a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of farming knowledge of the primary male. Only 1 of 15 differences in means are significant at the 5 percent level (knowledge of mature soy bean) and the normalized means are well below the .25 threshold. For the subsample of encouraged households with both a primary male and primary female, only 1 out of 15 variables are significantly different at the 5 percent level across the targeted male and female groups: males in households randomized to target a female are significantly less likely than those randomized to target a male to know that maize can be stored longer if the chaff is removed. Normalized differences, however, are all below the .25 threshold. In terms of the joint significant test for the four encouraged groups in the subsample of households with a primary male and female, only 1 is significant at the 5 percent level (Annex H, Table 7.11b). Overall, the household-level randomization seems to have successfully created similar groups in terms of farming knowledge of the primary male.

7.4.3 Source of information on agriculture and nutrition

Annex H, Table 7.12a reveals that the agriculture script group and agriculture and nutrition script group are similar in terms of main source of information and trust of sources. Only 2 of 18 differences in means are

significant at the 5 percent level (trust nutrition information from government extension worker or community health worker) and the normalized means are well below the .25 threshold.

In contrast to tables 7.8-7.11 where both a primary male and female responded to the module, the module on source of information and trust was only conducted on the randomly selected male or female. We expect differences in mean characteristics across male and female respondents, so the differences reported do **not** inform us about the success of balance of the randomization. Thus, we do not discuss the balance of the randomization across these two subgroups and we do not conduct the joint significant test across the four encouraged groups. However, we proceed with discussion of differences across male- and female-targeted respondents, as it gives us insight to gender differences in source of information and trust. There are large and significant differences across male and female respondents on the source of information for crop production and nutrition. Males are significantly more likely than females to say that government extension workers are the main source of information for crop production (29 percent versus 21 percent respectively) and females are significantly more likely than males to say community health workers are the main source of information for nutrition (49 percent versus 37 percent respectively). Females are also more likely than males to agree that they trust agriculture information from their spouse (90 percent versus 83 percent respectively), and nutrition information from other family members (85 percent versus 80 percent respectively), and friends/neighbours (83 percent versus 79 percent respectively).

8 Willingness to Pay

Despite the proliferation of ICT interventions and studies on the topic, there has been little, if any, research on the demand for agriculture and health information. We conducted a willingness-to-pay (WTP) experiment to ascertain the maximum amount that an individual is willing to pay for VFC service. Information on willingness-to-pay for the service at the time of its introduction allows us to determine whether consumers are willing to pay a positive price for the service at the outset, before they had any exposure to using it; or if a price subsidy is necessary in order for users to gain experience with the product to strengthen demand. In addition, we randomly varied the framing of VFC to investigate whether emphasizing the platform's nutrition and agriculture information leads to higher stated WTP than highlighting just the program's agriculture information, and we randomly varied the targeting of VFC to investigate whether there are differences in WTP by gender. During the impact evaluation analysis at endline, this information will also be used to test the relationship between stated and realized demand by measuring how take-up and use of VFC varies with stated willingness-to-pay.

To explore whether an individual's WTP for the service is affected by the script they receive (agriculture script or agriculture plus nutrition script) or the gender of the person targeted (male or female), we randomly assigned households in the encouraged group (that have both a primary male and female) to one of the four groups: (1) agriculture script + male targeted; (2) agriculture script + female targeted; (3) agriculture + nutrition script + male targeted; (4) agriculture + nutrition script +female targeted. Households with only a primary female were randomly assigned to either the agriculture script or the agriculture plus nutrition script.

At the end of the baseline household questionnaire, we asked households in our treatment group if they had heard of the VFC service and if they consented to receive information on the VFC and play a game. If consent was given, enumerators read either the agriculture script or the agriculture and nutrition script to the randomly assigned primary male or female. The agriculture script was Vodafone's default script for the VFC product that emphasized the value added of the agriculture information (weather, price, and agriculture tips). The agriculture + nutrition script used the same agriculture script and added two lines on the value added of the nutrition information (see Annex E for questionnaire with WTP script).

After the scripts were read, we measured WTP from revealed preferences using a two-step procedure where we used the Becker-DeGroot-Marschak (BDM) method in the first step (Berry et al. 2015). In particular, the farmer was asked how much they were willing to pay for the VFC service. After the farmer's bid was recorded, a random price was drawn. To be transparent, the random price was drawn by the farmer using buttons in a cup that represented different prices from a distribution of prices [0.2-3 GHS].[31] If the farmer's bid was greater than or equal to the price drawn, he/she was offered the product at the randomly drawn price. If the farmer's bid was below the price drawn, he/she was not offered the product. Once the random price was revealed, the farmer was not allowed to change his/her bid. For expected utility maximizers, the farmer's best strategy is to bid his/her maximum WTP. To ensure that farmers understood the exercise, they first practiced the BDM method on a bar of soap before playing for the VFC service.

In the second stage, regardless of the outcome of the first stage, farmers were offered another opportunity to receive the VFC at an additional discount. Farmers were informed that the new price would be lower than the price they drew in the first round if they won the BDM game, and lower than their bid if they lost the BDM game. Farmers again selected a random price from a cup, but this time the price was drawn from a degenerate distribution where the only possible price was 0. The two stages were necessary in order to first elicit a farmer's WTP and then to offer the product for free to all farmers in the encouraged group.

The BDM exercise provides a precise measure of WTP that allows us to measure demand for the VFC service at all potential prices. Figure 8.1 shows the inverse demand curve for all households in the encouraged group that participated in the game (N=1,857). As expected, the share of households willing-to-pay a certain price for the service decreases as the price increases. At 1.0 GHS, the share of households

[31] Distribution of prices was {0.2,0.4,0.6,0.8,1.0,1.2,1.4,1.6,1.8,2.0,2.2,2.4,2.6,2.8,3.0}.

willing to pay this price is 85 percent, at 2 GHS the share is 50 percent, and at 3.0 GHS the share is 19 percent.[32] After 3.0 GHS, the share drops dramatically. The mean price farmers are willing to pay for VFC is 2.05 GHS and the median is 1.90 GHS (Table 8.1).

Figure 8.1: Farmer's WTP for VFC, all encouraged households

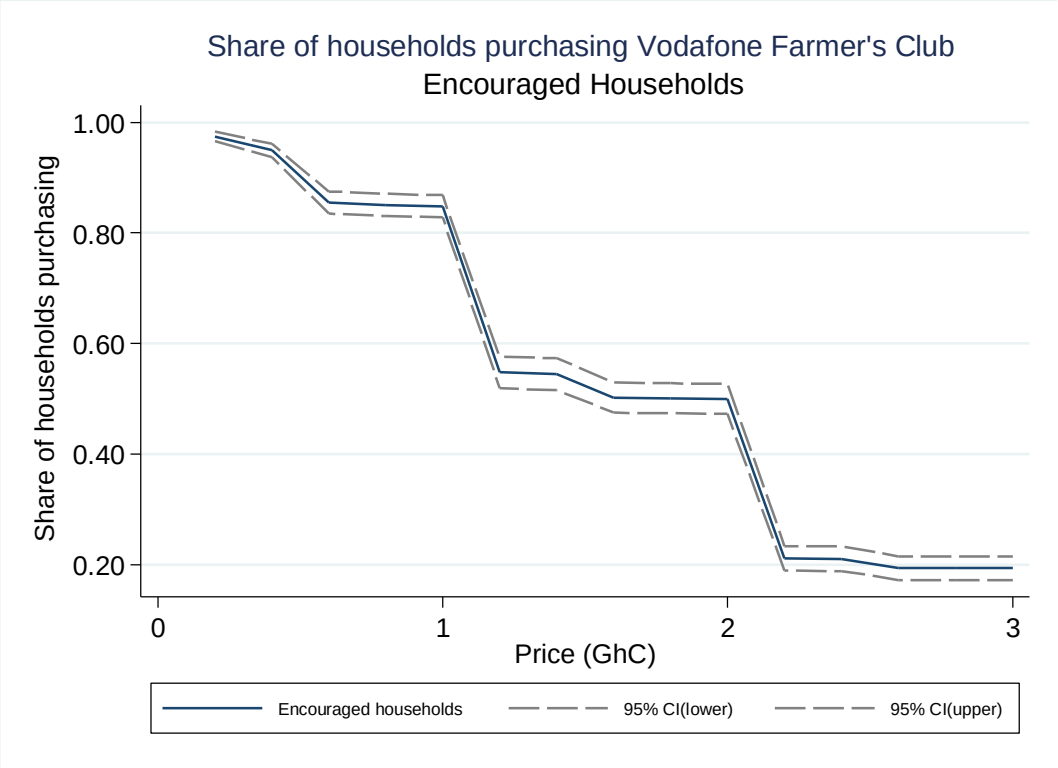


Table 8.1: Willingness-to-pay, by mNutrition sub-treatment status

	Full encouraged sample						Subsample of encouraged households with a primary male and female			
	All		Agriculture Script		Ag and Nutrition Script		Female Targeted		Male Targeted	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Respondent's willingness to pay (GHS)	2.05	1.90	1.97	1.60	2.12	2.00	1.91	1.50	2.11	2.00

Notes: Estimates from the mNutrition Ghana Baseline Survey sample. The full encouraged sample consists of 1857 households, while the subsample of encouraged households with a primary male and female consists of 1617 households.

To explore whether the script used to promote VFC affected a farmer's WTP for the service, we pool together all individuals in encouraged households that received the agriculture script (regardless of targeting) and similarly, we pool together all that received the agriculture and nutrition script. Figure 8.2 shows farmer's WTP by the script received. The share of households willing-to-pay prices between 0-2 GHS is very similar across scripts. After 2.0 GHS, differences emerge, with farmers in the agriculture and nutrition script willing to pay more than farmers with only the agriculture script (although differences are not significant). The mean and median price that farmers in the agriculture and nutrition script are willing to pay for VFC is 2.12 GHS and 2.00 GHS, respectively, compared to the mean and median price that farmers in the agriculture script are willing to pay, which is 1.97 GHS and 1.60 GHS, respectively (Table 8.1). Differences in WTP across agriculture and agriculture and nutrition scripts are not significant.

[32] The inverse demand curve is plotted till price 3 GhC since that was the highest price that could be drawn by the farmer.

For the subsample of households with both a primary male and a primary female, we explore whether targeting a male or female member affects the WTP for the VFC service. Figure 8.3 reveals that the share of farmers willing to pay between 0-1 GHS is similar for males and females. After 1.0 GHS, significant differences emerge, with males willing to pay more for the VFC service than females. The mean and median price that males are willing to pay for VFC service is 2.11 GHS and 2.00 GHS, respectively, compared to the mean and median price of females of 1.91 GHS and 1.5 GHS, respectively. Differences in median WTP across male and female are significant.

Figure 8.2: Farmer's WTP for VFC, by script, all encouraged households

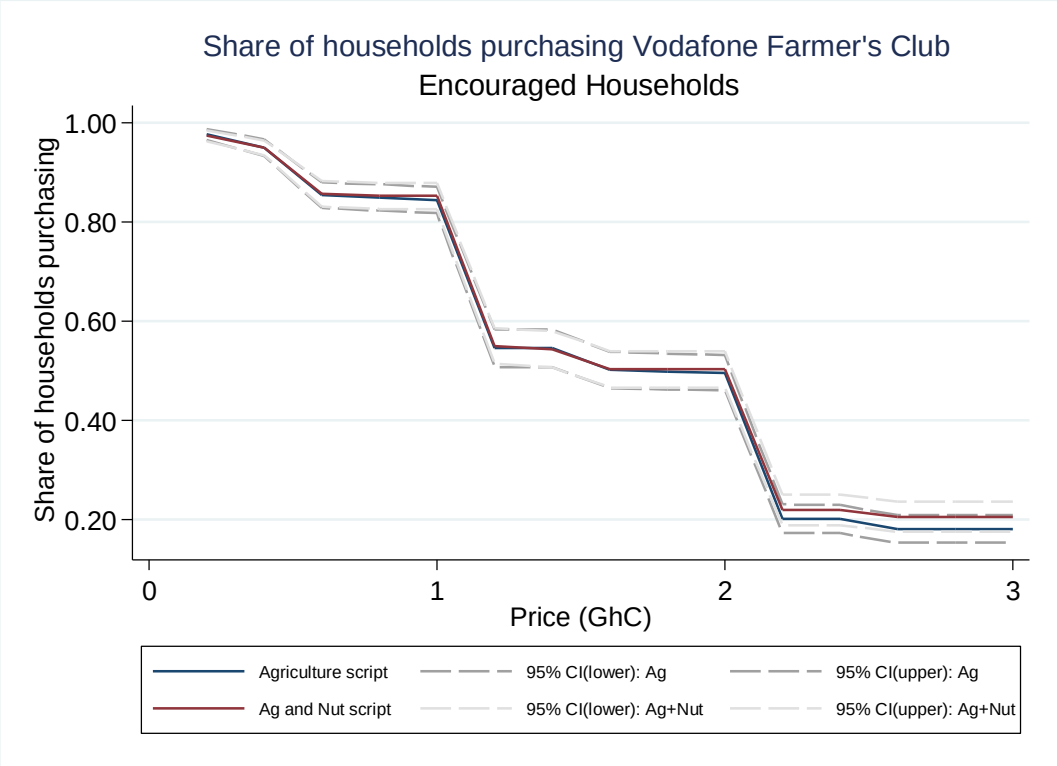
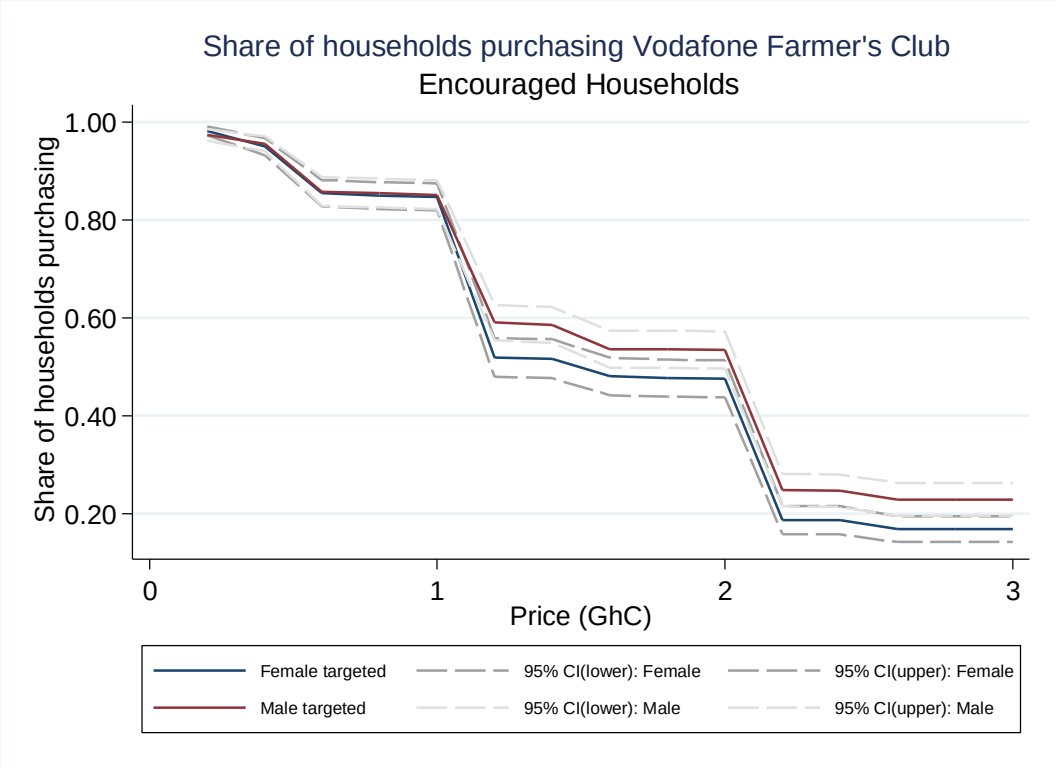


Figure 8.3: Farmer's WTP for VFC by targeting, subsample of encouraged households with primary male and female



These results suggest a number of potentially important contributions. First, there is little evidence about demand for mobile phone based agricultural information campaigns, and virtually none about nutrition-sensitive agricultural information campaigns. Also, to date, many of these services have been heavily subsidized at the outset (e.g., Fafchamps and Minten 2012), with adoption and usage dropping off once such subsidies are removed. A common motivation for these temporary initial price subsidies is that they allow users to gain experience with the product to strengthen demand. However, this justification requires that initial demand for the product would be low in the absence of price subsidies. We test this argument for temporary price subsidies for the Vodafone Farmers' Club in Ghana at the moment of its introduction to the user. Based on results of the experimental game, we find that WTP for the VFC service is high at low prices and then decreases rapidly as the price increases; at 1.0 GHS, 85% would register for the service; at 2.0 GHS 50% would register; and at 3.0 GHS, just 19% would still be willing to register. This suggests that it may be possible to charge a positive price from the outset (based on a door-to-door enrolment campaign), although the rate of take-up is highly price sensitive. Half of the participants in the willingness to pay elicitation stated they were willing to pay 2.0 GHS, which was the price initially charged by Vodafone for the service (Barnett et al 2016). This rate of take-up is higher than experienced in Vodafone's own promotion campaigns at that price and the difference may lie in the how the promotion campaigns were carried out, with the evaluation study conducting door-to-door campaigns and scripts that focused on the agriculture and nutrition value added of the service. We also find that women have statistically lower WTP than men, but that the framing has no significant impact on WTP. Thus, if the goal of the service is to reach women, lower prices may be needed.

9 Conclusion

The baseline data collection successfully implemented the randomized study encouragement design, and generated a multitude of relevant data for the quantitative evaluation of Ghana's mNutrition programme—VFC service. In total, data were collected across 3,936 households in the Central region and UW region of Ghana. Collaboration across study partners—ISSER, IFPRI, Vodafone, Esoko, IDS, and Gamos—ensured a successful completion of the baseline data collection.

The impact evaluation will use the information gathered in the baseline survey along with the endline quantitative survey data to conduct the quantitative impact analysis described in Section 3. In addition to establishing the pre-intervention situation of study households for context, and empirically confirming that observable characteristics are well-balanced across the arms, the baseline survey data provides important contextual control variables and baseline measures of agriculture and nutrition outcome variables for the impact analysis. The quantitative impact analysis will be informed by findings from the two qualitative data collection rounds. In this section, we highlight some of the most important findings of the baseline data and discuss the implications that the sample characteristics and the baseline balance in observables are likely to have for the mNutrition intervention and the quantitative evaluation.

9.1 Sample characteristics and implications for mNutrition

Key Highlights:

- Low literacy rates in the Central and UW region highlight the importance of using voice-over text to send mNutrition messages.
- Given the low access and use of mobile phones by females, reaching female farmers with the mNutrition messages could be challenging even if they are explicitly targeted through the study.
- Across both regions, only a small share of women consumes pulses, dairy, eggs, and nuts/seeds; thus, these food groups have the largest potential for improvement through mNutrition messages.
- Regional differences in agricultural production reveal the importance of profiling households for the VFC service and sending crop-specific agriculture messages.
- The portion of respondents that state automated text messages as the most important source of information is nearly zero for both crop production and nutrition, this highlights the importance of voice messages or call centres as a means of reaching farmers with agriculture and nutrition information as opposed to text messages.
- There are differences across men and women in their source of information and trust of information, with women trusting more than men agriculture information from their spouse, and nutrition information from other family members and friends/neighbours. This highlights that different approaches may be needed to target women and men.

There are large differences across the Central and UW regions in household demographics, assets, and wealth. In particular, households in the Central region, compared to the UW region, are smaller in size, more likely to have a female head and to have a head with some education that can read a phrase in English, and less likely to have a head that is polygamous or engages in agriculture as the main activity. In terms of assets and wealth, households in the Central region compared to the UW region have a higher poverty index and consumer asset index, but a lower agriculture and livestock index, likely indicating that households in the Central region engage less in agriculture and livestock rearing. For both regions, literacy

is low, with only 31.3 percent of household heads and 16.5 percent of primary females knowing how to read in English (literacy in the local language is even lower). Low literacy highlights the importance of using voice over text to send mNutrition messages.

For both the primary male and female respondents, access and usage of mobile phone is higher in the Central region than UW region. However, individuals in the UW region are more likely to have a Vodafone SIM card than those in the Central region. For both regions, while receiving and making calls is very common, less common is sending and receiving text messages, and even less common is sending or receiving mobile money. This again highlights the importance of voice messages as a means of sending nutrition messages. There are also large differences in phone access and use between the primary male and female respondents. Compared to the primary male, the primary female has less access to a mobile phone and uses it less to make and receive a call, send and receive a text message, and send and receive mobile money. Therefore, reaching female farmers with the mNutrition messages could be challenging even if they are explicitly targeted through the study.

In terms of diets, households in the Central region compared to the UW region have a higher HDDS and MDD-W. In other words, households in the Central region have more economic access to food, and women have better diets in terms of nutritional adequacy. In particular, women in the Central region are more likely than those in the UW to consume meat, fish, and poultry, eggs, and other fruits and vegetables. Across both regions, only a small share of women consumes pulses, dairy, nuts/seeds, and eggs; thus, these food groups have the largest potential for improvement through mNutrition messages.

There are also large differences in terms of agriculture production across regions. While both the Central and UW regions cultivate, on average, three crops, the main crops cultivated for the Central region are cassava, maize, and cocoa, while the main crops for the UW region are maize and groundnut. Total value of production and profits from production are larger for the Central region compared to the UW region, and this is mainly driven by the high value of production of cocoa. These regional differences reveal the importance of profiling households for the VFC service and sending crop-specific agriculture and nutrition messages.

For both the primary male and primary female respondents, nutrition knowledge and behaviour is low, with females answering 59 percent of questions correctly and males, 55 percent. Nutrition knowledge scores are also lower in the Central region compared to the UW region for both the primary male and female. Topics with the lowest scores (where less than half the sample answer correctly) and thus largest room for improvements are on cutting and drying mangoes, the health benefits of papaya, feeding avocados to babies, and not cleaning tubers with water. Farming knowledge is also low for both the primary male and primary female, with females answering 53.8 percent of questions correctly and males, 57.9 percent. Similar to nutrition knowledge, scores on farming knowledge are lower in the Central region compared to the UW region for both the primary male and female. Topics with the lowest scores and thus the largest room for improvement are on harvesting peppers and placement of pepper fields. Differences across regions in types of crops produced and consumed could explain the differences in knowledge, and again reveal the importance of profiling households for the VFC service and sending crop-specific agriculture messages.

In terms of sources of information and trust, government extension workers are the most important source of information for crop production and community health workers for nutrition. Nearly all respondents agree they trust government extension workers for information on agriculture and community health workers for information on nutrition. In contrast, the portion of respondents that state automated text messages as the most important source of information is nearly zero for both crop production and nutrition. The proportion of respondents that agree they trust automated text messages is also lower compared to other sources. This again highlights the importance of voice messages or call centres as a means of reaching farmers with agriculture and nutrition information as opposed to text messages. There are also differences across men and women in their source of information and trust of information, with women trusting more than men agriculture information from their spouse, and nutrition information from other family members and friends/neighbours.

9.2 Baseline balance in observable characteristics

To assess how likely it is that the quantitative evaluation will be able to accurately estimate the causal effect of VFC service on primary outcomes, we checked for balance in baseline characteristics between the encouraged and comparison groups, as well as between the different encouragement groups: agriculture script versus agriculture and nutrition script; and male versus female targeting. We assess balance using two different measures: the normalized differences between the encouraged and comparison group distributions and p-values from tests of the null hypotheses of no difference in means between the encouraged and comparison groups. We follow Imbens (2015) and interpret normalized differences below 0.25 in absolute value as being indicative of sufficient balance for the variable being tested. We also treat p-values below 0.05 as evidence of imbalance in the characteristic being tested—though we recognize that we should expect to observe that roughly 1 out of every 20 tests have a p-value below 0.05 simply by chance.

Randomization successfully achieved baseline balance across the encouraged and comparison groups. Normalized differences between the encouraged and comparison groups are well below the 0.25 cut-off for baseline characteristics regarding demographics, wealth and assets, mobile phone access, dietary diversity, agriculture production, nutrition knowledge, farming knowledge, and source of information (Tables 6.1–6.12). A few tests of differences across encouraged and comparison groups on demographics, wealth and assets, mobile phone access, and source of information have a p-value that is less than 0.05; however, our primary and secondary outcomes are well balanced and none have a p-value less than 0.05. Overall, from 208 tests of significant differences between the encouraged and comparison groups, only 8 are significant. This is a rejection rate of 3.8 percent, a little less than what we should expect to find by chance. This suggests that estimating the causal impact of VFC service will be possible through the empirical strategies discussed in Section 3.

For the sub-treatment randomization, balance was successfully achieved across the agriculture and agriculture and nutrition script. Normalized differences between these two groups are well below the 0.25 cut-off for baseline characteristics regarding demographics, wealth and assets, mobile phone access, dietary diversity, agriculture production, nutrition knowledge, and farming knowledge (see Annex H, Tables 7.1-7.12). Overall, only 4 of 208 tests of significant differences between the agriculture and agriculture and nutrition script group are significant. This suggests that estimating the added impact of emphasizing the value added of the nutrition messages will be possible.

Balance in baseline characteristics across male and female targeted groups was not as successful in the subsample of households with both a primary male and primary female. Overall, from 190 tests of significant differences between the male and female targeted groups, 22 are significant. This is a rejection rate of 11.6 percent, more than what we should expect to find by chance. The differences in baseline characteristics are concentrated in demographics, nutrition knowledge of males, and farming knowledge of females. The differences are likely due to the different replacement procedures for sampling households across male and female targeted groups. This suggests that we will need to take these differences into account when estimating the differential impact of targeting women. However, normalized differences between these two groups are well below the 0.25 cut-off.

9.3 Willingness to pay for VFC service

Using the BDM method, we elicited a farmer's willingness to pay for the VFC service in encouraged households. As expected, the share of farmers willing to pay for VFC service decreases as the price increases. At 1.0 GHS, the share of farmers willing to pay this price is 85 percent; at 2.0 GHS, the share is 50 percent; and at 3.0 GHS, the share is 19 percent. From the standpoint of pricing policy, these results suggest that small positive prices (between 0-1 GHS) for the VFC service do not substantially decrease

demand, but after 1.0 GHS, demand drops dramatically. Farmer's demand for the VFC service depends on the targeting but not the advertisement scripts. Although farmers who heard the agriculture and nutrition script were willing to pay more for the service than farmers who only heard the agriculture script, differences were not statistically different. However, men were willing to pay significantly more for the service than women.

These estimates have several implications for policy and for the business model for a nutrition-sensitive mAgri service. First, farmers state that they are willing to pay a positive price to participate in VFC when first introduced to the product, without having any experience in using it. This suggests that it may be possible to charge a positive price from the outset (based on a door-to-door enrolment campaign), although the rate of take-up is highly price sensitive. Half of the participants in the willingness to pay elicitation stated they were willing to pay 2.0 GHS, which was the price initially charged by Vodafone for the service (Barnett et al 2016). This rate of take-up is higher than experienced in Vodafone's own promotion campaigns at that price. The data also show that demand for the service is much higher at the price of 1.0 GHS, where 85 percent of respondents are willing to pay that much for the service. If Vodafone expects that sustained participation may be driven by earlier experience with the service, then keeping prices low (at 1.0 GHS) at least initially may be the best strategy to draw in a large pool of customers over time.

9.4 Limitations of the study

One limitation of the study design is that we will not be able to isolate the impact of the encouragement on the farmers' decision to take-up the Farmer Club product. The encouragement design randomly assigns some households to receive a very intensive form of encouragement in order to prompt high rates of take-up. Relatedly, our encouragement could lead to a different type of user signing up for a product than would otherwise sign up. However, the encouragement design does make it possible to measure the impact of participation in the Farmer Club on the main study outcomes including agricultural productivity and nutrition knowledge, attitudes and behaviours, albeit in a pilot that prompted high rates of take up. While we recognise this limitation, we also believe that any successful mobile information platform will have a strong marketing/encouragement component, and thus measuring the impact derived from an intensive promotion campaign is still of interest.

Another limitation of the study design is the selection criteria for enrolment in the study which may limit the study's external validity. While the randomized design ensures the internal validity of the study (i.e. that our impact estimates are not biased within our study sample), the external validity (i.e., that the study findings are representative of impacts on the overall rural population in Ghana) may be compromised due to the criteria for selecting EAs and households into the sample. The sample for the evaluation was not designed to be representative of Ghana, but instead designed to measure impacts on the most relevant group of households. In other words, we are only measuring the impact of VFC service on a sample of households who 1) are farming households, 2) own a mobile phone during the CLE, 3) are not VFC members at the time of the CLE, and 4) have a primary female respondent 15-60 years old. Moreover, EAs were selected into the sample based on 1) availability of Esoko market price information, 2) low VFC subscription rates, and 3) being within a 10 km radius of a Vodafone tower. EAs with less than 40 households were also excluded in order to ensure enough eligible households per EA. While many of these inclusion criteria were selected in order to maximize VFC usage, impact of the VFC service will be on those most likely to access the service, which has implications on how much we can generalize our findings to the overall Ghana population. For example, households who do not own a mobile phone are likely poorer and more vulnerable, and thus could benefit more from the service if they had access to a phone. EAs that are not close to a Vodafone cell tower or have less than 40 households are also likely to be more remote and vulnerable. In general, the issue of reaching the most vulnerable households without mobile phones or coverage is a policy issue that plagues all ICT interventions. The criteria of having a primary female respondent also makes it more likely that households in our sample have two adult members and are thus less vulnerable. This type of "proof of concept" evaluation, in which we demonstrate impact of the intervention among a likely user group, is common when studying an intervention whose effectiveness is not yet well understood. Lastly, households who met the sampling criteria and whose target individual was

available for the interview are likely to be different to households that met the sampling criteria but whose targeted individual was not available. Again, if the non-response is similar across the encouraged and comparison group, then it may threaten the external validity of the study but not the internal validity. Compared to rural households in the GLSS 6 (2014), households in our sample are more likely to own a mobile phone (89.4 percent versus 70.3 percent), own or operate a farm (98.4 percent versus 82.5 percent), and have two adult members (86 percent versus 63 percent[33]).

Lastly, the potential for the Vodafone Farmers' Club mNutrition platform to build a nutrition-sensitive dimension into its agriculture information platform derives from its ability to deliver a comprehensive suite of nutrition messages at frequent intervals to a large number of households at low cost. Initially with only 1 nutrition message per month, the Farmers' Club platform fell short of this potential. It is yet to be seen whether the increase to 3 messages per month is enough to affect the nutrition knowledge, behaviours, and outcomes for recipient farmers. There remain practical challenges for mobile phones to be an effective means of improving nutrition knowledge, behaviours, or nutrition outcomes. In contrast with more typical in-person methods of conducting behaviour change communication whereby programme staff are physically available to deliver content to beneficiaries, to work, mobile phone-based information interventions need to ensure that targeted mobile phone numbers are activated, profiled, still in use, charged, and accessible, and that the desired user has the time and desire to read or listen to the delivered content. Low usage, high drop-out rates from the service, and high SIM turnover has implications for the impact evaluation, and in particular, diminishes the probability of finding any impact on the primary outcomes of interest. The qualitative surveys in addition to the endline survey will capture any barriers to use of the VFC service, which will provide insight as to why we may or may not see any impacts on our primary outcomes of interest.

9.5 Next steps

The baseline results will be disseminated in an in-country workshop in March 2018, and a mixed method report will be written in the spring of 2018 that brings together and triangulates the findings of all four evaluation components (quantitative, qualitative, business model, and cost-effectiveness). Both these events will help inform the next steps for the quantitative endline survey and impact analysis. The quantitative impact evaluation will continue through December of 2018, with preparations for the endline survey beginning in the fall of 2018 and endline data collection activities starting in November of 2018. Between now and the end of the evaluation period the mNutrition programme will operate as discussed in Section 2: registered individuals will receive voice messages on agriculture and nutrition tips tailored to their selected crop and language for free. Once the endline data has been collected and cleaned, we will conduct the analysis to estimate the causal impacts of the mNutrition programme using the outcomes and methods detailed in Section 3. We anticipate that the evaluation will provide well-powered estimates of the causal impacts of the mNutrition programme for the primary and secondary outcomes, thus providing answers to research questions outlined in Section 1.3.

[33] Statistic for two adult member households was only provided for all of Ghana and not by rural/urban areas.

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Annex A Terms of Reference

Call-down Contract

Terms of Reference

PO 6420: External evaluation of mobile phone technology based nutrition and agriculture advisory services in Africa and South Asia

Introduction

DFID (Research and Evidence Division) wishes to commission an external impact evaluation of mNutrition, a mobile phone technology based nutrition and agricultural advisory service for Africa and South Asia. mNutrition is a programme supported by DFID that, through business and science partnerships, aims to build sustainable business models for the delivery of mobile phone technology based advisory services that are effective in improving nutrition and agricultural outcomes.
mNutrition is primarily designed to use mobile phone based technologies to increase the access of rural communities to nutrition and agriculture related information. The initiative aims to improve knowledge among rural farming communities especially women and support beneficial behaviour change as well as increasing demand for nutrition and agriculture extension services. The mNutrition initiative launched in September 2013 will work in 10 countries in Africa (Cote d'Ivoire, Ghana, Malawi, Mozambique, Nigeria, Tanzania, Kenya, Rwanda, Uganda, Zambia) and four countries in South Asia (Bangladesh, India, Pakistan and Sri Lanka). The desired impact of mNutrition will be improved nutrition, food security and livelihoods of the poor.

Mobile phone based services have been endorsed by WHO as an effective strategy for behaviour change and for driving adherence to anti-retroviral treatment protocols (Horvath, Azman, Kennedy and Rutherford 2012). There is currently scant evidence on the impact and cost-effectiveness of mobile phone technology based services for nutrition and agriculture and on the sustainability of different business models for their provision. A rigorous evaluation of mobile phone technology based nutrition services would add significantly to the current evidence base. An external evaluation team managed by the Evaluator, independent of the programme delivery mechanism, will conduct an assessment of the impact, cost-effectiveness and sustainability of mobile phone technology based information and behaviour change messages for nutrition and agriculture.

Background to mNutrition

Introduction

Undernutrition is a major challenge to human and economic development globally. It is estimated that almost one billion people face hunger and are unable to get enough food to meet their dietary needs. Agriculture is a major source of livelihood in many poor countries and the sector has a potentially critical role in enhancing health, specifically maternal and child health and nutritional status. A well-developed agriculture sector will deliver increased and diversified farm outputs (crops, livestock, non-food products) and this may enhance food and nutrition security directly through increased access to and consumption of diverse food, or indirectly through greater profits to farmers and national wealth. Better nutrition and health of farmers fosters their agricultural and economic productivity. Current agricultural and health systems and policies are not meeting current and projected future global food, nutrition and health needs.

Despite major investment in agricultural and nutrition research and its uptake and application, there is significant social and geographic inequality in who benefits from these investments. Furthermore, in many developing countries, public extension systems for agriculture, health and nutrition are inefficient, have limited capacity and have a poor track record of delivery, especially in terms of supporting women and girls and the most marginalised populations (Alston, Wyatt, Pardey, Marra and Chan-Kang 2000; Anderson 2007; IFPRI 2010; Van den Berg and Jiggins 2007).

Several research and mobile network operators (MNOs) are testing a range of information and communication technology (ICT) solutions for improving access to a wide range of information and advisory services. Mobile phone based technologies are among the most promising ICT strategies, although current initiatives in nutrition are relatively small and fragmented.

What is mNutrition?

Enhancing access to the results of nutrition and agricultural research and development is potentially critical for improving the nutrition, health and livelihoods of smallholders and rural communities. mNutrition will harness the power of mobile phone based technologies and the private sector to improve access to information on nutrition, health and agricultural practices especially for women and farmers (both male and female). Specifically, mNutrition will initiate new partnerships with business and science to deliver a range of services including:

- An open-access database of nutrition and agriculture messages for use in mobile phone based communication (for example, information and behaviour change messages on practices and interventions that are known to have a direct impact on nutrition or an indirect impact via for example agriculture);
- A suite of mobile phone based nutrition and agriculture information, extension and registration services designed to: improve knowledge and generate beneficial behaviour change in nutrition and agriculture; increase demand for nutrition, health and agriculture goods and services; register and identify target populations for support; and, using real-time monitoring, support the conduct of nutrition risk assessments by community health workers.

The impacts of mNutrition are expected to include improved nutrition, food security and livelihoods of the poor, especially women in 10 countries in Africa (Cote d'Ivoire, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Tanzania, Uganda and Zambia) and 4 countries in South Asia (Bangladesh, India, Pakistan and Sri Lanka). This impact will result from the increased scale and sustainability of mobile phone based nutrition and agricultural-based information services, delivered through robust public private partnerships in each country.

mNutrition has two major outcomes. One outcome will be cost-effective, sustainable business models for mobile phone enabled nutrition and agriculture services to 3 million households in 10 countries in Africa and 4 countries in South Asia that can be replicated in other countries. Linked to this outcome, the second outcome will expect these services to result in new knowledge, behaviour change and adoption of new practices in the area of agriculture and nutrition practices among the users of these mobile phone based services.

These outcomes will be achieved through four outputs:

- Improved access to relevant mobile based health, nutrition and agricultural advisory services for 3 million poor people and community health workers across 10 SSA and 4 Asian countries;
- Launch and scaling of mobile phone based health, nutrition and agricultural advisory services targeted to poor people and community health workers;
- Generation and dissemination of high quality research and evidence on the impact, cost-effectiveness and sustainability of mobile phone based advisory services in nutrition and agriculture in South Asia and SSA; and
- Development of locally relevant content for mobile phone technology based agriculture and nutrition services meeting demands from users and community health workers.

In terms of promoting behaviour change and/or adoption of new practices, mNutrition will seek to achieve changes in one or more of the following areas:

- Adoption of new agricultural practices that are nutrition sensitive, improve agricultural productivity and utilise post-harvest technologies
- Changes in nutrition practices in either one or several knowledge domains including improved maternal nutrition practices during pregnancies; infant and young child feeding practice; and micro-nutrient supplementation to children at risk (i.e. Vitamin A, Zinc and Oral Rehydration Solution (ORS)).

mNutrition has started implementation from September 2013. For the 2 countries selected for the impact evaluation (Tanzania and Ghana), mobile network operators and content providers have been identified through a competitive process during the first half of 2014. The MNOs and content providers started developing and launching their services during the 4th quarter of 2014 and early 2015. The mobile phone based advisory services are expected to run at least till 3rd quarter of 2018.

mNutrition Project Coordination
DFID support to mNutrition will be channelled to GSMA, as well as directly to this associated independent external impact evaluation. GSMA is a global body that represents the interests of over 800 mobile operators. GSMA already works with the major mobile operators across Africa, (including Airtel, MTN, SafariCom/VodaCom) with a collective mobile footprint of more than 67 percent of total African connections. GSMA has a number of existing development initiatives, including mHealth and mFarmer, that are part of GSMA's Mobile for Development which brings together mobile operator members, the wider mobile industry and the development community to drive commercial mobile services for underserved people in emerging markets. GSMA will provide technical assistance to mobile phone operators, and support new partnerships with content providers to develop and scale up new nutrition and agriculture message services. GSMA will ensure sharing of best practices and promote wider replication and uptake of effective business models.

Objective and Main Questions

The objective of this work is to conduct an external evaluation of the impacts and cost-effectiveness of the nutrition and agriculture advisory services provided by mNutrition compared to alternative advisory services available in the two selected countries (Ghana and Tanzania), with particular attention paid to gender and poverty issues. The impact assessment is required to answer the following questions that relate to impact, cost-effectiveness and commercial viability:

- What are the impacts and cost-effectiveness of mobile phone based nutrition and agriculture services on nutrition, health and livelihood outcomes, especially among women, children and the extreme poor?
- How effective are mobile phone based services in reaching, increasing the knowledge, and changing the behaviour, of the specific target groups?
- Has the process of adapting globally agreed messages to local contexts led to content which is relevant to the needs of children, women and poor farmers in their specific context?
- What factors make mobile phone based services effective in promoting and achieving behaviour change (if observed) leading to improved nutrition and livelihood outcomes?
- How commercially viable are the different business models being employed at country level?
- What lessons can be learned about best practices in the design and implementation of mobile phone based nutrition services to ensure a) behaviour change and b) continued private sector engagement in different countries?

Further evaluation questions related to other aims of mNutrition will be addressed in at least 1 country (either Ghana and/or Tanzania):

- Are mobile phone based services a cost-effective way to register and identify at risk populations to target with nutrition support?
- Are mobile phone based services a cost-effective way for community health workers to improve the quality and timeliness of data surveillance (a core set of nutrition-related indicators)?

The content for the mobile phone based advisory services will be based on international best practices and widely endorsed protocols (i.e. by the World Health Organisation) and evidence-based nutrition-sensitive agricultural practices identified by international experts. Through an iterative multi-stakeholder process, international and country experts will localise and adapt the content to make it relevant to the specific target audience in the 14 countries. The adapted content and nature of messages is expected to vary across specific target audiences within and across countries. The main purpose of assessing the relevance of the content is not to evaluate the overall health and nutrition content but on how this content has been localised and adapted and to what extent the needs of the specific target groups within their particular context have been met.

In assessing the commercial viability, it is recognised that evaluating the sustainability/long-term financial viability of the mobile phone based advisory services will be difficult as mobile network operators may not be willing to provide this potentially commercially sensitive information. Therefore, GSMA will provide support through its access to aggregated confidential financial results of the mobile network operators providing the service. GSMA will provide a financial summary report on the commercial viability of the business models without compromising the commercial sensitivity of the data for the mobile network operators. The evaluator will assess and validate commercial sustainability through an analysis of the aggregated information provided by GSMA and additional qualitative business analysis approaches.

The Evaluator has the option of proposing refinements of the existing evaluation questions during the inception phase as part of developing the research protocol. These suggestions will be considered by the Steering Committee and an independent peer review during the review of the research protocol as part of the inception phase.

Output
The output of this work will be new and robust evidence on the impact, cost-effectiveness and commercial viability of mobile phone based advisory services focusing on nutrition and agriculture delivered by public and private partners, and including the development of robust methodological approaches to impact assessment of phone based advisory services.

Recipient
The primary recipient of this work will be DFID, with the beneficiaries being GSMA, governments, international agencies, foundations, MNOs and other private companies and civil society involved in policies and programmes in nutrition and agriculture that are aimed at improving nutritional, health and agricultural outcomes. The findings of this impact evaluation are intended as global public goods.

Scope and timeline
The scope of this work is to:
- Develop a research protocol for the external evaluation of mNutrition;
- Design and undertake an external evaluation of mNutrition in two countries: Ghana and Tanzania;
- Contribute to the communication of the learning agenda, evaluation strategy and evaluation results.

The evaluation will be in two of the 14 mNutrition target countries; Ghana and Tanzania. These countries have been selected based on the phased start-up of mNutrition programme activities. The focus and approach in the two respective countries will be different allowing for a comparison of the effectiveness of approaches applied. In Tanzania, mNutrition will focus on mobile phone technology based nutrition and health services and registration and identification of target population. In Ghana, the mobile phone technology will focus on nutrition and agriculture sensitive services.

In terms of coverage in number of people being targeted for these services, in total 3 million people will be reached through mNutrition; including 2 million for nutrition sensitive agriculture advisory messages in 4 Asian and at least 2 African countries and about 1 million beneficiaries for mobile phone based nutrition services in 10 countries in SSA.

The evaluation contract period will be September 2014 to 31st December 2019. The development of the research protocol must be completed by month 4 for review and approval by DFID. Full details on tasks and deliverables are provided in sections below.

Statement on the design of the mNutrition evaluation
The evaluation design is expected to measure the impact, cost-effectiveness and commercial viability of mNutrition, using a mixed methods evaluation design and drawing on evidence from two case study countries and the M&E system of the programme. Overall, the proposed design should ensure that the evidence from the two case study countries has high internal validity and addresses the priority evidence gaps identified in the Business Case. Being able to judge the generalisability/replicability of lessons learned from the programme is of equal importance and so a credible approach to generalization and external validity will be an important component of the overall evaluation design. The final evaluation design and methodology to generate robust evidence will be discussed in detail with DFID and GSMA before implementation.

For assessing cost-effectiveness, the Evaluator will further fine-tune their proposed evaluation approach and outline their expectations in terms of data they will require from implementers. A theory based evaluation design, using mixed methods for evaluating the impact has been proposed. During the inception phase, the Evaluator will put forward a robust evaluation design for the quantitative work, either an experimental or a quasi-experimental method, with a clear outline of the strengths and limitations of the proposed method relative to alternatives. During the inception phase, the Evaluator is also expected to identify clearly what will be the implications of the design for implementers in terms of how the overall programme would be designed and implemented and for evidence to be collected in the programme's monitoring system. The Evaluator will also assess the degree to which it is realistic to assess impacts by early 2019 for a programme where implementation started mid 2015 and, if there are challenges, how these would be managed.

The Evaluator, in its 6 monthly reports, will be required to provide information to feed into the DFID Annual Review and Project Completion Report of mNutrition.

Gender and inclusiveness

The impact evaluation will pay particular attention to gender and other forms of social differentiation and poverty issues. From current experiences, it is clear that access to and use of mobile services is differentiated along a range of factors, including gender, poverty, geographic marginalisation, education and illiteracy levels. Therefore, the impact evaluation will look at and analyse differentiated access to and potential utilisation of mobile phone based services for improved nutrition and agricultural production. Based on the findings, it will identify opportunities and challenges in having an impact on women in general and more specifically the poor and the marginalised.

Tasks

The Evaluator will perform the following tasks:

A. Finalise a coherent and robust evaluation approach and methodology based on their proposal (inception phase)

- Conduct landscape analysis of existing experiences in mobile phone based services for nutrition and agriculture based on available publications and grey project documents to identify additional critical lessons and priorities for evidence gathering and programme design and implementation;
- Ensure that gender issues and poverty issues are well integrated into the impact evaluation design;
- Develop robust sampling frameworks, core set of indicators and research protocols that allow the consistent measurement and comparison of impacts across study countries, taking into account differences in business models and programmes as needed;
- Work closely with mNutrition programme team in GSMA to familiarise them with impact assessment methodology, discuss evaluation approaches, identify and agree on data provided by programme monitoring system and possible modifications to design;
- Identify risks to the evaluation meeting its objectives and how these risks will be effectively managed;
- Review existing evaluation questions and if deemed relevant propose refinement of existing questions and/or add other questions;
- Prepare a research protocol, including an updated workplan, project milestones and budget. The research protocol will be subject to an independent peer review organised by DFID; and
- Develop a communication plan.

B. Implement and analyse evaluations of impact, cost-effectiveness and commercial viability in accordance with established best practices

- Based upon the agreed evaluation framework, develop and test appropriate evaluation instruments which are likely to include data collection forms for households, community health workers, service providers including health and agricultural services, content providers and private sector stakeholders including mobile network operators. Instruments will involve both quantitative and qualitative methods;
- Register studies on appropriate open access study registries and publish protocols of studies where appropriate;
- Conduct baselines and end-lines, qualitative assessments and business model assessments in both of the two impact evaluation countries;
- Conduct and analyse the evaluations and present findings in two well-structured reports addressing the evaluation questions. The reports should follow standard reporting guidelines as defined by, for example, the Equator Network. Primary findings should be clearly presented along with a detailed analysis of the underlying reasons why the desired outcomes were/were not achieved;
- The Evaluating Organisation or Consortium may subcontract the administration of surveys and data entry, but not the supervision of those tasks, study design, or data analysis; and
- The country-specific mixed methods evaluation reports, cost effectiveness and business models studies and final evaluation report will be subject to an independent peer review organised by DFID.

C. Contribute to the communication of the learning agenda, impact evaluation strategy, and evaluation results.

- Develop a communication plan outlining the main outputs and key audiences;

- Conduct lessons learnt workshops in each of the 2 impact evaluation countries and key dissemination events; and
- Assist in communicating the results of the evaluation and contribute to the development and communication of lessons learnt about mobile phone based extension approaches in nutrition and agriculture.

Deliverables

The Evaluator will deliver the following outputs[34]**:**

During the design and study inception phase of maximum 4 months:
- A publishable landscape analysis report highlighting lessons learnt from existing initiatives on mobile phone based advisory services related to nutrition and agriculture by month 4;
- A updated work plan with project milestones and budget by end of month 1 (possibly adjusted based on the approved research protocol by month 4);
- A communication plan outlining the key outputs, audience and timeline for review and approval by month 4; and
- A full research protocol by month 4 for review and approval. The research protocol should be registered with appropriate open access study registries;

Interim reports:
- 4 biannual progress reports for the External Evaluation as a whole, and for each country evaluation, against milestones set out in the workplan;
  - Two desk reviews submitted by June 2016
  - Two Baseline quantitative reports submitted by April 2017
  - Two Baseline qualitative reports submitted by February 2017
  - Two Cost-effectiveness reports 1 submitted by March 2017
  - Two Business Model reports 1 submitted by March 2017
  - Two Mixed Methods Baseline reports completed by September 2017
  - Two Midline qualitative reports submitted by March 2018
- All survey data collected during the evaluation provided in a suitable format to DFID for public release.

At project's end:
- Two Endline quantitative reports submitted by June 2019
- Two Endline qualitative reports submitted by August 2019
- Two Cost-effectiveness report 2 submitted by July 2019
- Two Business Model report 2 submitted by July 2019
- Two Evaluation reports submitted by October 2019
- At least 1 article, based on the findings from the country evaluation reports, published in a research journal;
- A shared lesson learnt paper published and at least one presentation highlighting key lessons for similar initiatives of promoting mobile based technologies for providing extension services and the promotion of uptake of technologies by December 2019.

Research protocol and all final reports will be independently peer reviewed. This will be organised by DFID. Outputs are expected to be of sufficiently quality so that a synthesis of findings can be published in a leading peer-reviewed journal.

Coordination and reporting requirements

A mNutrition Advisory Group (AG) will be established for the programme which will a) provide technical oversight and b) maximise the effectiveness of the programme. The Advisory Group will meet on a bi-annual basis and comprises of representatives of DFID, NORAD and GSMA representatives and independent technical experts. The Evaluator will be managed by DFID on behalf of the mNutrition Advisory Group. The

[34] Exact timeframe of deliverables will be agreed on during the design phase as appropriate.

Evaluator will work closely with the mNutrition programme team in GSMA and its specific country implementing partners. The Evaluator will:

- Ensure coherence and lesson learning across all pilot impact assessments on the key evaluation questions and indicators identified.
- Incorporate a clear code of ethics; incorporate plans for open access publications and public access to data sets.

The Evaluator will work closely with the mNutrition project management team, in particular in the design of the overall evaluation framework and the evaluation plan for the specific project components and the countries selected for the evaluation. Collaboration and regular communication between Evaluator and mNutrition project management team and implementing partners in selected case study countries is crucial as the evaluation design may have implications for project implementation and vice versa. The mNutrition project management team will lend support in communication as requested by the Evaluator or the Advisory Group. The Evaluator will report directly to DFID who will manage the evaluation on behalf of the mNutrition Advisory Group. The main point of contact for technical matters is Louise Horner, Livelihoods Adviser and Hugh McGhie, Deputy Programme Manager for all other project related issues. The mNutrition Advisory Group will be the arbiter of any disputes between the evaluation function and the overall programme implementation.

At the end of each 6 months, the Evaluator will submit a brief report outlining key achievements against the agreed deliverables. Pre-agreed funding will then be released provided that deliverables have been achieved.

In addition to the 6 monthly reports outlined above, the Evaluator will provide information to feed into the DFID Annual Review of mNutrition. The 6 monthly reports will be a key source of information used to undertake the Annual Review and Project Completion Report for the programme. These reviews will be led by the Livelihoods Adviser and Deputy Programme Manager, in consultation with the mNutrition AG. All reviews will be made available publicly in line with HMG Transparency and Accountability Requirements.

Mandatory financial reports include an annual forecast of expenditure (the budget) disaggregated monthly in accordance with DFID's financial year April to March. This should be updated at least every quarter and any significant deviations from the forecast notified to DFID immediately. In addition the Evaluator will be required to provide annual audited statements for the duration of the contract.

Contractual Arrangements

The contract starts in September 2014 and will run till end of December 2019 subject to satisfactory performance as determined through DFID's Annual Review process. Progression is subject to the outcome of this review, strong performance and agreement to any revised work plans or budgets (if revisions are deemed appropriate).

A formal break clause in the contract is included at the end of the inception period. Progression to the implementation phase will be dependent on strong performance by the Evaluator during the inception period and delivery of all inception outputs, including a revised proposal for implementation period. Costs for implementation are expected to remain in line with what has been agreed upon for this contract, with costs such as fee rates fixed for contract duration. DFID reserves the right to terminate the contract after the inception phase if it cannot reach agreement on the activities, staffing, budget and timelines for the implementation phase.

DFID reserves the right to scale back or discontinue this assignment at any point (in line with our Terms and Conditions) if it is not achieving the results anticipated. The Evaluator will be remunerated on a milestone payment basis. DFID has agreed an output based payment plan for this contract, where payment will be explicitly linked to the Evaluator's performance and effective delivery of programme outputs as set out in the ToR and approved workplan. The payment plan for the implementation phase will be finalised during the inception period.

Open Access

The Evaluator will comply with DFID's Enhanced and Open Access Policy. Where appropriate the costs of complying with out open access policy should be clearly identified within your commercial proposal.

Branding
The public has an expectation and right to know what is funded with public money. It is expected that all research outputs will acknowledge DFID support in a way that is clear, explicit and which fully complies with DFID Branding Guidance. This will include ensuring that all publications acknowledge DFID's support. If press releases on work which arises wholly or mainly from the project are planned this should be in collaboration with DFID's Communications Department.

Duty of Care
The Evaluator is responsible for the safety and well-being of their Personnel (as defined in Section 2 of the Contract) and Third Parties affected by their activities under this contract, including appropriate security arrangements. The Evaluator is responsible for the provision of suitable security arrangements for their domestic and business property. DFID will share available information with the Evaluator on security status and developments in-country where appropriate.

The Evaluator is responsible for ensuring appropriate safety and security briefings for all of their Personnel working under this contract and ensuring that their Personnel register and receive briefing as outlined above. Travel advice is also available on the FCO website and the Evaluator must ensure they (and their Personnel) are up to date with the latest position.

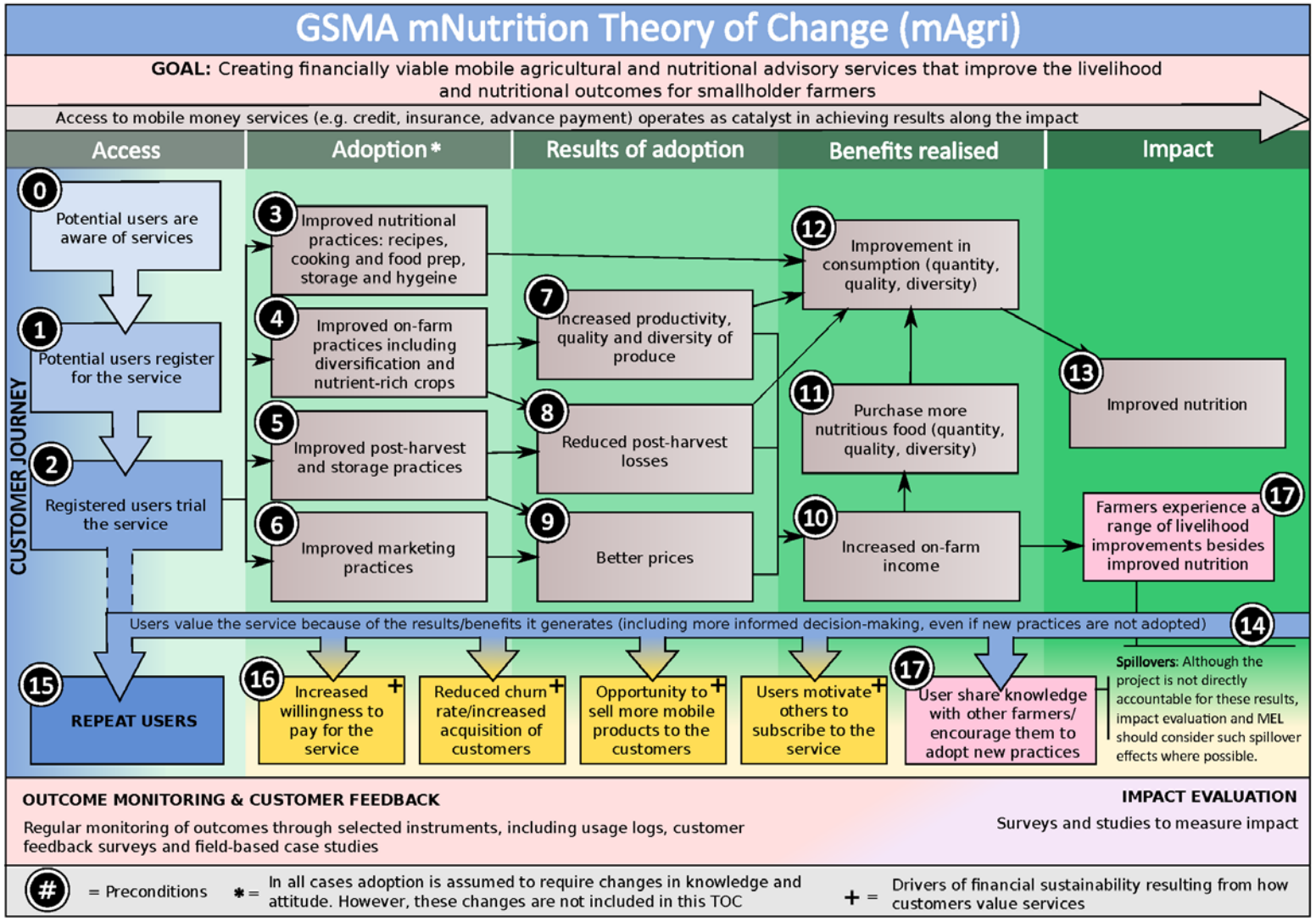
The Evaluator has confirmed that:

- The Evaluator fully accepts responsibility for Security and Duty of Care.
- The Evaluator understands the potential risks and have the knowledge and experience to develop an effective risk plan.
- The Evaluator has the capability to manage their Duty of Care responsibilities throughout the life of the contract.

Annex B Timeline of the Impact Evaluation

	2016						2017												2018												2019											
ACTIVITY	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
QUANTITATIVE COMPONENT																																										
Baseline survey																																										
Endline survey																																										
QUALITATIVE COMPONENT																																										
Baseline data collection																																										
Midline data collection																																										
Endline data collection																																										
BUSINESS MODEL & COST EFFECTIVENESS COMPONENT																																										
Phase 1 stakeholder interviews & data collection																																										
Phase 2 stakeholder interviews & data collection																																										
MIXED METHODS																																										
Mixed methods report																																										
Mixed methods final report																																										

Annex C GSMA's theory of change



Annex D Community Listing Exercise (CLE) Questionnaire

Study on mobile phone technology based agriculture and nutrition advisory services in Ghana
COMMUNITY LISTING EXERCISE: Household Questionnaire – February 6, 2017

ENUMERATOR INSTRUCTIONS:

For this survey, use the following definitions of a household, household member, primary female respondent, household head, and spouse of household head:

- *Household: a group of people who live and eat together, share resources and form a common decision-making unit. Often, a household is composed of a head of household, spouse(s), their unmarried children, and possibly their relatives or other persons to whom they are unrelated. The household can be limited to only one person or a person with his or her children. In a polygamous household where all the spouses do not live in the same compound as their husband, each of the spouses living elsewhere will be listed as a separate household with the persons they live with (the spouse being the head of that household). A tenant who does not take his meals where he lives is considered as a separate household. In a case where a household head lives in a compound with a spouse or spouse(s) and their children, among which some are married, each of the married children with their spouse(s) and own children and other unmarried dependents under their responsibility are all part of the same single household. In this case, all three generations (and other unmarried dependents) belong to one household. In a group of unmarried people living together where everyone has his own means of livelihood, each member of the group will form his own household.*

- *Household member: anyone who met the criteria for being part of the household more than half of the time during the past 3 months, as well as anyone who recently entered the household through birth or marriage to a household member.*

- *Household head: the individual who plays a leading role in household decision-making, particularly concerning farming and household expenditures. Generally, the person identified by the household as the household head is accepted in this role for the survey.*

- *Main spouse of household head: the individual who is married to the household head. In the event there are multiple spouses of the head of household, this should be the highest order (earliest) spouse.*

Module A: Household Information

ENUMERATOR: Ask the questions below of the household head. If the household head is not available for interview, ask the spouse of the head or the next most responsible household member.

No.	Household Identification	Response	No.	Household Identification	Response
A00	Do we have consent to interview your household?	☐ Yes……1 No…….2 >>end interview	**A09**	Relationship of respondent to household head	☐ Spouse 2 Other adult HH member 3 Other child HH member 4 Non-HH adult 5 Non-HH child 6
A00a	GPS coordinates, Latitude (minutes)	☐☐ ☐☐☐	**A10**	What is the sex of the household head?	☐ Male..... 1 Female ..2
A00b	GPS coordinates, Longitude (minutes)	☐☐ ☐☐☐	**A11**	What is the marital status of the household head?	☐ Unmarried (never married) 1>> if A10=1 skip to A13; if A10=2 skip to A13a Married, monogamous 2 Married, polygamous 3 Widow/widower 4>> if A10=1 skip to A13; if A10=2 skip to A13a Divorced 5>> if A10=1 skip to A13; if A10=2 skip to A13a Separated/Deserted 6>> if A10=1 skip to A13; if A10=2 skip to A13a
A00c	Accuracy	☐☐☐☐	**A12**	What is the (main) spouse's name?	>>skip to A15 after if A11=2 or A11=3
A01	Region (code)	☐☐	**A13**	Is there an adult female member in the household who also plays a role in decision making around farming and housing expenditure?	☐ Yes……1>> skip to A14 No…….2 >>skip to A15
A01a	Region (name)		**A13a**	Is there is an adult male member in the household who also plays a role in decision making around farming and household expenditure?	☐ Yes……1 No…….2 >>skip to A15
A02	District (code)	☐☐	**A14**	What is that person's name?	
A02a	District (name)		**A15**	Does anyone in the household own a mobile phone?	☐ Yes……1 No…….2
A03	EA (code)	☐☐☐	**A16**	Does anyone in the household operate a farm?	☐ Yes……1 No…….2
A03a	EA (name)		**A17**	Is anyone in the household an existing member of Vodafone's Farmers' Club?	☐ >> if A15=2 then skip this question Yes……1 No…….2
HH_NUM	Household number	☐☐	**A18**	Is the household head literate in English?	☐ Yes……1 No…….2
A04d	Day of the first visit (dd)	☐☐	**A18a**	Is the household head literate in the local language?	☐ Yes……1 No…….2
A04m	Month of the first visit (mm)	☐☐	**A19**	What is the age of the household head? (years)	☐☐ >>if A11=1,4,5 or 6 skip to A19b >> if <5, end survey.
A04y	Year of first visit (yyyy)	2 0 1 7	**A19a**	What is the age of the (main) spouse of the household head? (years)	☐☐ >> if A11=2 or A11=3 skip to A21

No.	Household Identification	Response	No.	Household Identification	Response
A05	Code of Interviewer	☐☐	**A19b**	What is the age of the main [female/male] adult decision-maker? (years)	☐☐ >>if A11=2,3 or A10=2 skip to A21
A06	Code of Supervisor	☐☐	**A20**	What is the marital status of the main female adult decision-maker?	☐ Unmarried (never married) .....1 Married, monogamous .....2 Married, polygamous .....3 Widow/widower .....4 Divorced .....5 Separated/Deserted 6
HHID	Household Census ID	☐☐☐☐☐☐☐☐☐	**A21**	[Enumerator: Did you finish the questionnaire in the first visit?]	☐ Yes……1>>end interview No…….2
A07	Name of household head		**A22d**	Day of the second visit (dd)	☐☐
A07a	Is the respondent the household head?	☐ Yes……1>>skip to A10 No…….2	**A22m**	Month of the second visit (mm)	☐☐
A08	Name of respondent		**A22y**	Year of second visit (yyyy)	2 0 1 7

Annex E Household Survey

Study on mobile phone technology based nutrition and agriculture advisory services in Ghana
BASELINE SURVEY: Household Questionnaire – March 8, 2017

For Research Purpose only

Outline:

Module A: Household Identification - Front Page

Module B: Household Composition and Education
- Part 1: Household Roster

Module C: Housing and Assets
- Part 1: Housing
- Part 2: Current Household Assets

Module D: Agriculture
- Part 1: Agricultural land
- Part 2a: Agricultural crop choice – Major Season
- Part 3a: Inputs and labor – Major Season
- Part 4a: Crop production, sales and use – Major Season
- Part 5: Crop storage – Major Season

Module E: Access to Credit

Module F: Market Information
- Part 1: Market information (female)
- Part 2: Market information (male)

Module G: Mobile phone access and usage
- Part 1: Mobile phone access and usage (female)
- Part 2: Mobile phone access and usage (male)

Module H: Nutrition Knowledge
- Part 1: Nutrition Knowledge (female)
- Part 2: Nutrition Knowledge (male)

Module I: Food Security
- Part 1: Household Dietary Diversity
- Part 2: Women's Dietary Diversity

Module J: Women's Empowerment in Agriculture
- Part 1: Role in Household Decision Making
- Part 2: Access to Community Groups
- Part 3: Physical Mobility
- Part 4: Health and Nutrition

Module K: Farming Knowledge and Best Practices
- Part 1: Farming Knowledge and Best Practices (female)
- Part 2: Farming Knowledge and Best Practices (male)

Module L: Trust likelihood of nutrition and agriculture information

Module M: Willingness to Pay (treatment only)

Universal Codes (Include with all CAPI options):

97=Don't know
98=Not applicable
99=Response refusal

ENUMERATOR INSTRUCTIONS:

For this survey, use the following definitions of a household, household member, primary female respondent, household head, and spouse of household head:

- *Household: a group of people who live and eat together, share resources and form a common decision-making unit. Often, a household is composed of a head of household, spouse(s), their unmarried children, and possibly their relatives or other persons to whom they are unrelated. The household can be limited to only one person or a person with his or her children. In a polygamous household where all the spouses do not live in the same compound as their husband, each of the spouses living elsewhere will be listed as a separate household with the persons they live with (the spouse being the head of that household). A tenant who does not take his meals where he lives is considered as a separate household. In a case where a household head lives in a compound with a spouse or spouse(s) and their children, among which some are married, each of the married children with their spouse(s) and own children and other unmarried dependents under their responsibility are all part of the same single household. In this case, all three generations (and other unmarried dependents) belong to one household. In a group of unmarried people living together where everyone has his own means of livelihood, each member of the group will form his own household.*

- *Household member: anyone who met the criteria for being part of the household more than six of the last twelve months, as well as anyone who recently entered the household through birth or marriage to a household member.*

- *Household head: the individual who plays a leading role in household decision-making, particularly concerning farming, household economic activity and expenditures. Generally, the person identified by the household as the household head is accepted in this role for the survey.*

- *Main spouse of household head: the individual who is married to the household head. In the event there are multiple spouses of the head of household, this should be the highest order (earliest) spouse.*

- *Primary female respondent: If the head of household is a female, they must be selected as the primary female respondent. If the head of household is a male and married, the spouse of the head of household should be selected as the primary female respondent. In the event there are multiple spouses of the head of household, the primary female respondent should be the highest order (earliest) wife. If the head of household is male and is unmarried, the primary female respondent is the primary decision-maker on farming and household expenditure. They must be between 15 years or older.*

- *Primary male respondent: If the head of household is a male, they must be selected as the primary male respondent. If the head of household is female and married, the spouse of the head of household should be selected as the primary male respondent. If the head of household is female and is unmarried, the primary male respondent is the primary decision-maker on farming and household expenditures. They must be between 15 years or older.*

Module A: Household Identification - Front Page

ENUMERATOR: Ask the questions below of the household head. If the household head is not available for interview, ask the spouse of the head or the next most responsible household member.

No.	Household Identification	Response	No.	Household Identification	Response
HHID	Household Census ID	☐☐☐☐☐☐☐☐☐	**A04d**	Day of the first visit (dd)	☐☐
A00a	GPS coordinates, Latitude (minutes)	☐☐ ☐☐☐	**A04m**	Month of the first visit (mm)	☐☐
A00b	GPS coordinates, Longitude (minutes)	☐☐ ☐☐☐	**A04y**	Year of first visit (yyyy)	2 0 1 7
A00c	Accuracy	☐☐☐☐	**A05**	Code of Interviewer	☐☐
A01	Region (code)	☐☐	**A06**	Code of Supervisor	☐☐
A01a	Region (name)		**A07**	Name of household head	
A02	District (code)	☐☐	**A07a**	What is the relationship of the respondent to the household head?	☐ Code a >>if 1 then skip to A09
A02a	District (name)		**A08**	Name of primary respondent (if different from household head)	
A03	EA (code)	☐☐☐	**A09**	What is the main language spoken by the household head?	☐ Ga .....1 Twi.....2 Ewe .....3 Fante .....4 Dagaare .....5 Waali .....6 Sissale.....7 Brifo.....8 Other 9
A03a	EA (name)		**A10d**	Day of the second visit (dd)	☐☐
A04	[Enumerator: Are you able to track the household?]	☐ Yes, found and able to start interview ……1 Yes, found but refused to start interview ……2 Yes, found but no one at home for interview ……3 No……4 If 2, 3, or 4 >> end interview and find replacement	**A10m**	Month of the second visit (mm)	☐☐

CONSENT OF RESPONDENT

The University of Ghana Institute of Statistical, Social and Economic Research (ISSER) is working with the International Food Policy Research Institute (IFPRI) to conduct research on how farmers access information to help with their farming decisions. The outcomes of this study should provide added knowledge on new ways to help farmers improve their agricultural yield and make nutritious decisions for their families to inform future policies and programmes in the provision of services for rural farmers in Ghana.

Your household has been chosen by a random selection process to participate in this study. We will conduct a survey that will take approximately 2 hours of your time. We will ask you to share basic information about the members of your household, your household's assets, agricultural practices, production and yield, mobile phone use, food consumption, and nutrition knowledge. In addition to this, we may access your phone data on use of service from your mobile network provider, for research purposes only. Any information we obtain from you during the research will be kept strictly confidential.

There will be no cost to you other than your time. There will be no risk as a result of your participation in the study. Your participation in this research is completely voluntary. You are free to withdraw your consent and discontinue participation in this study at any time and will not be adversely affected. You are also free to refuse to answer any question we may ask. You will be informed in a timely manner if information becomes available that may be relevant to your willingness to continue participation or withdraw. You are free to ask any questions on the objectives of the study or your participation at any time.

For answers to any specific questions about the research and in case of research-related injury you may contact the Institute of Statistical, Social and Economic Research at the University of Ghana (Dr. Simon Bawakyillenuo or Dr. Felix Asante) or the International Food Policy Research Institute (Dr. Melissa Hidrobo)

Please tick mark on the right box depending on the respondent's consent
Consent given: Yes ☐ No ☐

Signature of the Enumerator: _____ **Date:** **DD MM YY**
/_____/_____/_____/

Module B: Household Composition and Education

Module B, Part 1: Household Roster

ENUMERATOR: Ask the questions below of the household head. If the household head is not available for interview, ask the spouse of the head or the next most responsible household member.

Member ID	Name Instructions: Household head will always be listed first (from question A07). After household head ensure that you list the primary female if not the household head. In the census the primary female was [name]. Also, ensure that you list the primary male if not the household head and if one is available.	Sex Male... 1 Female 2	Age (in years) If answer is < 2, then → B1_02b If >=2, skip to B1_03	Age (in months)	Relationship to household head	Marital Status (ages 12 and older)	Can [NAME] read a phrase in English? (ages 10 and older)	Can [NAME] read a phrase in any local language? (ages 10 and older)	Education (Highest class passed) (Only for individuals 5 years and older) If B1_06=99, then skip to B1_08a	Is [NAME] currently (2017) attending school/ college? (Only for children 5-17) Yes.... 1 No 2	What is the main activity of [name]? >> skip for those under 17 years of age
		Code↑			Code a	Code b			Code c		Code d
MID	**Name**	**B1_01**	**B1_02a**	**B1_02b**	**B1_03**	**B1_04**	**B1_05**	**B1_05a**	**B1_06**	**B1_07**	**B1_08**

B1_09a	Treatment status of household	☐	Treatment……..1 Control.……...2
B1_09	Strata of sampling *(preloaded from CLE)*	☐	Two-person household……..1 Single female household……...2 Single male household……3
B1_10	Treatment status for intervention *(preloaded from CLE)*	☐	Primary female respondent.……..1 Primary male respondent..……...2
B1_11	[Enumerator: Who is the primary female respondent? If there is no primary female please write 96] Instructions: In the census primary female respondent was [name]. Remember if the head of household is a female, they must be selected as the primary female respondent. If the head of household is a male and married, the spouse of the head of household should be selected as the primary female respondent. In the event there are multiple spouses of the head of household, the primary female respondent should be the highest order (earliest) wife. If the head of household is male and is unmarried, the primary female respondent is the primary decision-maker on farming and household expenditure. They must be between 15 years or older.	☐	MID >> B1_11=98 if B1_09=3
B1_12	[Enumerator: Who is the primary male respondent? If there is no primary male please write 96] Instructions: In the census primary male respondent was [name]. Remember if the head of household is a male, they must be selected as the primary male respondent. If the head of household is female and married, the spouse of the head of household should be selected as the primary male respondent. If the head of household is female and is unmarried, the primary male respondent is the primary decision-maker on farming and household expenditures. They must be between 15 years or older.	☐	MID >> B1_11=98 skip if B1_09=2
B1_13	[Enumerator: Which script is the household to be read for Willingness to Pay?] *(preloaded from CLE)*	☐	Agriculture script……..1 Nutrition and ag script.……...2

Code a: Relationship to household head Household head..... 1 Spouse of household head..... 2 Son/daughter ..... 3 Daughter/son -in-law..... 4 Grandson/daughter ..... 5 Father/mother ..... 6 Brother/sister ..... 7 Niece/Nephew ..... 8 Household head's cousin ..... 9 Father-in-law/mother-in-law..... 10 Brother/Sister-in-law ..... 11 Spouse's niece/nephew ..... 12 Spouse's cousin..... 13 Primary caregiver.....14 Other ..... 15 **Code b: Marital status code** Unmarried (never married)..... 1 Married, monogamous ..... 2 Married, polygamous ..... 3 Widow/widower ..... 4 Divorced ..... 5 Separated/Deserted..... 6	**Code c: Education (Highest class passed)** Never attended school.....99 Reads in class I .....0 Completed class I .....1 Completed class II .....2 Put number of highest completed class. For example, if currently in class IV, put 3 (class III completed) Completed class X.....10 Completed Senior High School..... 12 BA/BSC .....14 Higher National Diploma.....15 MA/MSC and above .....16 Certificate .....22 Preschool class (general) .....66 Preschool (religious).....67 Other .....76 **Code d: Activity** Crop Production.....1 Livestock .....2 Commerce or other business..3 Skilled labor.....4 Employee .....5 Student.....6 Unpaid housework.....7 Retired.....8 Volunteer/unpaid apprentice...9 Looking for work .....10 Other .....11 None.....12

Module C: Housing and Assets

Module C, Part 1: Housing

ENUMERATOR: Ask the questions below of the household head. If the household head is not available for interview, ask the spouse of the head or the next most responsible household member.

C1_01	What is the main material used for the outer walls of the dwelling occupied by your household? [Observation only]	☐	Mud/Mud brick/Cow dung……..1 Wood/Bamboo……...2 Metal/slate/asbestos……3 Stone/Burned bricks……4 Cement/Sandcrete block……5 Landcrete……6 Thatch/ Cardboard/Plastic……..7 Other (specify)……8

C1_02	What is the main material used for the floor in your dwelling? [Observation only]	☐	Earth/mud/Mud brick/Cow dung……...1 Wood……...2 Stone……3 Cement/Conrete……4 Ceramic/tile……5 Other (specify)……6
C1_03	What is the main material used for the roof in your dwelling? [Observation only]	☐	Leaves ……..1 Wood……...2 Corrugated metal……3 Cement/ Concrete……4 Asbestos/ Slate/ Tiles……5 Mud brick/Earth……6 Plastic sheeting……7 Other (specify)……8
C1_04	How many distinct rooms does the household occupy? (exclude kitchen, bathrooms, and storage rooms)		Number
C1_05	What is your main source of drinking water for your household?	☐	Piped into dwelling.....1 Public tap/ tank.....2 Borehole, well with pump .....3 Well without pump.....4 Spring.....5 Pond/Lake/Dam.....6 River.....7 Rainwater .....8 Sachet or bottled water .....9 Other (specify).....10

C1_06	What is the main type of toilet used by your household?	☐	Flush / Pour flush Flush to piped sewer system ..... 1 Flush to septic tank ..... 2 Flush to pit (latrine) ..... 3 Flush to somewhere else ..... 4 Flush to unknown place / Not sure / DK where ..... 5 Pit latrine Ventilated Improved Pit latrine (VIP) ..... 6 Pit latrine with slab ..... 7 Pit latrine without slab / Open pit ..... 8 Composting toilet ..... 9 Bucket ..... 10 Hanging toilet, Hanging latrine, flying toilet ..... 11 No facility, Bush, Field ..... 12 >> skip to C1_08 Other (*specify*) _____ 13
C1_07	Do you share this toilet facility with other households?	☐	Yes ..... 1 No 2
C1_08	What is the main type of lighting used by your household?	☐	Electric lights/Solar home system .... 1 Torch ..... 2 Candles ..... 3 Oil or kerosene lamp ..... 4 Solar lanterns……..5 Other ..... 6 None 7
C1_09	What is the main type of cooking fuel used by your household?	☐	Wood ..... 1 Charcoal ..... 2 Gas/LPG ..... 3 Electricity ..... 4 Other 5
C1_10	If you were to rent or pay for a dwelling similar to the one you live in, how much would you expect to pay monthly?		Ghanaian cedi/month
C1_11	Does anyone in your household know how to send and receive mobile text messages?	☐	Yes……..1 No……..2
C1_12	How much does your household spend in total on airtime in an average month?	☐	Ghanian cedis

Module C, Part 2: Current Household Assets

ENUMERATOR: Ask the questions below of the household head. If the household head is not available for interview, ask the spouse of the head or the next most responsible household member.

C2_ID	Respondent ID		MID

Description of asset	Asset code	Does your household own the item? Yes...1 No....2 >> skip to next row	Quantity	How many are owned by primary male respondent **only**?	How many are owned by the primary female respondent **only**?	How many are jointly owned by the primary male and female respondent?
		Code↑	(No.)	(No.)	(No.)	(No.)
Asset	**C2_01**	**C2_02**	**C2_03**	**C2_04**	**C2_05**	**C2_06**
Box iron/ Electric iron	1					
Video player, VCD/DVD/MP3/MP4 player, iPod	2					
Television (B/W or color)	3					
Satellite dish	4					
Bicycle	5					
Motorcycle	6					
Car	7					
Working mobile phone	8					
Livestock						
Bulls/oxen	9					
Cattle	10					
Buffalo	11					
Goat	12					
Sheep	13					
Pigs	14					
Chicken	15					
Horses	16					
All other poultry (guinea fowl, pigeon, ducks etc)	17					
Donkeys	18					
Rabbits	19					
Farm assets						
Plough and yoke for animals	20					
Wheelbarrow or cart for hauling	21					
Other Non-mechanized farm equipment (hoe, rake, shovel)	22					
Mechanized farm equipment (tractor-plough, power tiller, treadle pump)	23					

Module D: Agriculture

Module D, Part 1: Agricultural land

ENUMERATOR: Ask the questions below of the household member most responsible for farming and agriculture. Encourage the member to include other members on the questions relating to their parcels.

D_ID	Respondent ID		MID

I would like to list all the agricultural land owned or/and operated by household members during the past 12 months (excluding land rented out or sharecropped out). Does the household operate any parcels? If none, skip to D1_11.
Enumerator: Draw a simple map of the parcels of agricultural land owned or farmed by members of the household. Then number the parcels, starting with those that are farmed by the household in the past 12 months. Finally, list any parcels owned by the household which have remained fallow for the 12-month period. DEFINITION OF A PARCEL: For this survey, a parcel is a continuous piece of land under one ownership status.

Parcel Name	Parcel ID	How large is this parcel?	Area unit 1- Acre 2- Hectare 3- Poles 4- Ropes 5- Plots 6- M2	Does this parcel belong to your household?? (either purchased land or allocated by traditional authorities) 1- Yes 2- No, rented >> skip to D1_06 3- No, sharecropped >> D1_07w 4- No, borrowed at no cost >> D1_08w	Who in your household owns this parcel? (Multiple entries allowed)	How did your household obtain this parcel? 1- Allocated by family 2- Allocated by chief 3- Allocated by govt 4- Purchased 5- Gift 6- Inherited 7- Other	Does the household have the right to sell this parcel or use it as collateral security? 1- Sell 2- Security 3- Both 4- No rights >> skip to D1_08w	How much did your household pay in rent for this parcel in the past 12 months? >> skip to D1_08w		What share of the harvest was/is received by the household in the last [season] season? 1- 75% (3/4th) 2- 66% (2/3rd) 3- 50% (1/2) 4- 33% (1/3rd) 5- 25% (1/4th) 6- 20% (1/5th) 7- 10% (1/10th) 8- 5% (1/20th)		What was the main source of water for this parcel in the last the last [season] season? 1- Rainfed 2- Surface irrigation 3- Groundwater irrigation 4-Water from well, lake or rive brought by hand 5- Other		How long does it take you to go from your house to this parcel on foot? *[Enumerator: Write 999 if unable to go by foot]*	What is the quality* of soil in this parcel? 1- Poor 2- Average 3- Good
								Value	Time period	Major	Minor	Major	Minor		
		Area	Code↑	Code↑	MID	Code↑	Code↑	GHc	1- Per month 2- Per season 3- Per year	Code↑	Code↑	Code↑	Code↑	Minutes	Code↑
D1_00A	D1_00	D1_01	D1_01a	D1_02	D1_03	D1_04	D1_05	D1_06	D1_06a	D1_07w	D1_07d	D1_08w	D1_08d	D1_09	D1_10
	1														
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

*Explanation of soil quality: "Poor" means low yield in a normal rainfall year because sandy, rocky, or weed-infested. "Medium" means average yield with normal rainfall. "Good" means good yield with normal rainfall because soil is dark, soft-textured, and weed-free.

Question Number	Questions	Response	Response Code
D1_11	Is there any land owned by the household, but rented out or sharecropped out to another household?	☐	1- Yes 2- No >> skip to D1_12
D1_11a	What is the area of land rented out or sharecropped to another household?		Area
D1_11b	Unit	☐	1- Acre 2- Hectare 3- Poles 4- Ropes 5- Plots 6- M2
D1_12	Does any household member work on someone else's land?	☐	1- Yes 2- No >> skip to next module
D1_13	How many total person-days did members of this household work on someone else's land in the last 12 months?		

Module D, Part 2a: Agricultural crop choice – Major season

Now we want to ask you questions about parcels that were operated by your household during the last major season. **Enumerator: Copy the parcel numbers and names from D1_00 and D1_00a.**

Parcel Name	Parcel ID	How did your household use this land in the the last major season? 1- Crops 2- Livestock >> next parcel 3- Forest >> next parcel 4- Unused/fallow >> next parcel 5- Multiple uses 6- Other	How much of the parcel was cultivated? If 0 skip to D2a_07	Area unit 1- Acre 2- Hectare 3- Poles 4- Ropes 5- Plots 6- M2	During the major season, what crops were cultivated on this parcel? For each crop, what area was under production? [Enumerator: If more than 5 crops are planted, list crops in order of importance in terms of area. See CROP CODES on page 13. Use the area unit in D2a_01b.]										*(Enumerator: For each question, record up to two household member IDs, putting the person primarily responsible in the first column.)* During the last major season…				Was there intercropping on this parcel? 1- Yes 2- No 3- Don't know
															…who decided what to grow on this parcel?		…who spent the most time working on this parcel?		
		Code↑	Area	Code↑	CROP	AREA	CROP	AREA	CROP	AREA	CROP	AREA	CROP	AREA	ID Code	ID Code	ID Code	ID Code	Code↑
D2a_00a	D2a_00	D2a_01	D2a_01a	D2a_01b	D2a_02	D2a_02a	D2a_03	D2a_03a	D2a_04	D2a_04a	D2a_05	D2a_05a	D2a_06	D2a_06a	D2a_07a	D2a_07b	D2a_08a	D2a_08b	D2a_09
	1																		
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
	10																		

Code f: Crops

Cereals	
11	White maize
12	Yellow maize
13	Sorghum/guinea corn
14	Early millet
15	Late millet
16	Rice
19	Other grains
Root crops	
21	Yams
22	Cassava
23	Sweet potato
24	Tiger nut
29	Other root crops
Pulses	
31	Cowpeas
32	Bambara beans
39	Other beans
Oilseeds	
41	Groundnut
42	Soya
43	Sesame
44	Sunflower
49	Other oilseeds

Vegetables	
51	Tomato
52	Onion
53	Okra
54	Eggplant
55	Chili peppers
56	Leafy vegetables
59	Other vegetables
Fruit	
61	Mango
62	Citrus
63	Pawpaw
64	Banana
69	Other fruit
Other crops	
70	Shea
71	Plantains
72	Cocoa
73	Coffee
74	Oil palm
75	Tobacco
76	Cotton
77	Cashew
78	Moringa
79	Other crops

Module D, Part 3a: Inputs and labor – Major season

Crop code (Copy from section D2a)	For this crop what was the source of seed used in the last major season? 1- All from own harvest or gifts >> skip to D3a_02 2- All purchased or bartered 3- Some own harvest or gifts, some purchased or bartered 98 Not applicable>> skip to D3a_02	How much did your household pay for seed that was purchased and planted in the last major season?	Did your household apply any manure to this crop during the last major season? 1- Yes 2- No	Did your household apply any inorganic fertilizer to this crops during the last major season? 1- Yes 2- No >> skip to D3a_05	How much fertilizer did your household apply to this crops during the last major season?		How much did your household pay for fertilizer applied to this crop during the last major season?	For the [crop] grown in the last major season what was the combined value of pesticides, herbicides, & spraying services that this household used?	For the [crop] grown in the last major season how much did the household pay for tractor hire?	Was any seed or fertilizer provided on credit to this household for this crop? 1- Yes, seed 2- Yes, fertilizer 3- Yes, both 4- No	Did you use hired or exchange labor for this crop in the the last major season? 1- Yes 2- No >> skip to D3a_12	How many person-days* of HIRED LABOR were used on this crop during in the last major season?	What was the average cash daily wage paid to the hired labor (excluding value of exchange labor)?	If there were other labor costs, what was the total amount spent on this crop (in-kind labor payments, contract labor teams etc.) in the last major season?	How large was the [crop] harvest this last major season compared to other havests for a normal major season? 1- Much larger >> skip to next crop 2- A little larger >> skip to next crop 3- Same >> skip to next crop 4- A little smaller 5- Much smaller 97- Don't know>> skip to next crop 98 – Not applicable>>skip to next crop	Why was the [crop] harvest smaller than usual? 1- Too little rain 2- Too much rain 3- Insects 4- Rodents 5- Wildlife 6- Poor inputs 7- Soil fertility 8- Planted more/less area 9- Other
	Code↑	Value in GHc	Code↑	Code↑	Quantity	Unit 1- Kg 2- Bowl 3- Liter 4-Other	Value in GHc	Value in GHc	Value in GHc	Code↑	Code↑		Value in GHc	Value in GHc	Code↑	Code↑
D3a_00	D3a_01	D3a_01a	D3a_02	D3a_03	D3a_04	D3a_04a	D3a_04b	D3a_05	D3a_06	D3a_07	D3a_08	D3a_09	D3a_10	D3a_11	D3a_12	D3a_13

*Note: Person-days are calculated as the number of workers times the number of days they worked. For example, if 5 people work for 3 days and 2 people continue for 6 more days, the total number of person-days is 5x3 + 2x6 = 27.

Module D, Part 4a: Crop production, sales and use – Major season

Crop codes (Copy crop codes from D3a_00)	How much of [crop] was harvested in the last major season? If D4a_01=0 then skip to next crop.	Unit 1- Kg 2- Maxibag 3- Minibag 4- Crate 5- Bowl 6- Unit or piece	How much of [crop] harvested was consumed by the household? (same units as D4a_01a)	How much of [crop] harvested was used for animal feed? (same units as D4a_01a)	How much of [crop] harvested was sold? (same units as D4a_01a)	How much of [crop] harvested was saved for seed? (same units as D4a_01a)	How much of [crop] harvested was used for gifts, losses, exchange, processing etc? (same units as D4a_01a) If D4a_04=0 >> skip to next crop	What price did the household receive when selling this crop? (per unit in D4a_01a)	What was the main place where the crop was sold by the household in the last major season? 1- On farm or home 2- Market in village 3- Market outside village 4- Road side 5- At cooperative 6- At processor/mill 7- Other	Who was the main buyer of the crop in the last major season? 1- Farmer/consumer 2- Trader 3- Processor 4- NAFCO/MOFA 5- Other 97- Don't know	Did the buyer contract the household to grow this crop? 1- Yes 2- No	In the last major season, Who was the main seller of [crop]? *(Enumerator: record up to two household member IDs, putting the person primarily responsible in the first column.)*	
Code f								GHc per unit	Code↑	Code↑	Code↑	ID Code	ID Code
D4a_00	D4a_01	D4a_01a	D4a_02	D4a_03	D4a_04	D4a_05	D4a_06	D4a_07	D4a_08	D4a_09	D4a_10	D4a_11a	D4a_11b

Module D, Part 5: Crop storage

Crop code	Crop name	Did you have any [crop] in storage one month after the last major season harvest? 1- Yes 2- No >> skip to next crop	What is the total quantity of [crop] that you had in storage one month after the harvest?	Unit 1- Kilogram 2- Maxibag 3- Minibag 4- Crate 5- Bowl 6- Unit or piece 7- Other	What type of structure was used for storing this [crop]? 1- Traditional granary 2- Crib 3- Pots 4- Metal tanks 5 -Storage sacks 6- Other	How much of what you stored was lost before you could sell or consume it? >>if D5_06=0 then skip to D5_08	What is the main cause of these losses? 1- Rodents 2- Insects 3- Mold 4- Theft 5- Fire 6 - Flood 7- Other	What does your household use most of the stored [crop] for? 1- Seed 2- To consume later 3- To sell at better price 4- To meet cash needs later 5- Animal feed 6- Other
		Code↑		Code↑		Percent	Code↑	Code↑
D5_00	D5_01	D5_02	D5_03	D5_04	D5_05	D5_06	D5_07	D5_08

Module E: Access to Credit

ENUMERATOR: Ask the questions below of the household head. If the household head is not available for interview, ask the spouse of the head or the next most responsible household member.

Question number	Question	Response	Response option
E1_1D	Copy the respondent's ID from module B		Member ID
E1_01	Have you or any household member borrowed any funds or obtained goods or services on credit in the last 12 months?		Yes.....1 No 2
E1_02	During the last 12 months did any household member try to borrow funds or obtain goods or services on credit from any person or institution and was refused?		Yes.....1 No 2
E1_03	During the last 12 months did any household member want to borrow but did not apply for it?		Yes.....1 No ..... 2>>skip to E1_05 Don't know..... 97>>skip to E1_05
E1_04	Why did they not apply for borrowing?		BELIEVED WOULD BE REFUSED BECAUSE HAVE DEFAULTED IN PAST.....1 BELIEVED WOULD BE REFUSED FOR OTHER REASONS.....2 TOO EXPENSIVE (HIGH INTEREST RATE OR HIGH COST OF OBTAINING LOAN)..3 INADEQUATE COLLATERAL.....4 DO NOT LIKE TO BE IN DEBT.....5 DO NOT KNOW ANY LENDER.....6 BELIEVED WOULD NOT BE ABLE TO PAY IT BACK.....7 BELIEVED LENDER DID NOT HAVE ANY FUNDS.....8 CORRUPTION/POLITICS/BUREAUCRACY.....9 DID NOT WANT TO REGISTER.....10 OTHER (SPECIFY).....11 DON'T KNOW……97
E1_05	Who makes the decision to borrow most of the time?		Household head 1 Spouse/partner 2 Other household member 3 Other non-household member 4 Not applicable 98

Question number	Question	Response	Response option
E1_06	Who makes the decision about what to do with the money/item borrowed most of the time?		Household head 1 Spouse/partner 2 Other household member 3 Other non-household member 4 Not applicable 98

Lender code	Lending sources "I'd like to ask about your household's experience with borrowing money or other items in the past 12 months."	Would you or anyone in your household be able to take a loan or borrow cash/in-kind from [source] if you wanted to? 1 Yes 2 No 3 Maybe
E1_07a	**E1_07**	**E1_08**
1	Non-government organization	
2	Formal lender (bank/financial institution)	
3	Informal lender	
4	Friends or relatives	
5	Group based microfinance organization	
6	Informal credit/savings groups (such as merry-go-rounds, susu, funeral societies)	

Module F, Part 2: Market Practices (male)

ENUMERATOR: Ask the questions below of the primary male respondent.

F2_ID	Respondent ID		MID

F2_01	What was the most important crop for **you, (name of primary male respondent),** in terms of sales revenue in the last year?		Code f 98=Not applicable, If 98 skip to next module	
F2_02	How long does it take you to get to the market where you sell this crop by your usual means?		0-30 minutes…….1 More than 30 minutes to 1 hour….2 1 hour to 2 hours…….3 Over 2 hours……4	
F2_02a	What was the LOWEST price per unit you received for this crop from the 2016 main harvest?		Price GHc	
F2_02aa	Unit of crop		1- Kg 2- Maxibag 3- Minibag 4- Crate	5- Bowl 6- Unit or piece
F2_02b	In what month did you receive the LOWEST price?		Month	
F2_02c	What was the HIGHEST price per unit you received for this crop from the 2016 main harvest?		Price GHc	
F2_02ca	Unit of crop		1- Kg 2- Maxibag 3- Minibag	4- Crate 5- Bowl 6- Unit or piece
F2_02d	In what month did you receive the HIGHEST price?		Month	
F2_03	How many buyers do you, **(name of primary male respondent)**, know who would have been willing to buy this crop from you in the main season of last year?		Just one buyer…….1 2-3 buyers……..2 4-5 buyers……...3	6-10 buyers……4 More than 10 buyers...5 Don't know…….97
F2_04	What is the main reason you decided to sell to the main buyer?		Best price…….. …….1 Immediate payment……2 Good location…… 3 To repay input credit……..4	Pre-planting commitment...5 Only one available……. 6 Other……...7
F2_05	If you had sold this crop at a different place could you have gotten a better price?		1…. Yes 2 ….No >> skip to F2_07 97 …Don't know >> skip to F2_07	
F2_06	Why didn't you sell the crop at this other place offering a better price?		1. Don't know buyers there 2. Don't trust the buyers there 3. Don't have a way to transport crops 4. Cost of getting there	5. Contract with buyer before planting 6. Buyer paid before harvest 7. Other (specify)
F2_07	If you had sold this crop to a different buyer, could you have gotten a better price?		1 Yes 2 No >> skip to next section 97 Don't know >> skip to next section	
F2_08	Why didn't you sell the crop to this other buyer offering a better price?		1. Other buyer delayed payment 2. Don't trust other buyers 3. Don't have a way to transport crops 4. Cost of getting it to other buyers	5. Contract with buyer before planting 6. Buyer paid before harvest 7. Other (specify)

Module G, Part 2: Mobile phone access and usage (male)

ENUMERATOR: Ask the questions below of the primary male respondent.

G2_ID	Respondent ID		MID

G2_01	Do you, (name of primary male respondent), own a working mobile phone?		Yes……..1>> skip to G2_03 No……..2
G2_01a	Does anyone in your household own a working mobile phone that you have access to?		Yes……..1 No……..2>>skip to next module
G2_02	Who owns the mobile phone you have access to?		MID
G2_03	Which is your main phone number?		Mobile phone number
G2_03a	**[Enumerator: Is the phone with the respondent]**		Yes……..1 No……..2>> skip to G2_04
G2_03b	**[Enumerator: Is the phone on or can it be switched on?]**		Yes……..1 No……..2>> skip to G2_04
G2_03c	**[Enumerator: Dial and verify the number. If it does not ring, ask the respondent to check the number and keep trying until you hear the phone ring. Was the number verified?]**		Yes……..1 No……..2
G2_04a	How long have you had this SIM card?		Less than 6 months….1 More than 6 months but less than a year….2 1 – 2 years…..3 More than 2 years……4
G2_04b	Which network provider does this SIM card use?		MTN..1 Expresso..5 Tigo..2 Glo..6 Vodafone..3 Other..7 Airtel..4
G2_04c	How likely is it that you would recommend your friends and family use this provider? *(Read options aloud)*		Very unlikely.....1 Somewhat unlikely .....2 Neither likely nor unlikely.....3 Something likely .....4 Very likely.....5
G2_05	Who else has access to this mobile phone? *(Multiple answers allowed)*		Spouse……..1 Another member in this household……..2 A neighbor……..3 A family member in the village……4 A friend in the village…….5 Another person outside the village….6 Nobody….7 Other……..8

G2_06	How often did you,(name of primary male respondent), use this mobile phone in the last fourteen days?	☐	Never……..1>>skip to G2_08 Every day……..2 Every other day……..3 A few times a week……..4
G2_07a	Did you use this mobile phone in the last fourteen days to make calls?	☐	Yes……..1 No……..2
G2_07b	Did you use this mobile phone in the last fourteen days to receive calls?	☐	Yes……..1 No……..2
G2_07c	Did you use this mobile phone in the last fourteen days to send text messages?	☐	Yes……..1 No……..2
G2_07d	Did you use this mobile phone in the last fourteen days to receive text messages?	☐	Yes……..1 No……..2
G2_07e	Did you use this mobile phone in the last fourteen days to send mobile money?	☐	Yes……..1 No……..2
G2_07f	Did you use this mobile phone in the last fourteen days to receive mobile money?	☐	Yes……..1 No……..2>> and if G2_07e=2 then skip to G2_07h
G2_07g	Which mobile money service do you use? *(Multiple options allowed)*	☐	Vodafone Cash 1 MTN Mobile Money 2 Airtel Money 3 Tigo Cash 4 Other 5
G2_07h	Did you use this mobile phone in the last fourteen days to use mobile internet (e.g.: Facebook, WhatsApp, and email)?	☐	Yes……..1 No……..2
G2_08	Have you ever used any mobile phone to get agriculture advice of any kind?	☐	Yes……..1 No……..2
G2_09	Have you ever received automated text messages with information about agricultural tips, weather information, market price information, or nutrition information?	☐	Yes……..1 No……..2 >> skip to G2_12
G2_10	Who sent these text messages?	☐	Government health facility 1 NGO……2 Religious institution……3 Other……4 Don't Know……97
G2_11	When was the last time you received these text message?	☐	Yesterday……..1 Last week……..2 Two weeks ago……3 Last month……4 Two months ago……5 Less than six months ago but more than two months ago…6 In the last year but more than six months ago….7 13 to 24 months ago……..8 More than 2 years……..9

G2_12	Would you find it useful to receive information via text messages on agriculture tips, weather information, market price information, and nutrition information?	☐	Yes……1 No……..2 [Skip this question if G2_09==yes]
G2_13	How much do you, **(primary male respondent)**, spend in total on airtime in an average month?		Ghanian cedis
G2_14	Do you typically charge your phone at home?	☐	Yes……..1 >>skip to G2_17 No……..2
G2_15	How long does it take to get to the nearest place to charge your phone?	☐	1. Less than 10 minutes 2. 10-30 minutes 3. 31 minutes to an hour 4. More than an hour
G2_16	How much do you spend to charge your phone in an average month?		Ghanian cedis

Mobile phone roster number	Please list the mobile phone number of all phones that you own or have access to *(Enumerator: enter 99999999 if the respondent cannot recall the number. Enter all numbers they own)*	Who owns this SIM card? Self……1 Spouse……2 Another member in this household……3	What network provider does this SIM card use? MTN..1 Tigo..2 Vodafone..3 Airtel..4 Expresso..5 Glo..6 Other..7	Can you receive signal for this network at your household compound? Yes……..1>>skip to next SIM card No……..2	Can you receive signal for this network somewhere in the village? Yes……1 No……..2	How long does it take to walk from your household to the nearest place where you can receive a signal from this network?
				Code↑		Minutes
G2_17	**G2_18**	**G2_19a**	**G2_19b**	**G2_20**	**G2_21**	**G2_22**
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Module H, Part 2: Nutrition Knowledge and practices (male)

ENUMERATOR: Ask the questions below of the primary male respondent. The following questions relate to caregivers' knowledge of feeding practices, not their actual behavior, which may or may not be consistent with their awareness and knowledge due to a number of circumstances. DO NOT PROMPT.

H2_ID	Respondent ID		MID

Question number	Question	Response	Response option
H2_01	When was the last time you washed your hands?		Today……1 Yesterday……..2 Within the last 2-7 days..... 3 Longer than a week.....4 Don't know.....97 Not applicable 98
H2_02	Where should perishable foods be kept?		Refrigerator..... 1 Cold areas……..2 Other.....3 Don't know.....97 Not applicable 98
H2_03	Did you wash your crops under clean water to remove debris and pesticide residues in the past month?		Yes ..... 1 No .....2 Don't know.....97 Not applicable 98
H2_04	When should you wash your hands? *(Multiply answers allowed)*		Before eating .....1 After using the toilet .....2 Before feeding the child .....3 After cleaning a child who has defecated 4 Other .....5 Don't know.....97 Not applicable 98
H2_05	True or false: Water must not be used to clean tubers before storage because of increased susceptibility of infection from germs.		True ..... 1 False.....2 Don't know.....97 Not applicable 98
H2_06	From cassava, do you get more nutrients from eating the root or the leaf?		Leaf..... 1 Roots .....2 Don't know.....97 Not applicable 98
H2_07	True or false: You should cook potatoes immediately after peeling or keep them in a bowl covered completely with water.		True ..... 1 False.....2 Don't know.....97 Not applicable 98

Question number	Question	Response	Response option
H2_08	What are the health properties of ripe tomatoes? *(Multiply answers allowed)*	☐	Promote good health ..... 1 Anti-cancer properties .....2 Other.....3 Don't know.....97 Not applicable 98
H2_09	What foods are rich in vitamin A? (Vitamin A supports growth, repair body tissues and assists in protecting the body against diseases) *(Multiply answers allowed)*	☐	Orange-fleshed sweet potato .....1 Orange fruits/vegetables .....2 Green leafy vegetables ..... 3 Eggs .....4 Breastmilk .....5 Cow milk ..... 6 Liver.....7 Meat/fish .....8 Other..... 9 Don't know.....97 Not applicable 98
H2_10	What are the health benefits of papaya? *(Multiply answers allowed)*	☐	Healing wounds .....1 Fighting diseases .....2 Other.....3 Don't know.....97 Not applicable 98
H2_11	How can you preserve mangoes and store them for later use?	☐	Cut and dry mango.....1 Other.....2 Don't know.....97 Not applicable 98
H2_12	Is avocado an appropriate food to feed babies when first introducing solid foods?	☐	Yes ..... 1 No .....2 Don't know.....97 Not applicable 98
H2_13	What are the benefits of consuming beans? *(Multiply answers allowed)*	☐	Help the heart beat normally ..... 1 Maintain normal body growth .....2 Regulate body temperature..... 3 Other.....4 Don't know.....97 Not applicable 98
H2_14	Did you remove stones, damaged beans, and dry soybeans to avoid the bean from getting moldy in the past month?	☐	Yes ..... 1 No .....2 Don't know.....97 Not applicable 98
H2_15	True or false, adding pulse flour to porridge increases the protein content.	☐	True ..... 1 False.....2 Don't know.....97 Not applicable 98

Question number	Question	Response	Response option
H2_16	Is it safe to consume cereals that have been affected by aflatoxin?	☐	Yes ..... 1 No .....2 Don't know .....97 Not applicable 98

Module K, Part 2: Farming Knowledge and Best Practices (male)

ENUMERATOR: Ask the questions below of the primary male respondent. Do not read answer options or prompt.

K2_ID	Respondent ID		MID

K2_01	In the production season, with what should you top-dress your maize one month after planting? *(Multiply answers allowed)*	☐	Urea ..... 1 Sulphate of ammonia ..... 2 Other ..... 3 Don't know 97
K2_02	What can be used to weed onion fields at regular intervals? *(Multiply answers allowed)*	☐	Hoes ..... 1 Handforks ..... 2 Other ..... 3 Don't know 97
K2_03	True or false. Maize can be stored for longer when the shaft is removed.	☐	True ..... 1 False ..... 2 Don't know 97
K2_04	Does burning groundnut fields after harvest increase or decrease crop yield.	☐	Increase ..... 1 Decrease ..... 2 Don't know 97
K2_05	How should plants be spaced in order to make full use of all available sun energy?	☐	Rectangular spacing ..... 1 Other ..... 2 Don't know 97
K2_06	What color are oil palm fruits when ripe?	☐	Red ..... 1 Other ..... 2 Don't know 97
K2_07	After the first harvest, when should peppers be harvested again for maximum yield?	☐	After a two-week interval ..... 1 Other ..... 2 Don't know 97
K2_08	How many months after planting is cassava ready for harvesting?	☐	9-18 months ..... 1 Other ..... 2 Don't know 97
K2_09	When is the plantain fruit considered mature? *(Multiply answers allowed)*	☐	When fingers become full ..... 1 When the tip blackens ..... 2 Other ..... 3 Don't know 97
K2_10	What are the signs of a matured soyabean? *(Multiply answers allowed)*	☐	Yellowing and shedding of leaves ..... 1 Yellowing and drying of pod ..... 2 Hardening of seeds ..... 3 Other ..... 4 Don't know 97
K2_11	Pepper fields should be located as far away from which non-food crops to avoid potential spread of viruses to pepper fields?	☐	Tobacco plantations ..... 1 Other ..... 2 Don't know 97
K2_12	When storing grain crops, what can cause post-harvest loss? *(Multiply answers allowed)*		Insects ..... 1 Rodents ..... 2 Moisture ..... 3 Mold ..... 4 Other ..... 5 Don't Know 97

Module F, Part 1: Market Practices (female)

ENUMERATOR: Ask the questions below of the primary female respondent.

F1_ID	Respondent ID	MID

F1_01	What was the most important crop for you, **(name of primary female respondent)**, in terms of sales revenue in the last year?	☐	Code f 98=Not applicable, If 98 skip to next module	
F1_02	How long does it take you to get to the market where you sell this crop by your usual means?	☐	0-30 minutes……..1 More than 30 minutes to 1 hour….2 1 hour to 2 hours…….3 Over 2 hours……..4	
F1_02a	What was the LOWEST price per unit you received for this crop from the 2016 major harvest?		GHc	
F1_02aa	Unit of crop		Unit 1- Kg 2- Maxibag 3- Minibag	4- Crate 5- Bowl 6- Unit or piece
F1_02b	In what month did you receive the LOWEST price?			
F1_02c	What was the HIGHEST price per unit you received for this crop from the 2016 major harvest?		GHc	
F1_02ca	Unit of crop		Unit 1- Kg 2- Maxibag 3- Minibag	4- Crate 5- Bowl 6- Unit or piece
F1_02d	In what month did you receive the HIGHEST price?			
F1_03	How many buyers do you, **(name of primary female respondent**), know who would have been willing to buy this crop from you in the main season of last year?	☐	Just one buyer…….1 2-3 buyers……..2 3-4 buyers……..3	6-10 buyers……4 More than 10 buyers...5
F1_04	What is the main reason you decided to sell to the main buyer?	☐	Best price…… …….1 Immediate payment……2 Good location…… 3 To repay input credit……..4	Pre-planting commitment...5 Only one available……. 6 Other……..7
F1_05	If you had sold this crop at a different place could you have gotten a better price?	☐	1…. Yes 2 ….No >> skip to F1_07 97 …Don't know >> skip to F1_07	
F1_06	Why didn't you sell the crop at this other place offering a better price?	☐	1. Don't know buyers there 2. Don't trust the buyers there 3. Don't have a way to transport crops 4. Cost of getting there	5. Contract with buyer before planting 6. Buyer paid before harvest 7. Other (specify)
F1_07	If you had sold this crop to a different buyer, could you have gotten a better price?	☐	1 Yes 2 No >> skip to next section 97 Don't know >> skip to next section	

F1_08	Why didn't you sell the crop to this other buyer offering a better price?	☐	1. Other buyer delayed payment 2. Don't trust other buyers 3. Don't have a way to transport crops 4. Cost of getting it to other buyers	5. Contract with buyer before planting 6. Buyer paid before harvest 7. Other (specify)

Module G, Part 1: Mobile phone access and usage (female)

ENUMERATOR: Ask the questions below of the primary female respondent.

G1_ID	Respondent ID		MID

G1_01	Do you, (name of primary female respondent), own a working mobile phone?		Yes……..1>> skip to G1_04 No……..2
G1_01a	Does anyone in your household own a working mobile phone that you have access to?		Yes……..1 No……..2>>skip to next module
G1_02	Who owns the mobile phone you have access to?		MID
G1_03	Which is your main phone number?		Mobile phone number
G1_03a	**[Enumerator: Is the phone with the respondent]**		Yes……..1 No……..2>> skip to G1_04
G1_03b	**[Enumerator: Is the phone on or can it be switched on?]**		Yes……..1 No……..2>> skip to G1_04
G1_03c	**[Enumerator: Dial and verify the number. If it does not ring, ask the respondent to check the number and keep trying until you hear the phone ring. Was the number verified?]**		Yes……..1 No……..2
G1_04a	How long have you had this SIM card?		Less than 6 months….1 More than 6 months but less than a year….2 1 – 2 years…..3 More than 2 years……4
G1_04b	Which network provider does this SIM card use?		MTN..1 Expresso..5 Tigo..2 Glo..6 Vodafone..3 Other..7 Airtel..4
G1_04c	How likely is it that you would recommend your friends and family use this provider? *(Read options aloud)*		Very unlikely.....1 Something unlikely .....2 Neither likely nor unlikely.....3 Something likely .....4 Very likely.....5
G1_05	Who else has access to this mobile phone? *(Multiple answers allowed)*		Spouse……..1 Another member in this household……..2 A neighbor……..3 A family member in the village……4 A friend in the village…….5 Another person outside the village….6 Nobody……..7 Other……..8

G1_06	How often did you, (name of primary female respondent), use this mobile phone in the last fourteen days?	☐	Never……..1>> skip to G1_08 Every day……..2 Every other day……..3 A few times a week……..4
G1_07a	Did you use this mobile phone in the last fourteen days to make calls?	☐	Yes……..1 No……..2
G1_07b	Did you use this mobile phone in the last fourteen days to receive calls?	☐	Yes……..1 No……..2
G1_07c	Did you use this mobile phone in the last fourteen days to send text messages?	☐	Yes……..1 No……..2
G1_07d	Did you use this mobile phone in the last fourteen days to receive text messages?	☐	Yes……..1 No……..2
G1_07e	Did you use this mobile phone in the last fourteen days to send mobile money?	☐	Yes……..1 No……..2
G1_07f	Did you use this mobile phone in the last fourteen days to receive mobile money?	☐	Yes……..1 No……..2 >> and G1_07e=2 skip to G1_07h
G1_07g	Which mobile money service do you use? *(Multiple options allowed)*	☐	Vodafone Cash 1 MTN Mobile Money 2 Airtel Money 3 Tigo Cash 4 Other 5
G1_07h	Did you use this mobile phone in the last fourteen days to use mobile internet (e.g.: Facebook, WhatsApp, and email)?	☐	Yes……..1 No……..2
G1_08	Have you ever used any mobile phone to get agriculture advice of any kind?	☐	Yes……..1 No……..2
G1_09	Have you ever received automated text messages with information about agricultural tips, weather information, market price information, or nutrition information?	☐	Yes……..1 No……..2 >> skip to G1_12
G1_10	Who sent these text messages?	☐	Government health facility 1 NGO……2 Religious institution……3 Other……4 Don't Know……97
G1_11	When was the last time you received these text message?	☐	Yesterday……..1 Last week……..2 Two weeks ago……3 Last month……4 Two months ago……5 Less than six months ago but more than two months ago…6 In the last year but more than six months ago….7 13 to 24 months ago……8 More than 2 years……..9

G1_12	Would you find it useful to receive information via text messages on agriculture tips, weather information, market price information, and nutrition information?	☐	Yes……1 No……..2 [Skip this question if G1_09==1]
G1_13	How much do you, **(name of primary female respondent)**, spend in total on airtime in an average month?	☐	Ghanian cedis
G1_14	Do you typically charge your phone at home?	☐	Yes……..1 >>skip to G1_17 No……..2
G1_15	How long does it take to get to the nearest place to charge your phone?	☐	1. Less than 10 minutes 2. 10-30 minutes 3. 31 minutes to an hour 4. More than an hour
G1_16	How much does you spend to charge your phone in an average month?		Ghanian cedis

Mobile phone roster number	Please list the mobile phone number of all phones that you own or have access to *(Enumerator: enter 99999999 if the respondent cannot recall the number. Enter all numbers they own)*	Who owns this SIM card? Self……1 Spouse……2 Another member in this household……3	What network provider does this SIM card use? MTN..1 Tigo..2 Vodafone..3 Airtel..4 Expresso..5 Glo..6 Other..7	Can you receive signal for this network at your household compound? Yes……..1 >> skip to next SIM card No……..2	Can you receive signal for this network somewhere in the village? Yes……1 No……..2	How long does it take to walk from your household to the nearest place where you can receive a signal from this network?
				Code↑		Minutes
G1_17	**G1_18**	**G1_19a**	**G1_19b**	**G1_20**	**G1_21**	**G1_22**
1						
2						
3						
4						
5						
6						
7						
8						
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10						

Module H, Part 1: Nutrition Knowledge (female)

Enumerator: The following questions relate to caregivers' knowledge of feeding practices, not their actual behavior, which may or may not be consistent with their awareness and knowledge due to a number of circumstances. DO NOT PROMPT.

H1_ID	Respondent ID		MID

Question number	Question	Response	Response option
H1_01	When was the last time you washed your hands?		Today……1 Yesterday……..2 Within the last 2-7 days ago ..... 3 Longer than one week.....4 Don't know.....97 Not applicable 98
H1_02	Where should you keep perishable foods?		Refrigerator..... 1 Cold areas……..2 Other.....3 Don't know.....97 Not applicable 98
H1_03	Did you wash your crops under clean water to remove debris and pesticide residues in the past month?		Yes ..... 1 No.....2 Don't know.....97 Not applicable 98
H1_04	When should you wash your hands? *(Multiply answers allowed)*		Before eating .....1 After using the toilet .....2 Before feeding the child .....3 After cleaning a child who has defecated 4 Other .....5 Don't know.....97 Not applicable 98
H1_05	True or false: Water must not be used to clean tubers before storage because of increased susceptibility of infection from germs.		True ..... 1 False.....2 Don't know.....97 Not applicable 98
H1_06	From cassava, do you get more nutrients from eating the root or the leaves?		Leaf..... 1 Roots .....2 Don't know.....97 Not applicable 98
H1_07	True or false: You should cook potatoes immediately after peeling or keep them in a bowl covered completely with water.		True ..... 1 False.....2 Don't know.....97 Not applicable 98
H1_08	What are the health properties of ripe tomatoes? *(Multiply answers allowed)*		Promote good health..... 1 Anti-cancer properties .....2 Other.....3 Don't know.....97 Not applicable 98

Question number	Question	Response	Response option
H1_09	What foods are rich in vitamin A? (Vitamin A supports growth, repair body tissues and assists in protecting the body against diseases) *(Multiply answers allowed)*	☐	Orange-fleshed sweet potato .....1 Orange fruits/vegetables .....2 Green leafy vegetables ..... 3 Eggs .....4 Breastmilk .....5 Cow milk ..... 6 Liver.....7 Meat/fish .....8 Other..... 9 Don't know .....97 Not applicable 98
H1_10	What are the health benefits of papaya? *(Multiply answers allowed)*	☐	Healing wounds .....1 Fighting diseases .....2 Other.....3 Don't know .....97 Not applicable 98
H1_11	How can you preserve mangoes and store them for later use?	☐	Cut and dry mango.....1 Other.....2 Don't know .....97 Not applicable 98
H1_12	Is avocado an appropriate food to feed babies when first introducing solid foods?	☐	Yes ..... 1 No .....2 Don't know .....97 Not applicable 98
H1_13	What are the benefits of consuming beans? *(Multiply answers allowed)*	☐	Help the heart beat normally ..... 1 Maintain normal body growth .....2 Regulate body temperature..... 3 Other.....4 Don't know .....97 Not applicable 98
H1_14	Did you remove stones, damaged beans, and dry soybeans to avoid the bean from getting moldy in the past month?	☐	Yes ..... 1 No .....2 Don't know .....97 Not applicable 98
H1_15	True or false, adding pulse flour to porridge increases the protein content.	☐	True ..... 1 False.....2 Don't know .....97 Not applicable 98
H1_16	Is it safe to consume cereals that have been affected by aflatoxin?	☐	Yes ..... 1 No .....2 Don't know .....97 Not applicable 98

Module I: Dietary Diversity

Module I, Part 1: Household Dietary Diversity

ENUMERATOR: Ask the questions below to the primary female respondent.

Question Number	Questions	Anyone in household	Code
I1_ID	Copy the respondent's name and ID from Module B	Name:_____ Mem ID ☐	Name and Mem ID
The following questions are based on previous day recall, i.e., Yesterday during the day and the night. Foods consumed outside the home that were not prepared in the home should not be included.			
I1_02	Yesterday (during the day or the night) did anyone in your **household** eat or drink any:		
I1_02a	Milk such as tinned, powdered, or fresh animal milk	☐	Yes..... 1 No 2
I1_02b	Tea or coffee	☐	
I1_02c	Any other liquids (juice, cocoa)	☐	
I1_02d	Maize, rice, wheat, sorghum, millet, Bread, noodles, porridge or other foods made from grains (kenkey, banku, koko, tuo zaafi, akple)	☐	
I1_02e	Pumpkin, red or yellow yams, carrots, sweet potatoes that are yellow or orange inside	☐	
I1_02f	White potatoes, white yams, manioc, cassava, cocoyam, fufu, or any other foods made from roots, tubers or plantain	☐	
I1_02g	Any dark green, leafy vegetables (kontomire, aleefu, ayoyo, kale, cassava leaves)	☐	
I1_02h	Ripe mangoes, papaya	☐	
I1_02i	Any other fruits or vegetables (e.g. bananas, avocados, tomatoes, oranges, apples)	☐	
I1_02j	Liver, kidney, heart or other organ meats	☐	
I1_02k	Any meat, such as beef, pork, lamb, goat, chicken, or duck	☐	
I1_02l	Eggs	☐	
I1_02m	Fresh or dried fish or shellfish (e.g. prawn, lobster)	☐	
I1_02n	Any foods made from beans, peas, lentils,	☐	
I1_02o	Nuts and seeds	☐	
I1_02p	Yogurt, cheese, or other milk products	☐	
I1_02q	Any oil, fats, or butter, or foods made with any of these	☐	
I1_02r	Any sugary foods such as chocolates, sweets, candies, pastries, cakes, or biscuits	☐	
I1_02s	Condiments for flavor, such as peppers, spices, herbs or fish powder	☐	
I1_02t	Grubs, snails or insects	☐	

Question Number	Questions	Anyone in household		Code
I1_02u	Foods made with red palm oil, red palm nut, or red palm nut pulp sauce			

Module I, Part 2: Women's Dietary Diversity

Instructions: Ask the following for the primary female respondent.

Question Number	Questions	Female Respondent		Code
I2_ID	Copy the respondent's ID from Module B	Mem ID		MID
I2_01	Copy the respondent's name from Module B	Name:_____		
The following questions are based on previous day recall, i.e., Yesterday during the day and the night.				
I2_02	Did you, (name of primary female respondent), eat or drink any [.] yesterday (during the day or night):			
I2_02a	Milk such as tinned, powdered, or fresh animal milk			Yes..... 1 No 2
I2_02b	Tea or coffee			
I2_02c	Any other liquids (juice, cocoa)			
I2_02d	Maize, rice, wheat, sorghum, millet, Bread, noodles, porridge or other foods made from grains (kenkey, banku, koko, tuo zaafi, akple)			
I2_02e	Pumpkin, red or yellow yams, carrots, sweet potatoes that are yellow or orange inside			
I2_02f	White potatoes, white yams, manioc, cassava, cocoyam, fufu, or any other foods made from roots, tubers or plantain			
I2_02g	Any dark green, leafy vegetables (kontomire, aleefu, ayoyo, kale, cassava leaves)			
I2_02h	Ripe mangoes, papaya			
I2_02i	Any other fruits or vegetables (e.g. bananas, avocados, tomatoes, oranges, apples)			
I2_02j	Liver, kidney, heart or other organ meats			
I2_02k	Any meat, such as beef, pork, lamb, goat, chicken, or duck			
I2_02l	Eggs			
I2_02m	Fresh or dried fish or shellfish (e.g. prawn, lobster)			
I2_02n	Any foods made from beans, peas, lentils, nuts, or seeds			
I2_02o	Nuts or seeds			
I2_02p	Yogurt, cheese, or other milk products			
I2_02q	Any oil, fats, or butter, or foods made with any of these			
I2_02r	Any sugary foods such as chocolates, sweets, candies, pastries, cakes, or biscuits			

Question Number	Questions	Female Respondent		Code
I2_02s	Condiments for flavor, such as peppers, spices, herbs or fish powder	☐		
I2_02t	Grubs, snails or insects	☐		
I2_02u	Foods made with red palm oil, red palm nut, or red palm nut pulp sauce	☐		

Module J: Women's Empowerment in Agriculture

Instructions: Ask the following questions to the primary female respondent. Try to conduct this interview in private with the respondent, without others present during the discussion.

J1_ID	Respondent ID		MID
J1_00	Was the woman able to be interviewed by herself?		Yes 1 No 2

Module J, Part 1: Role in Household Decision Making Around Production and Income Generation

Activity code	Activity name "I'd like to ask you some questions about your participation in certain types of work activities and on making decisions on various aspects of household life."	Did you yourself participate in [activity] in the past 12 months? Yes 1 No 2 >> next activity	When decisions are made regarding [activity], who is it that normally makes the decision? Allow multiple responses Self 1 Spouse 2 Other female HH member 3 Other male HH member 4 Other female non-HH member 5 Other male non-HH member 6 Not applicable 98 If only 1 >> skip to J1_05	How much input did you have in making decisions about [activity]? Little to no input in decision 1 Input into some decisions 2 Input into most or all decisions 3 Not applicable / no decision made 98	To what extent are you able to access information that you feel is important for making informed decisions regarding [ACTIVITY]? Not at all 1 Small extent 2 Medium extent 3 To a high extent 4	How much input did you have in decisions about how much of the outputs of [ACTIVITY] to keep for consumption at home rather than selling? Little to no input in decision 1 Input into some decisions 2 Input into most or all decisions 3 Not applicable / no decision made 98	How much input did you have in decisions on the use of income generated from [activity]? Little to no input in decision 1 Input into some decisions 2 Input into most or all decisions 3 Not applicable / no decision made 98
		Code↑	Code↑	Code↑	Code↑	Code↑	Code↑
J1_01a	**J1_01**	**J1_02**	**J1_03**	**J1_04**	**J1_05**	**J1_06**	**J1_07**
A	Staple grain farming and processing of harvest: grains that are grown primarily for food consumption (rice, millet, maize, wheat)						
B	Horticulture (gardens) or high value crop farming and processing						
C	Livestock raising and processing of milk and/or						
E	Poultry and other small animal raising (chickens, ducks, etc.) and processing of eggs						
F	Fishing or fishpond culture						
G	Non-farm economic activities: Small business, self-employment, buy-and-sell						
H	Wage and salary employment: in kind or monetary work both agriculture and other wage						
I	Large, occasional household purchases (such as a bicycle, land, okada)						

Activity code	Activity name "I'd like to ask you some questions about your participation in certain types of work activities and on making decisions on various aspects of household life."	Did you yourself participate in [activity] in the past 12 months? Yes 1 No 2 >> next activity	When decisions are made regarding [activity], who is it that normally makes the decision? Allow multiple responses Self 1 Spouse 2 Other female HH member 3 Other male HH member 4 Other female non-HH member 5 Other male non-HH member 6 Not applicable 98 If only 1 >> skip to J1_05	How much input did you have in making decisions about [activity]? Little to no input in decision 1 Input into some decisions 2 Input into most or all decisions 3 Not applicable / no decision made 98	To what extent are you able to access information that you feel is important for making informed decisions regarding [ACTIVITY]? Not at all 1 Small extent 2 Medium extent 3 To a high extent 4	How much input did you have in decisions about how much of the outputs of [ACTIVITY] to keep for consumption at home rather than selling? Little to no input in decision 1 Input into some decisions 2 Input into most or all decisions 3 Not applicable / no decision made 98	How much input did you have in decisions on the use of income generated from [activity]? Little to no input in decision 1 Input into some decisions 2 Input into most or all decisions 3 Not applicable / no decision made 98
		Code↑	Code↑	Code↑	Code↑	Code↑	Code↑
J1_01a	**J1_01**	**J1_02**	**J1_03**	**J1_04**	**J1_05**	**J1_06**	**J1_07**
J	Food purchases for daily consumption						

Module J, Part 2: Access to Community Groups

Group code	Group "I'd like to ask about your involvement with community groups in the past 12 months."	Are you a member of a [group] group? 1 Yes 2 No >> skip to next group	Have you discussed agriculture in this [group] in the last 3 months? 1 Yes 2 No	Have you discussed nutrition in this [group] in the last 3 months? 1 Yes 2 No
			Code↑	Code↑
J2_01	**J2_01a**	**J2_02**	**J2_03**	**J2_04**
A	Self-help group			
B	Women's group			
C	Credit and savings group			
D	Farmers group			
E	Health group			
F	Traditional or religious group			
G	Trade and business association group			

QUESTION	Code →	
J3_01 How often do you visit an urban center?		EVERYDAY 1 EVERY WEEK AT LEAST ONCE 2 EVERY 2 WEEKS AT LEAST ONCE 3 EVERY MONTH AT LEAST ONCE 4 LESS THAN ONCE A MONTH 5 NEVER 6
J3_02 How often do you go to the market / haat / bazaar?		
J3_03 How often do you go to visit family or relatives?		
J3_04 How often do you go to visit a friend / neighbor's house?		
J3_05 How often do you go to the hospital / clinic / doctor (seek health service)?		
J3_06 How often do you go to a public village gathering / community meeting / training for NGO or programmes?		
J3_07 In the last 12 months, how many times have you been away from home for one or more nights (in other words, sleeping somewhere else for the night)?		
J3_08 In the last 12 months, have you been away from home for more than one month at a time?	YES……1 NO……2	

Now I'd like to ask you some questions about different places you might visit.		Does your husband/partner or other household member object to you going <u>alone</u> to [PLACE]?
PLACE J3_09		**J3_10**
A	Urban center	YES……1 NO……2
B	Market / haat / bazaar	YES……1 NO……2
C	Visit family or relatives	YES……1 NO……2
D	Visit a friend / neighbor's house	YES……1 NO……2
E	Hospital / clinic / doctor (seek health service)	YES……1 NO……2
F	Public village gathering or community meeting	YES……1 NO……2
G	Training for NGO / programmes	YES……1 NO……2

Now I'd like to ask you some questions on making decisions about your health and nutrition.	Who in the household generally makes decisions about [DECISION]? Allow multiple responses Self 1 Spouse 2 Other female HH member 3 Other male HH member 4 Other female non-HH member 5 Other male non-HH member Not applicable 98 **IF RESPONSE IS MEMBER ID (SELF) ONLY → *next item*** **J4_01**			To what extent do you feel you can participate in decisions regarding [ACTIVITY] if you want(ed) to? **CIRCLE ONE** **J4_02**
WOMAN'S HEALTH AND NUTRITION	**1**	**2**	**3**	
A What foods to prepare every day?				NOT AT ALL 1 SMALL EXTENT 2 MEDIUM EXTENT 3 TO A HIGH EXTENT 4
B What foods (available in the house) you can eat?				NOT AT ALL 1 SMALL EXTENT 2 MEDIUM EXTENT 3 TO A HIGH EXTENT 4

Module K, Part 1: Farming Knowledge and Best Practices (female)

ENUMERATOR: Ask the questions below of the primary female respondent. Do not read answer options or prompt.

K1_ID	Respondent ID		MID

K1_01	In the production season, with what should you top-dress your maize one month after planting? *(Multiply answers allowed)*		Urea ..... 1 Sulphate of ammonia ..... 1 Other ..... 2 Don't know 97
K1_02	What can be used to weed onion fields at regular intervals? *(Multiply answers allowed)*		Hoes ..... 1 Handforks ..... 1 Other ..... 2 Don't know 97
K1_03	True or false. Maize can be stored for longer when the shaft is removed.		True ..... 1 False ..... 2 Don't know 97
K1_04	Does burning groundnut fields after harvest increase or decrease crop yield.		Increase ..... 1 Decrease ..... 2 Don't know 97
K1_05	How should plants be spaced in order to make full use of all available sun energy?		Rectangular spacing ..... 1 Other ..... 2 Don't know 97
K1_06	What color are oil palm fruits when ripe?		Red ..... 1 Other ..... 2 Don't know 97
K1_07	After the first harvest, when should peppers be harvested again for maximum yield?		After a two-week interval ..... 1 Other ..... 2 Don't know 97
K1_08	How many months after planting is cassava ready for harvesting?		9-18 months ..... 1 Other ..... 2 Don't know 97
K1_09	When is the plantain fruit considered mature? *(Multiply answers allowed)*		When fingers become full ..... 1 When the tip blackens ..... 1 Other ..... 2 Don't know 97
K1_10	What are the signs of a matured soyabean? *(Multiply answers allowed)*		Yellowing and shedding of leaves ..... 1 Yellowing and drying of pod ..... 1 Hardening of seeds ..... 1 Other ..... 2 Don't know 97
K1_11	Pepper fields should be located as far away from which non-food crop to avoid potential spread of viruses to pepper fields?		Tobacco plantations ..... 1 Other ..... 2 Don't know 97
K1_12	When storing grain crops, what can cause post-harvest loss? *(Multiply answers allowed)*		Insects ..... 1 Rodents ..... 1 Moisture ..... 1 Mold ..... 1 Other ..... 2 Don't Know 97

Module L: Trust likelihood of agriculture and nutrition information

ENUMERATOR: Ask the questions below to randomly selected primary male or female respondent.

L1_ID	Respondent ID		MID

Question number	Question	Response	**Source** Spouse ..... 1 Other family ..... 2 Friend/neighbor..... 3 Automated text message. 4 Government extension worker……5 Cooperative staff.... 6	Research stations……7 Traders/Processors 8 Newspaper/TV/Radio/Poster (Other public advertisement). 9 Community health worker 10 NGO, private organization, religious, or voluntary organization…11 Other (specify)……....12
L1_00a	Is [source] a source of information about crop prices and markets?			
L1_00b	Which source is most important? (Up to 2 options)			
L1_01a	Is [source] a source of information about crop production methods?			
L1_01b	Which source is most important? (Up to 2 options)			
L1_02a	Is [source] a source of information about weather forecasts?			
L1_02b	Which source is most important? (Up to 2 options)			
L1_03a	Is [source] a source of information on nutrition for you?			
L1_03b	Which source is most important? (Up to 2 options)			
L1_04	How many times have you met with an agricultural extension worker in the last three months?		Number	
L1_05	How many times have you met with a community health worker in the last three months?		Number	

Instructions: Below are a series of statements that you may agree or disagree with. Using the scales below indicate your agreement with each item. Please be open and honest in your response.

		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Response Code
L1_06	If I were to receive any agricultural advice or information from my spouse, I would feel confident and trust it completely.	1	2	3	4	5	
L1_07	If I were to receive any agricultural advice or information from my other family members, I would feel confident and trust it completely.	1	2	3	4	5	
L1_08	If I were to receive any agricultural advice or information from my neighbors and friends, I would feel confident and trust it completely.	1	2	3	4	5	
L1_09	If I were to receive any agricultural advice or information from newspaper/TV/radio/posters and other public advertisements, I would feel confident and trust it completely.	1	2	3	4	5	
L1_10	If I were to receive any agricultural advice or information from automated text messages from an NGO, private organization, religious, or voluntary organization, I would feel confident and trust it completely.	1	2	3	4	5	
L1_11	If I were to receive any agricultural advice or information from the cooperative staff, traders, or processors, I would feel confident and trust it completely.	1	2	3	4	5	
L1_12	If I were to receive any agricultural advice or information from a government extension worker or research station, I would feel confident and trust it completely.	1	2	3	4	5	
L1_13	If I were to receive any agricultural advice or information from a community health worker, I would feel confident and trust it completely.	1	2	3	4	5	
L1_14	If I were to receive any nutrition advice or information from my spouse, I would feel confident and trust it completely.	1	2	3	4	5	
L1_15	If I were to receive any nutrition advice or information from my other family members, I would feel confident and trust it completely.	1	2	3	4	5	
L1_16	If I were to receive any nutrition advice or information from my neighbors and friends, I would feel confident and trust it completely.	1	2	3	4	5	
L1_17	If I were to receive any nutrition advice or information from newspaper/TV/radio/posters and other public advertisements, I would feel confident and trust it completely.	1	2	3	4	5	
L1_18	If I were to receive any nutrition advice or information from automated text messages from an NGO, private organization, religious, or voluntary organization, I would feel confident and trust it completely.	1	2	3	4	5	
L1_19	If I were to receive any nutrition advice or information from the cooperative staff, traders, or processors, I would feel confident and trust it completely.	1	2	3	4	5	
L1_20	If I were to receive any nutrition advice or information from a government extension worker or research station, I would feel confident and trust it completely.	1	2	3	4	5	
L1_21	If I were to receive any nutrition advice or information from a community health worker, I would feel confident and trust it completely.	1	2	3	4	5	

Module M: Willingness to pay – BDM

ENUMERATOR: Ask the questions below to randomly selected primary male or female respondent.

M1_ID	Respondent ID		MID

Enumerator: READ TO RESPONDENT:
Thank you for your responses to the survey questions. We are now done with the interview. Your household has been selected at random to receive information on the Vodafone's Farmers' Club service and to play a short game that may give you the opportunity to sign up for the service if you choose.

M1_00a	Have you, [name of selected respondent],heard of Vodafone's Farmers' Club service?	☐	Yes.....1 No 2
M1_00	Do you consent to receive this additional information and participate in the game?	☐	Yes.....1 No .....2 >>end survey

If B1_13=1 then read:
I would like to talk with you, *_NAME OF SELECTED TARGETED INDIVIDUAL___*, about Vodafone's Farmers Club package. Farmers Club is an association for farmers in Ghana, with a special SIM made only for farmers and other agric people. If you have this SIM, you can call an agric expert for free. This expert can give you agricultural information and tips that are useful for your crops and region, like an agricultural extension worker that you can contact at your convenience and for free on your mobile phone. The package also gives you weather, farming advice and helps you find best prices for your crops, all from your phone. The advice is tailored to your geographic region, in the language of your choosing for the 2 crops you are most interested in. Once you are a member, you can call any other farmer in the association for free. Do you have any questions about the Farmers Club package?

If B1_13=2 then read:
I would like to talk with you, *_NAME OF SELECTED TARGETED INDIVIDUAL___*, about Vodafone's Farmers Club package. Farmers Club is an association for farmers in Ghana, with a special SIM made only for farmers and other agric people. If you have this SIM, you can call an agric expert for free. This expert can give you agricultural information and tips that are useful for your crops and region, like an agricultural extension worker that you can contact at your convenience and for free on your mobile phone. The package also gives you weather, farming advice and helps you find best prices for your crops, all from your phone. The advice is tailored to your geographic region, in the language of your choosing for the 2 crops you are most interested in. Once you are a member, you can call any other farmer in the association for free.
Farmers Club also sends at least one recorded nutrition tip every month so that members can learn about how to grow and prepare certain foods that support health and nutrition. The nutrition tips help members learn about the health properties of different crops and how to preserve, store, and prepare food for the health for their family. Do you have any questions about the Farmers' Club package?

READ EXACTLY FROM SCRIPT. DO NOT SAY ANYTHING THAT IS NOT IN SCRIPT:
We would like to offer you, *NAME OF SELECTED TARGETED INDIVIDUAL,* the opportunity to become a Farmers' Club member. Members may pay a small monthly fee for the service, but you will not have to spend any more for the service than you believe it is worth. You can discontinue your membership at any time if you are not satisfied with the product.
We will play a game to determine the monthly fee you would be charged if you become a Farmers Club member. Remember, you will not have to pay any more than you want to for the service and you may even pay less than your selected price. Before we begin to play the game, I would like you to think about how much you would be willing and able to pay for the Farmers' Club service per month. I will ask you for this amount when we begin to play the game.

Here is how the promotion works:
I will ask you to tell me the maximum monthly price you are willing and able to pay for the Farmers' Club service.

This price should represent what you are willing and able to have deducted from your phone credit each month, in return for receiving the Farmers' Club service.
You must be willing and able to pay the price for the first month of the Farmers' Club service today.
In this cup, I have buttons with different numbers on them that represent monthly prices (in Cedis) for the Farmers' Club service.
I will ask you to pick a button from the cup, and we will look at the price together.
If the number you draw is less than your bid, you _NAME OF SELECTED TARGETED INDIVIDUAL, can become a Farmers' Club member and pay the price you pick from the cup each month.
If the number you draw is greater than your bid, then you cannot become a Farmers' Club member.
You will have one chance to play for the Farmers' Club service.
You cannot change your bid after you draw from the cup.
You must state a price that you are actually able to pay now for the first month of service.
We will practice in one moment, but for now, do you have any questions?
Answer any questions the respondent has.

REMEMBER: get the respondent to state the highest price they are willing and able to pay right now.
Before we play for the Farmers' Club product, lets practice the game. We'll play the same game, but instead of playing for the Farmers' Club product, we will play for this bar of soap. (Show respondent soap)

M1_01	What is the maximum amount that you, *name of selected targeted individual,* are willing and able to pay for this soap now?	☐	GHc

Now, if you pick a button with a price that is less than or equal to *M1_01*, you will buy the soap at the price you pick. If you pick a button with a price greater than *M1_01*, you will not be able to purchase the soap, even if you are willing to pay the greater number. You cannot change your bid after you pick a price. Do you understand? And if you pick button with a price [*M1_01*-0.1 cedis] now, what happens?

M1_02	[Enumerator: Did the respondent indicate that they were going to win?]	☐	Yes…….1 >> Ask the respondent how much they need to pay. No……..2 >> move back to M1_01 and explain the rules again
M1_03	[Enumerator: Did the respondent give the correct answer? The correct answer is M1_01-0.1 cedis]	☐	Yes…….1 No……..2 >> move back to M1_01 and explain the rules again

Please, tell me – if you pick a button with a price [*M1_01*+1 Cedis] now, what happens?

M1_04	[Enumerator: Did the respondent indicate that they were going to win?]	☐	Yes…….1 >> move back to M1_01 and explain the rules again No……..2
M1_05	If you draw a button with a price [M1_01+1 Cedis], will you want to purchase the soap for [M1_01+1 Cedis]?	☐	Yes…….1 No……..2 >> skip to M1_07
M1_06	Do you want to change your bid to M1_01+1 cedis?	☐	Yes…….1 >> move back to M1_01 using M1_01+1 as the new M1_01 (record both) No……..2
M1_07	So, is M1_01 truly the most you are willing and able to pay for the soap?	☐	Yes…….1 No……..2 >> move back to M1_01

M1_08	If you pick M1_01, you must be able to pay M1_01. Are you able to pay M1_01 now?	☐	Yes…….1 No……..2 >> move back to M1_01
M1_09	[Enumerator: Record the respondent's final bid		GHc

Could you please fetch the amount you have stated you are willing to pay and show it to me?
Wait for respondent to fetch money and check to see he/she has enough funds for the Final Bid, but don't take money until after the button is drawn.
Are you ready to pick a button?
Mix buttons in cup, hold cup above eye level of respondent.
Now you can draw a button from the cup.
Let respondent draw button while ensuring that he/she is not looking. Together, look at the button and read the price picked.

M1_10	What price did you draw?	☐	GHc
M1_11	[Enumerator: Record if drawn price is lower than, equal to, or higher than the final bid.]	☐	Price drawn is less than or equal to willingness to pay …….1 Price drawn is higher than willingness to pay…….2

If M1_11=1: "The price drawn is less than or equal to the amount you said you would be willing and able to pay for this soap. You can now buy the item at this price." Exchange the soap for M1_10.
If M1_11=2: "The price drawn is greater than the amount you said you would be willing to pay for this soap. You cannot purchase this soap."

M1_12	Do you have any questions about the game? [Enumerator: Address any questions or concerns the respondent has. Make sure he/she understands the rules of the game.]		

Enumerator: REMEMBER: Get the respondent to state the highest price they are willing and able to pay right now for the first month of farmers' club service.

Now you, *NAME OF SELECTED TARGETED INDIVIDUAL*, will play for the Farmers' Club service. You *NAME OF SELECTED TARGETED INDIVIDUAL*, will have the opportunity to purchase the Farmers' Club service for a monthly price between 0 and 3 GHSX. Have you thought about how much you are willing and able to pay monthly for the Farmers' Club service? Do you have the funds available for the first month now? Let's begin:

M1A_01	What is the maximum amount that you, *name of selected targeted individual,* are willing and able to pay for the Farmers' Club service?	☐	GHc

Now, if you pick a button with a price that is less than or equal to *M1A_01*, you will buy the Farmers' Club service at the price you pick. If you pick a button with a price greater than *M1A_01*, you will not be able to purchase the Farmers' Club service, even if you are willing to pay the greater number. You cannot change your bid after you pick a price. Do you understand? And if you pick button with a price [*M1A_01*-0.1 cedis] now, what happens?

M1A_02	[Enumerator: Did the respondent indicate that they were going to win?]	☐	Yes…….1 >> Ask the respondent how much they need to pay. No……..2 >> move back to M1A_01 and explain the rules again

M1A_03	[Enumerator: Did the respondent give the correct answer? The correct answer is M1A_01-0.1 cedis]	☐	Yes…….1 No……..2 >> move back to M1A_01 and explain the rules again

Please, tell me – if you pick a button with a price [*M1A_01*+1 Cedis] now, what happens?

M1A_04	[Enumerator: Did the respondent indicate that they were going to win?]	☐	Yes…….1 >> move back to M1A_01 and explain the rules again No……..2
M1A_05	If you draw a button with a price [M1A_01+1 Cedis], will you want to purchase the Farmers' Club service for [M1A_01+1 Cedis]?	☐	Yes…….1 No……..2 >> skip M1A_06
M1A_06	Do you want to change your bid to M1A_01+1 cedis?	☐	Yes…….1 >> move back to M1A_01 using M1A_01+1 as the new M1A_01 (record both) No……..2
M1A_07	So, is M1A_01 truly the most you are willing and able to pay monthly for the Farmers' Club service?	☐	Yes…….1 No……..2 >> move back to M1A_01
M1A_08	If you pick M1A_01, you must be able to pay M1A_01 for the first month of service. Are you able to pay M1A_01 now?	☐	Yes…….1 No……..2 >> move back to M1A_01
M1A_09	[Enumerator: Record the respondent's final bid		GHc

Could you please fetch the monthly amount you have stated you are willing to pay and show it to me?
Wait for respondent to fetch money and check to see he/she has enough funds for the Final Bid, but don't take money until after the button is drawn.
Are you ready to pick a button?
Mix buttons in cup, hold cup above eye level of respondent.
Now you can draw a button from the cup.
Let respondent draw button while ensuring that he/she is not looking. Together, look at the button and read the price picked.

M1A_10	What price did you draw?	☐	GHc
M1A_11	[Enumerator: Record if drawn price is lower than, equal to, or higher than the final bid.]	☐	Price drawn is less than or equal to willingness to pay …….1 Price drawn is higher than willingness to pay…….2

If M1A_11=2: "The price drawn is greater than the amount you said you would be willing to pay for the Farmers' Club service. You cannot purchase the Farmers' Club service."

If M1A_11=1:
The price drawn is less than or equal to the amount you said you would be willing and able to pay for the Farmers' Club service. You can now buy the item at this price.

For all:

We are running an additional promotion which will enable you, _*NAME OF SELECTED TARGETED INDIVIDUAL*_, to receive the Farmers' Club service for less than the monthly price you drew during the game. You will not have to pay an amount greater than the amount you bid (if you lost) or the amount you won for per month and you may be able to pay less.

M1A_12 A	[Enumerator: Is the respondent ready to do the 2nd stage randomization?]	☐	Yes…….1 No…….2

Take out the cup with the four 2nd stage buttons.

In this cup are four buttons. Each of these buttons corresponds to another monthly price. I will ask you to select one of these buttons, read me the letter written on the button, and I will then enter the letter you selected into this tablet. The tablet will then reveal what monthly price that letter corresponds to. If you would like, you, _*NAME OF SELECTED TARGETED INDIVIDUAL*_, can subscribe to the Farmers' Club service for the monthly price shown by the tablet.

M1A_12 B	[Enumerator: Record the letter written on the 2nd stage button picked.]	☐	A…….1 B…….2 C…….3 D…….4

You, _*NAME OF SELECTED TARGETED INDIVIDUAL*_, have been selected to receive an additional discount! You are being offered the Farmers' Club service for no monthly fee.

Inform the respondent that they will need a valid government ID to register a new SIM line. If the respondent does not have their own ID they can register the SIM in the name of another household member or neighbor. Record the ID information in in questions MIA_16 through MIA_21.

M1A_12	Would you, *name of selected targeted individual*, like to register for Farmers' Club service?	☐	Yes…….1 No…….2 >> end section
M1A_13	Do you have an existing Vodafone number which you would like to migrate to Farmers' Club?	☐	Yes…….1 No…….2
M1A_14	Please note the Vodafone number being used for Farmers' Club [Enumerator: If M1A_13=1, enter the number for the existing Vodafone line If M1A_13=2, enter the phone number on the new SIM card]		
M1A_14 a	Vodafone number for Farmer's Club (verify) If M1A_14a does not match M1A_14a, display error message		
M1A_15	Please note the last 4 digits of PUK (for new SIM only)		If M1A_13=1 then skip to M1A_23.
M1A_16	Record the name from the ID		
MIA_17	Gender from ID		Male…….1 Female….2
M1A_18	Record the region from the ID		Accra……1 Ashanti…….2 Brong Ahafo….3 Central……..4 Eastern……..5 Northern…….6 Upper East…….7 Upper West……8 Volta……..9 Western…….10

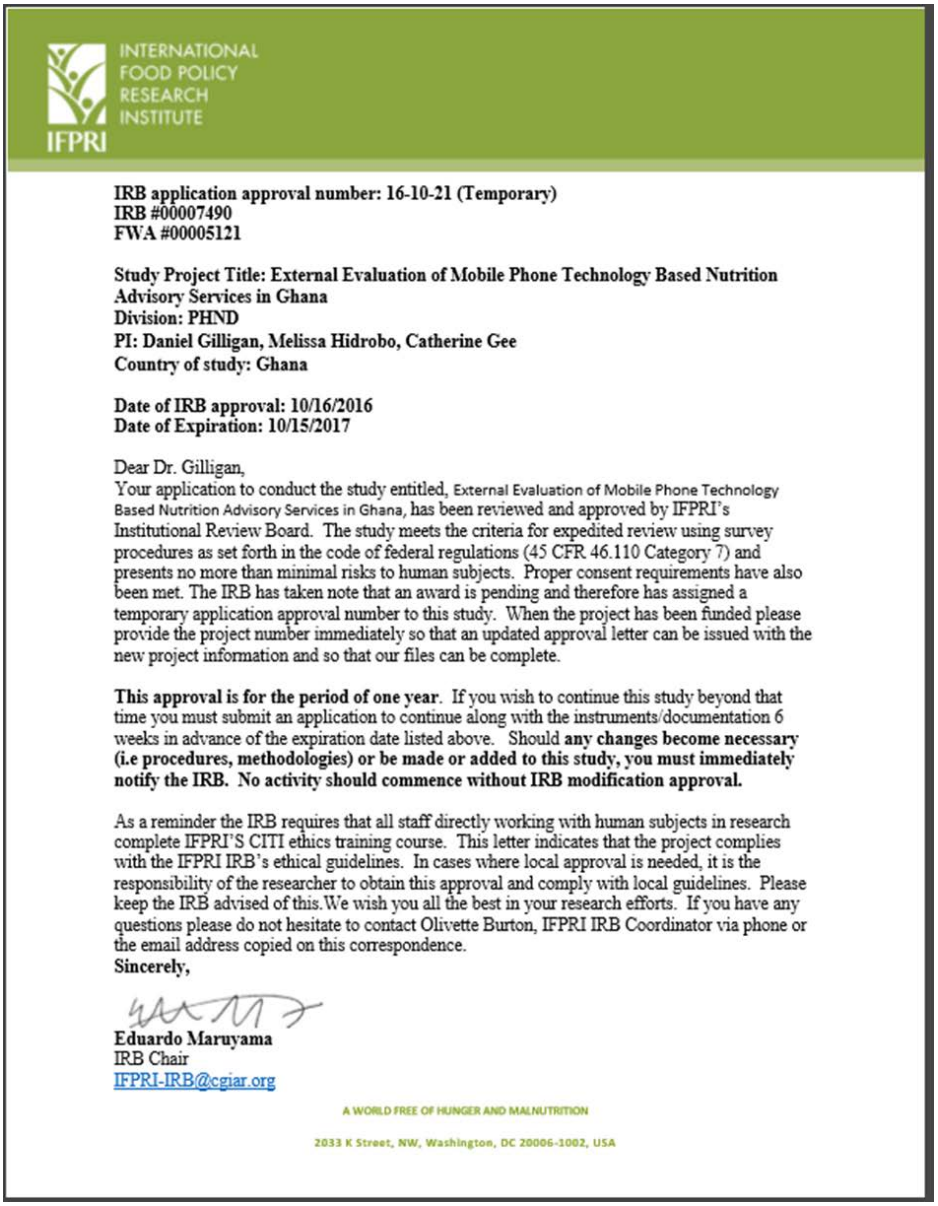
M1A_19d	Day of birth (dd) from the ID		
M1A_19m	Month of birth (mm) from the ID		
M1A_19y	Year of birth (yyyy) from the ID		
M1A_20	ID Type	☐	Passport……..1 Driver's license……2 National health insurance……...3 Voters ID……4 National identification.……5
M1A_20a	Nationality		Ghana….1 Other…..2
M1A_21	ID number		
M1A_21a	ID number (verification) If M1A_21b does not match M1a_21a, display error message		
M1A_22	[Enumerator: Attempt to complete registration. If you are unable to complete the new member registration on the first attempt due to network connectivity, leave the VFC SIM with the respondent and inform the respondent that registration will be completed within two weeks. Were you able to register the respondent?]	☐	Yes….1 No……2
M1A_23	Select one language for messages with farm tips		1- Dangbme 2- Fante 3- Dagaare 4- Ewe 5- Ga 6- Gonja 7- Gruni 8- Kasim 9- Kusaa 10- Mampruli 11- Sisaali 12- Twi 13- Waali
M1A_24	Select one town for weather information		**CODE MIA_24**
M1A_25	Select three days of the week to receive weather information	☐ ☐ ☐	1- Monday 2- Tuesday 3- Wednesday 4- Thursday 5- Friday 6- Saturday 7- Sunday
M1A_26	Select one day of the week to receive farm tips		1- Monday 2- Tuesday 3- Wednesday 4- Thursday 5- Friday 6- Saturday 7- Sunday

M1A_27	Select one commodity for farm tips		**CODE MIA_27**
M1A_28	Select one day of the week to receive market price information		1- Monday 2- Tuesday 3- Wednesday 4- Thursday 5- Friday 6- Saturday 7- Sunday
M1A_29	Select one market price commodity		**CODE MIA_29**
M1A_30	Select five markets for price information		**CODE MIA_30**

CODE MIA_24								CODE MIA_27
Central region		Upper West Region						1- Cashew
1- Abakrampa	27- Diaso	52- Buffiam	78- Daku	104- Gbarima	220- KARNI	246- Meteu	272- SORBELLE	298- Tasaw	2- Cassava
2- Aboabo Camp	28- Efutu	53- BURE	79- Dalle	105- Goli	221- Kpanyangah	247- NABRE	273- Saabaalong	299- Tie	3- Cattle
3- Abura Dunkwa	29- Elmina	54- Baayiri	80- Dazuuri	106- Gonggo	222- Kpongpaala	248- NAKO	274- Sabuli	300- Tigboro	4- Chillie & Pepper
4- Adiembra	30- Fomena	55- Baazing	81- Degri	107- Gowie	223- Kaleo	249- Naale	275- Sakai	301- Tolibri	5- Cocoa
5- Adubiase	31- Goli	56- Baazu	82- Deriguoyiri	108- Guo	224- Kalsagri	250- Nabulo	276- Sakalu	302- Toyaga	6- cowpea seed
6- Adugya	32- Juaso	57- Babile	83- Die	109- Guorpuo	225- Karni	251- Naburnye	277- Salimaana	303- Tumu	7- Eggplants
7- Adukrom	33- Kasoa	58- Bagri	84- Doggoh	200- Guri	226- Katua	252- Nadowli	278- Samambo	304- Tuolong	8- Goats
8- Afofosu	34- Koduakrom	59- Bantala	85- Dolibizon	201- Guripaala	227- Koab	253- Nambeg	279- Sankana	305- Tuori	9- Groundnuts
9- Afofosu	35- Koforidua	60- Basirisan	86- Domwine	202- Gurumbele	228- Koh	254- Nandom	280- Santijang	306- Vembeli	10- Maize
10- Agona Swedru	36- Kuntanase	61- Bielepong	87- Dorimon	203- Gwal	229- Kojokpere	255- Nankpawie	281- Sentu	307- Vieri	11- Mangoes
11- Ahuatem	37- Kwamikrom	62- Billaw	88- Du	204- Gwolu	230- Kompore	256- Nanyagri	282- Sigri	308- Vingving	12- Millets
12- Akim Swedru	38- Mampong	63- Bisikan	89- Duccie	205- Gwosi	231- Kondomwine	257- Naro	283- Siira	309- Wa	13- onion
13- Akropong	39- Mankessim	64- Bombaa	90- Duori	206- Gyan	232- Konta	258- Nebiewale	284- Siiri	310- Wallembelle	14- Oranges
14- Akweteykrom	40- Nkum	65- Bompari	91- Duori – Gyan	207- Halemboi	233- Konwob	259- Nyagli	285- Sombisi	311- Wechau	14- Palm fruits
15- Ankaako	41- Nkwanta	66- Boo	92- Dupare	208- Issah	234- Koroh	260- Oribili	286- Sombo	312- Wellembelle	16- Pig
16- Antwi kwa	42- Ntronang	67- Bulenga	93- Dusie	209- JONGA	235- Korro	261- Owlo	287- Sumboru	313- Wogu	17- Pineapples
17- Asebu	43- Nyankumasi	68- Bulu	94- Duu	210- Jaffiri	236- Kul-Ora	262- PIISI	288- TIBANI	314- Wulling	18- Potato
18- Asikuma	44- Odoben	69- Buree	95- Eremon-Dazuri	211- Jeffiri	237- Kulufu	263- POLE	289- TORKALI	315- Wuru	19- Poultry
19- Asikwa	45- Ojobi	70- Buu	96- Faalu	212- Jeffisi	238- Kulun	264- PUZENE	290- Tabiasi	316- Ya-gra	20- Rabbit
20- Bawjiase	46- Swedru	71- Chaggu	97- Fatchu	213- Jeyiri	239- Kumasal	265- Papu	291- Tabier	317- Yaala	21- Rice
21- Breman	47- Twifo-Praso	72- Chansa	98- Fian	214- Jirapa	240- Kuncheni	266- Pavuu	292- Takala	318- Yagha	22- Shea
22- Brofoyedru	48- Wurakese	73- Chawule	99- Funsi	215- Jirapa town	241- Kundungu	267- Piisie	293- Taliasi	319- Yala	23- Sheep
23- Cape Coast	49- Yamoransa	74- Chogsia	100- GOLI	216- Jolinyiri	242- Kuree	268- Pina	294- Tampie	320- ZANKO	24- Sorghum
24- Dadieso	50- Ziope	75- Dabo	101- GWOLLU	217- Jumo	243- LAMBUSSIE	269-	295- Tampoure	321- Zakpee	25- Soya Bean
25- Damang	51- Saltpond	76- Daffiama	102- Gbanko	218- Kalsegra	244- Lambussie	Poyentanga	296- Tanchara	322- Zimpen	26- Tomato
26- Debiso		77- Dafiama	103- Gbantala	219- KANDE	245- Lawra Town	270- Pudo	297- Tanchara-Ko	323- Zimpuoriyiri	27- Yam
						271- SAKAI			

CODE MIA_29				CODE MIA_30		
1- Ammonium Sulphate	14- Groundnut (Shelled)	28- Pineapple (MD2 medium)	42- Rice (Local White	1- Agbogbloshie	15- Gushiegu market	29- Nima Market
2- Bambara Beans	15- Maize (flour)	29- Pineapple (Cayenne)	43- Shea butter	2- Asafo Market	16- Hohoe Market	30- Nkwanta Market
3- Bull (Live 5-8 yrs)	16- Maize (white grain)	30- Pineapple (Sugar Loaf)	44- Shea (Nuts shelled)	3- Ashaiman Main Mkt	17- Jirapa Market	31- Salaga Market
4- Cassava Chips	17- Maize (yellow grain)	31- Plantain (Apem)	45- Sheep (live 15-30kgs)	4- Bawku Market	18- Kaneshie Market	32- Sekondi Market
5- Cassava (Fresh tuber)	18- Millet (Grain)	32- Plantain (Apentu)	46- Sorghum (Red grain)	5- Bimbilla Market	19- Kasoa, new market	33- Sunyani Market
6- Cassava (Gari)	19- NPK 15 15 15	33- Potato (Imported)	47- Sorghum (White grain)	6- Bole Market	20- Kintampo Market	34- Takoradi Market
7- Cocoyam (taro)	20- Okra (Fresh)	34- Potato (Local)	48- Soya bean	7- Bolgatanga Market	21- Koforidua Market	35- Tamale Market
8- Cow (Live 100-200kgs)	21- Onion (Violet)	35- Rice (American No.5)	49- Tomato (Cooking)	8- Borae Market	22- Kotokuraba Market	36- Techiman Market
9- Cowpea (Red)	22- Onion (Yellow)	36- Rice (Imported BigJoe)	50- Wheat grain	9- Briscoe Market	23- Kpassa Market	37- Tema Market
10- Cowpea (White)	23- Orange (Medium)	37- Rice (Imported Jasmine)	51- Yam (Pona Medium)	10- Dambai Market	24- Kumasi Central	38- Tumu Market
11- Eggplant	24- Palm Fruit (Loose)	38- Rice (Imported Sultana	52- Yam (Water Medium)	11- Damongo Market	25- Kumasi Mayanka	39- Turaku Cattle Mkt.
12- Ginger	25- Palm Oil (red)	39- Rice (Imported Uncle Sam)	53- Yam (White Medium)	12- Donkorkrom	26-	40- Wa Market
13- Goat (live 13-30kgs)	26- Pepper (Dried)	40- Rice (Local Brown	54- Young bull (Live 3-4yrs)	13- Ejura Market	27- Mankessim Market	41- Wenchi Market
	27- Pepper (Fresh)	41- Rice local (Paddy)		14- FUMBISI Market	28- Navrongo Market	42- Yeji Market

Annex F IFPRI Ethics Approval



INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

IRB application approval number: 16-10-21 (Temporary)
IRB #00007490
FWA #00005121

Study Project Title: External Evaluation of Mobile Phone Technology Based Nutrition Advisory Services in Ghana
Division: PHND
PI: Daniel Gilligan, Melissa Hidrobo, Catherine Gee
Country of study: Ghana

Date of IRB approval: 10/16/2016
Date of Expiration: 10/15/2017

Dear Dr. Gilligan,
Your application to conduct the study entitled, External Evaluation of Mobile Phone Technology Based Nutrition Advisory Services in Ghana, has been reviewed and approved by IFPRI's Institutional Review Board. The study meets the criteria for expedited review using survey procedures as set forth in the code of federal regulations (45 CFR 46.110 Category 7) and presents no more than minimal risks to human subjects. Proper consent requirements have also been met. The IRB has taken note that an award is pending and therefore has assigned a temporary application approval number to this study. When the project has been funded please provide the project number immediately so that an updated approval letter can be issued with the new project information and so that our files can be complete.

This approval is for the period of one year. If you wish to continue this study beyond that time you must submit an application to continue along with the instruments/documentation 6 weeks in advance of the expiration date listed above. Should **any changes become necessary (i.e procedures, methodologies) or be made or added to this study, you must immediately notify the IRB. No activity should commence without IRB modification approval.**

As a reminder the IRB requires that all staff directly working with human subjects in research complete IFPRI'S CITI ethics training course. This letter indicates that the project complies with the IFPRI IRB's ethical guidelines. In cases where local approval is needed, it is the responsibility of the researcher to obtain this approval and comply with local guidelines. Please keep the IRB advised of this.We wish you all the best in your research efforts. If you have any questions please do not hesitate to contact Olivette Burton, IFPRI IRB Coordinator via phone or the email address copied on this correspondence.
Sincerely,

Eduardo Maruyama
IRB Chair
IFPRI-IRB@cgiar.org

A WORLD FREE OF HUNGER AND MALNUTRITION

2033 K Street, NW, Washington, DC 20006-1002, USA

Annex G Ghana Ethics Approval

UNIVERSITY OF GHANA
ETHICS COMMITTEE FOR THE HUMANITIES (ECH)
P. O. Box LG 74, Legon, Accra, Ghana

My Ref. No.....

10th October 2016

Dr. Daniel O Galligan,
Poverty, Health and Nutrition Division,
International Food Research Policy Institute (IFPRI)
2033 K St .NW, Washington
DC 20006 -1002, USA

Dear Dr. Barnett,

ECH 013/15-16: EXTERNAL EVALUATION OF MOBILE PHONE TECHNOLOGY BASED NUTRITION AND AGRICULTURE ADVISORY SERVICES IN GHANA

This is to advise you that the above reference study has been presented to the Ethics Committee for the Humanities for a full board review and the following actions taken subject to the conditions and explanation provided below:

Expiry Date:	26/09/17
On Agenda for:	Initial Submission
Date of Submission:	12/09/16
ECH Action:	Approved
Reporting:	Bi-Annually

UG./ISSER/ECH VALID UNTIL 26 SEP 2017 APPROVED DOCUMENT

Please accept my congratulations.

Yours Sincerely,

Rev. Prof. J. O. Y. Mante
ECH Chair

CC: Dr. Inka Barnett, Institute of Development Studies

Annex H Household randomization in the encouragement group

Table 9.1a: Household demographics, by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Household size	5.343	5.184	-0.066	0.072	5.504	5.612	0.046	0.374
	(2.458)	(2.383)			(2.362)	(2.318)		
Female-Headed Household	0.207	0.191	-0.039	0.379	0.085	0.054	-0.125	0.007
	(0.405)	(0.393)			(0.279)	(0.225)		
Age of Household Head	47.980	47.367	-0.041	0.323	47.493	46.161	-0.090	0.068
	(14.532)	(15.271)			(15.133)	(14.367)		
Household Head can read a phrase in English	0.314	0.311	-0.007	0.845	0.333	0.347	0.030	0.509
	(0.464)	(0.463)			(0.471)	(0.476)		
Household Head can read a phrase in the local language	0.246	0.239	-0.015	0.698	0.272	0.249	-0.052	0.220
	(0.431)	(0.427)			(0.445)	(0.433)		
Household Head has some education	0.512	0.533	0.042	0.424	0.527	0.555	0.056	0.181
	(0.500)	(0.499)			(0.500)	(0.497)		
Household Head: Not Married, Divorced, Widowed, Separated	0.195	0.167	-0.072	0.070	0.081	0.056	-0.097	0.032
	(0.397)	(0.373)			(0.272)	(0.230)		
Household Head: Married, Monogamous	0.676	0.707	0.068	0.122	0.765	0.814	0.119	0.010
	(0.468)	(0.455)			(0.424)	(0.390)		
Household Head: Married, Polygamous	0.129	0.126	-0.010	0.763	0.154	0.130	-0.069	0.149
	(0.336)	(0.332)			(0.362)	(0.337)		
Household Head's main activity is crop production	0.867	0.866	-0.001	0.957	0.865	0.894	0.089	0.069
	(0.340)	(0.340)			(0.342)	(0.308)		
Age of the Primary Female	42.424	42.010	-0.029	0.553	41.259	39.749	-0.112	0.021
	(13.984)	(14.600)			(13.916)	(12.979)		
Primary Female can read a phrase in English	0.163	0.178	0.038	0.350	0.177	0.169	-0.022	0.687
	(0.370)	(0.383)			(0.382)	(0.375)		
Primary Female can read a phrase in the local language	0.096	0.100	0.015	0.693	0.097	0.086	-0.035	0.508

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
	(0.294)	(0.300)			(0.296)	(0.281)		
Primary Female has some education	0.402	0.427	0.049	0.288	0.418	0.406	-0.024	0.633
	(0.491)	(0.495)			(0.494)	(0.491)		
Primary Female: Not Married, Divorced, Widowed, Separated	0.203	0.175	-0.071	0.099	0.085	0.063	-0.084	0.066
	(0.402)	(0.380)			(0.279)	(0.243)		
Primary Female: Married, Monogamous	0.714	0.745	0.071	0.118	0.809	0.865	0.151	0.002
	(0.452)	(0.436)			(0.393)	(0.342)		
Primary Female: Married, Polygamous	0.084	0.080	-0.014	0.726	0.106	0.072	-0.118	0.021
	(0.277)	(0.271)			(0.308)	(0.259)		
Primary Female's main activity is crop production	0.763	0.762	-0.003	0.956	0.757	0.760	0.008	0.860
	(0.425)	(0.426)			(0.429)	(0.427)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.1b: Household Demographics, by mNutrition sub-treatment status, Encouraged Group, tests of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Household size	5.666	5.664	5.563	5.345	0.172
	(2.361)	(2.322)	(2.280)	(2.394)	
Female-Headed Household	0.054	0.096	0.053	0.074	0.059
	(0.225)	(0.295)	(0.225)	(0.263)	
Age of Household Head	46.628	47.413	45.735	47.571	0.263
	(14.134)	(14.737)	(14.580)	(15.530)	
Household Head can read a phrase in English	0.347	0.340	0.347	0.325	0.870
	(0.477)	(0.474)	(0.476)	(0.469)	
Household Head can read a phrase in the local language	0.242	0.281	0.256	0.264	0.550
	(0.429)	(0.450)	(0.437)	(0.441)	
Household Head has some education	0.531	0.527	0.577	0.526	0.189
	(0.500)	(0.500)	(0.495)	(0.500)	
Household Head: Not Married, Divorced, Widowed, or Separated	0.059	0.094	0.054	0.068	0.111
	(0.235)	(0.292)	(0.226)	(0.252)	
Household Head: Married, Monogamous	0.806	0.747	0.821	0.783	0.028
	(0.396)	(0.435)	(0.384)	(0.412)	
Household Head: Married, Polygamous	0.135	0.160	0.126	0.149	0.486
	(0.342)	(0.367)	(0.332)	(0.356)	
Household Head's main activity is crop production	0.903	0.858	0.886	0.871	0.238
	(0.296)	(0.349)	(0.318)	(0.335)	
Age of the Primary Female	40.199	40.833	39.345	41.681	0.063
	(12.734)	(13.429)	(13.197)	(14.384)	
Primary Female can read a phrase in English	0.161	0.171	0.176	0.183	0.867
	(0.368)	(0.377)	(0.381)	(0.387)	
Primary Female can read a phrase in the local language	0.090	0.082	0.083	0.111	0.533
	(0.287)	(0.275)	(0.276)	(0.314)	
Primary Female has some education	0.407	0.393	0.406	0.443	0.465
	(0.492)	(0.489)	(0.492)	(0.497)	
Primary Female: Never Married, Divorced, Widowed, or Separated	0.074	0.091	0.054	0.079	0.169
	(0.261)	(0.288)	(0.226)	(0.270)	

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Primary Female: Married, Monogamous	0.853	0.795	0.875	0.824	0.011
	(0.355)	(0.405)	(0.331)	(0.382)	
Primary Female: Married, Polygamous	0.074	0.114	0.071	0.097	0.126
	(0.261)	(0.318)	(0.257)	(0.297)	
Primary Female's main activity is crop production	0.769	0.751	0.752	0.762	0.912
	(0.422)	(0.433)	(0.432)	(0.426)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 9.2a: Asset Ownership and Poverty Index, by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Total PPI score	59.688	60.611	0.066	0.178	60.066	60.150	0.006	0.910
	(13.881)	(13.991)			(14.302)	(14.579)		
Consumer Durable Asset Index	-0.016	0.047	0.042	0.409	0.074	0.125	0.033	0.517
	(1.510)	(1.533)			(1.564)	(1.543)		
Household owns a box/electric iron	0.309	0.372	0.133	0.004	0.345	0.352	0.014	0.770
	(0.462)	(0.484)			(0.476)	(0.478)		
Household owns video players/iPods	0.185	0.191	0.015	0.782	0.194	0.220	0.064	0.186
	(0.388)	(0.393)			(0.396)	(0.415)		
Household owns a television	0.357	0.364	0.014	0.784	0.368	0.388	0.042	0.405
	(0.479)	(0.481)			(0.482)	(0.488)		
Household owns a satellite dish	0.128	0.123	-0.016	0.738	0.135	0.134	-0.004	0.949
	(0.334)	(0.328)			(0.342)	(0.341)		
Household owns a bicycle	0.413	0.434	0.042	0.385	0.467	0.485	0.038	0.364
	(0.493)	(0.496)			(0.499)	(0.500)		
Household owns a motorcycle	0.181	0.198	0.043	0.368	0.225	0.210	-0.035	0.502
	(0.385)	(0.399)			(0.418)	(0.408)		
Household owns a car	0.019	0.025	0.042	0.359	0.031	0.019	-0.072	0.186
	(0.135)	(0.155)			(0.172)	(0.138)		
Household owns a working mobile phone	0.903	0.900	-0.009	0.786	0.905	0.923	0.067	0.192
	(0.296)	(0.300)			(0.294)	(0.266)		
Household Agriculture Asset Index	0.054	0.010	-0.038	0.357	0.055	0.100	0.037	0.418
	(1.163)	(1.120)			(1.204)	(1.227)		
Household owns plough/yokes	0.017	0.017	0.002	0.980	0.020	0.018	-0.016	0.726
	(0.128)	(0.129)			(0.142)	(0.134)		
Household owns a wheelbarrow	0.081	0.067	-0.051	0.229	0.074	0.094	0.072	0.107
	(0.272)	(0.251)			(0.262)	(0.292)		
Household owns other non-mechanized farm equipment	0.986	0.981	-0.034	0.464	0.985	0.993	0.071	0.139
	(0.119)	(0.136)			(0.121)	(0.085)		

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Household owns mechanized farm equipment	0.013	0.010	-0.033	0.431	0.012	0.012	-0.003	0.954
	(0.115)	(0.099)			(0.111)	(0.110)		
Household Livestock Asset Index	0.086	0.068	-0.012	0.730	0.184	0.221	0.023	0.616
	(1.543)	(1.479)			(1.545)	(1.560)		
Household owns cattle/bull/oxen	0.076	0.071	-0.020	0.566	0.093	0.077	-0.059	0.202
	(0.266)	(0.257)			(0.291)	(0.266)		
Household owns goat	0.462	0.484	0.044	0.364	0.491	0.518	0.054	0.252
	(0.499)	(0.500)			(0.500)	(0.500)		
Household owns sheep	0.186	0.167	-0.049	0.278	0.184	0.204	0.052	0.267
	(0.389)	(0.373)			(0.388)	(0.403)		
Household owns pigs	0.181	0.195	0.036	0.408	0.198	0.208	0.026	0.563
	(0.385)	(0.396)			(0.398)	(0.406)		
Household owns chicken	0.647	0.647	0.000	0.967	0.672	0.673	0.002	0.972
	(0.478)	(0.478)			(0.470)	(0.469)		
Household owns other poultry	0.142	0.136	-0.017	0.696	0.153	0.155	0.004	0.943
	(0.349)	(0.342)			(0.360)	(0.362)		
Household owns donkeys	0.076	0.055	-0.085	0.110	0.075	0.077	0.007	0.885
	(0.266)	(0.229)			(0.263)	(0.266)		
Household Total Asset Index	0.096	0.091	-0.003	0.865	0.258	0.297	0.022	0.630
	(1.792)	(1.707)			(1.801)	(1.776)		
Household owns or operates a parcel of agricultural land	0.991	0.992	0.015	0.769	0.993	0.994	0.009	0.814
	(0.096)	(0.089)			(0.082)	(0.078)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.2b: Asset Ownership and Poverty Index, by mNutrition sub-treatment status, Encouraged Group, tests of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Total PPI score	59.903	59.231	60.374	60.892	0.419
	(14.528)	(14.136)	(14.639)	(14.432)	
Consumer Durable Asset Index	0.115	0.031	0.134	0.116	0.727
	(1.529)	(1.559)	(1.557)	(1.569)	
Household owns a box/electric iron	0.321	0.315	0.379	0.375	0.081
	(0.468)	(0.465)	(0.486)	(0.485)	
Household owns video players/iPods	0.235	0.178	0.207	0.210	0.351
	(0.424)	(0.383)	(0.406)	(0.408)	
Household owns a television	0.393	0.356	0.384	0.379	0.703
	(0.489)	(0.479)	(0.487)	(0.486)	
Household owns a satellite dish	0.138	0.137	0.130	0.133	0.989
	(0.345)	(0.344)	(0.337)	(0.340)	
Household owns a bicycle	0.490	0.445	0.481	0.488	0.339
	(0.501)	(0.498)	(0.500)	(0.500)	
Household owns a motorcycle	0.181	0.233	0.237	0.217	0.162
	(0.386)	(0.423)	(0.426)	(0.412)	
Household owns a car	0.013	0.030	0.026	0.032	0.230
	(0.112)	(0.170)	(0.158)	(0.175)	
Household owns a working mobile phone	0.929	0.911	0.919	0.898	0.446
	(0.258)	(0.285)	(0.274)	(0.302)	
Household Agriculture Asset Index	0.120	0.088	0.081	0.022	0.629
	(1.250)	(1.232)	(1.207)	(1.176)	
Household owns plough/yokes	0.018	0.021	0.019	0.020	0.985
	(0.133)	(0.142)	(0.135)	(0.141)	
Household owns a wheelbarrow	0.102	0.082	0.086	0.065	0.249
	(0.303)	(0.275)	(0.281)	(0.248)	
Household owns other non-mechanized farm equipment	0.987	0.993	0.998	0.977	0.103
	(0.112)	(0.083)	(0.048)	(0.149)	
Household owns mechanized farm equipment	0.013	0.016	0.012	0.009	0.772

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
	(0.112)	(0.126)	(0.107)	(0.095)	
Household Livestock Asset Index	0.273	0.157	0.173	0.212	0.811
	(1.637)	(1.547)	(1.488)	(1.544)	
Household owns cattle/bull/oxen	0.087	0.089	0.067	0.097	0.387
	(0.282)	(0.285)	(0.251)	(0.296)	
Household owns goat	0.520	0.470	0.516	0.512	0.380
	(0.500)	(0.500)	(0.500)	(0.500)	
Household owns sheep	0.212	0.194	0.198	0.174	0.638
	(0.409)	(0.396)	(0.399)	(0.379)	
Household owns pigs	0.204	0.189	0.212	0.205	0.750
	(0.404)	(0.392)	(0.409)	(0.404)	
Household owns chicken	0.684	0.660	0.663	0.684	0.842
	(0.466)	(0.474)	(0.473)	(0.465)	
Household owns other poultry	0.168	0.144	0.142	0.163	0.730
	(0.375)	(0.351)	(0.349)	(0.369)	
Household owns donkeys	0.084	0.094	0.070	0.056	0.334
	(0.278)	(0.292)	(0.255)	(0.231)	
Household Total Asset Index	0.323	0.248	0.274	0.268	0.955
	(1.863)	(1.822)	(1.695)	(1.782)	
Household owns or operates a parcel of agricultural land	0.997	0.991	0.991	0.995	0.497
	(0.051)	(0.095)	(0.096)	(0.067)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 9.3a: Mobile phone access and usage (female), by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Owns a mobile phone	0.447	0.446	-0.001	0.954	0.411	0.418	0.015	0.786
	(0.497)	(0.497)			(0.492)	(0.494)		
Has access to a mobile phone	0.823	0.824	0.004	0.931	0.830	0.813	-0.044	0.425
	(0.382)	(0.381)			(0.376)	(0.390)		
Main phone number uses a Vodafone SIM card	0.344	0.344	0.001	0.989	0.377	0.360	-0.036	0.465
	(0.475)	(0.475)			(0.485)	(0.480)		
No mobile phone use in the last 14 days	0.072	0.055	-0.072	0.120	0.066	0.070	0.017	0.751
	(0.259)	(0.228)			(0.248)	(0.255)		
Used mobile phone in the last 14 days to make calls	0.817	0.833	0.040	0.473	0.822	0.811	-0.028	0.596
	(0.387)	(0.373)			(0.383)	(0.392)		
Used mobile phone in the last 14 days to receive calls	0.855	0.884	0.085	0.145	0.869	0.858	-0.031	0.575
	(0.352)	(0.321)			(0.338)	(0.349)		
Used mobile phone in the last 14 days to send text messages	0.036	0.039	0.013	0.791	0.042	0.033	-0.052	0.385
	(0.187)	(0.193)			(0.202)	(0.178)		
Used mobile phone in the last 14 days to receive text messages	0.236	0.211	-0.060	0.285	0.204	0.209	0.011	0.844
	(0.425)	(0.408)			(0.404)	(0.407)		
Used mobile phone in the last 14 days to send mobile money	0.038	0.045	0.038	0.506	0.042	0.024	-0.103	0.070
	(0.190)	(0.208)			(0.202)	(0.153)		
Used mobile phone in the last 14 days to receive mobile money	0.095	0.097	0.007	0.874	0.096	0.062	-0.129	0.027
	(0.293)	(0.296)			(0.295)	(0.241)		
Used mobile phone to receive agriculture advice ever	0.010	0.018	0.066	0.165	0.014	0.020	0.047	0.428
	(0.101)	(0.133)			(0.117)	(0.140)		
Received agriculture and nutrition information via text message, ever	0.009	0.010	0.010	0.841	0.011	0.007	-0.040	0.490
	(0.095)	(0.099)			(0.105)	(0.085)		
Would find it useful to receive agriculture and nutrition information via text message	0.601	0.570	-0.063	0.310	0.561	0.585	0.049	0.427
	(0.490)	(0.495)			(0.497)	(0.493)		
Amount spent on airtime on all phones in an average month (GhC)	8.895	9.134	0.019	0.662	8.300	8.194	-0.009	0.867
	(12.321)	(12.153)			(11.627)	(11.956)		
Charges phone at home	0.722	0.700	-0.050	0.388	0.696	0.710	0.031	0.566
	(0.448)	(0.459)			(0.460)	(0.454)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.3b: Mobile Phone Access and Usage (female), by mNutrition sub-treatment status, Encouraged Group, tests of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Owns a mobile phone	0.415	0.422	0.421	0.400	0.896
	(0.493)	(0.495)	(0.494)	(0.490)	
Has access to a mobile phone	0.820	0.824	0.807	0.835	0.800
	(0.385)	(0.381)	(0.395)	(0.371)	
Main phone number uses a Vodafone SIM card	0.355	0.382	0.364	0.372	0.901
	(0.479)	(0.487)	(0.482)	(0.484)	
No mobile phone use in the last 14 days	0.074	0.075	0.066	0.057	0.700
	(0.262)	(0.263)	(0.249)	(0.231)	
Used mobile phone in the last 14 days to make calls	0.804	0.814	0.817	0.829	0.896
	(0.397)	(0.389)	(0.387)	(0.377)	
Used mobile phone in the last 14 days to receive calls	0.837	0.856	0.877	0.880	0.573
	(0.370)	(0.351)	(0.329)	(0.325)	
Used mobile phone in the last 14 days to send text messages	0.040	0.033	0.026	0.051	0.432
	(0.196)	(0.179)	(0.159)	(0.221)	
Used mobile phone in the last 14 days to receive text messages	0.225	0.219	0.195	0.191	0.671
	(0.418)	(0.414)	(0.397)	(0.394)	
Used mobile phone in the last 14 days to send mobile money	0.029	0.036	0.019	0.048	0.121
	(0.168)	(0.186)	(0.138)	(0.215)	
Used mobile phone in the last 14 days to receive mobile money	0.047	0.096	0.075	0.097	0.038
	(0.212)	(0.295)	(0.263)	(0.296)	
Used mobile phone to receive agriculture advice ever	0.008	0.016	0.031	0.012	0.300
	(0.087)	(0.124)	(0.175)	(0.110)	
Received agriculture and nutrition information via text message, ever	0.004	0.013	0.011	0.009	0.349
	(0.062)	(0.113)	(0.102)	(0.097)	
Would find it useful to receive agriculture and nutrition information via text message	0.597	0.574	0.574	0.548	0.760
	(0.491)	(0.495)	(0.495)	(0.498)	
Amount spent on airtime on all phones in an average month (GhC)	8.252	8.080	8.142	8.515	0.951
	(11.850)	(11.794)	(12.067)	(11.473)	

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Charges phone at home	0.738	0.705	0.684	0.687	0.528
	(0.441)	(0.457)	(0.466)	(0.464)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 9.4a: Mobile phone access and usage (male), by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Owns a mobile phone	0.807	0.800	-0.019	0.618	0.792	0.815	0.057	0.321
	(0.395)	(0.401)			(0.406)	(0.388)		
Has access to a mobile phone	0.912	0.899	-0.045	0.237	0.907	0.906	-0.002	0.967
	(0.283)	(0.301)			(0.291)	(0.292)		
Main phone number uses a Vodafone SIM card	0.391	0.373	-0.037	0.465	0.395	0.370	-0.050	0.373
	(0.488)	(0.484)			(0.489)	(0.483)		
No mobile phone use in the last 14 days	0.035	0.035	0.002	0.984	0.031	0.039	0.043	0.472
	(0.183)	(0.184)			(0.173)	(0.194)		
Used mobile phone in the last 14 days to make calls	0.941	0.951	0.046	0.500	0.946	0.947	0.003	0.957
	(0.236)	(0.216)			(0.225)	(0.224)		
Used mobile phone in the last 14 days to receive calls	0.964	0.971	0.038	0.500	0.964	0.971	0.040	0.466
	(0.187)	(0.169)			(0.187)	(0.169)		
Used mobile phone in the last 14 days to send text messages	0.127	0.138	0.033	0.592	0.135	0.131	-0.012	0.824
	(0.333)	(0.345)			(0.342)	(0.338)		
Used mobile phone in the last 14 days to receive text messages	0.486	0.496	0.019	0.729	0.476	0.506	0.059	0.292
	(0.500)	(0.500)			(0.500)	(0.500)		
Used mobile phone in the last 14 days to send mobile money	0.160	0.154	-0.018	0.733	0.160	0.155	-0.014	0.779
	(0.367)	(0.361)			(0.367)	(0.362)		
Used mobile phone in the last 14 days to receive mobile money	0.221	0.216	-0.010	0.877	0.224	0.213	-0.025	0.639
	(0.415)	(0.412)			(0.417)	(0.410)		
Used mobile phone to receive agriculture advice ever	0.047	0.053	0.029	0.595	0.046	0.054	0.037	0.517
	(0.211)	(0.224)			(0.210)	(0.226)		
Received agriculture and nutrition information via text message, ever	0.037	0.043	0.029	0.617	0.034	0.045	0.056	0.325
	(0.189)	(0.202)			(0.182)	(0.208)		
Would find it useful to receive agriculture and nutrition information via text message	0.627	0.620	-0.014	0.852	0.592	0.654	0.127	0.025
	(0.484)	(0.486)			(0.492)	(0.476)		
Amount spent on airtime on all phones in an average month (GhC)	21.659	23.676	0.085	0.126	22.564	22.830	0.011	0.840
	(21.233)	(25.973)			(24.962)	(22.614)		
Charges phone at home	0.684	0.687	0.007	0.917	0.684	0.687	0.007	0.899
	(0.465)	(0.464)			(0.465)	(0.464)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.4b: Mobile Phone Access and Usage (male), by mNutrition sub-treatment status, Encouraged Group, tests of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Owns a mobile phone	0.827	0.789	0.805	0.796	0.530
	(0.379)	(0.409)	(0.397)	(0.404)	
Has access to a mobile phone	0.918	0.908	0.895	0.906	0.610
	(0.274)	(0.289)	(0.306)	(0.293)	
Main phone number uses a Vodafone SIM card	0.383	0.401	0.358	0.389	0.677
	(0.487)	(0.491)	(0.480)	(0.488)	
No mobile phone use in the last 14 days	0.039	0.031	0.039	0.031	0.911
	(0.194)	(0.173)	(0.194)	(0.174)	
Used mobile phone in the last 14 days to make calls	0.948	0.936	0.946	0.957	0.598
	(0.222)	(0.245)	(0.226)	(0.204)	
Used mobile phone in the last 14 days to receive calls	0.974	0.954	0.968	0.974	0.395
	(0.159)	(0.211)	(0.177)	(0.160)	
Used mobile phone in the last 14 days to send text messages	0.107	0.148	0.153	0.122	0.147
	(0.309)	(0.355)	(0.361)	(0.328)	
Used mobile phone in the last 14 days to receive text messages	0.474	0.499	0.535	0.453	0.177
	(0.500)	(0.501)	(0.499)	(0.499)	
Used mobile phone in the last 14 days to send mobile money	0.150	0.171	0.159	0.148	0.844
	(0.358)	(0.377)	(0.366)	(0.356)	
Used mobile phone in the last 14 days to receive mobile money	0.211	0.229	0.215	0.218	0.949
	(0.409)	(0.421)	(0.411)	(0.414)	
Used mobile phone to receive agriculture advice ever	0.056	0.037	0.052	0.055	0.371
	(0.231)	(0.189)	(0.221)	(0.228)	
Received agriculture and nutrition information via text message, ever	0.045	0.028	0.045	0.040	0.362
	(0.208)	(0.166)	(0.208)	(0.196)	
Would find it useful to receive agriculture and nutrition information via text message	0.664	0.589	0.644	0.595	0.152
	(0.473)	(0.493)	(0.479)	(0.492)	
Amount spent on airtime on all phones in an average month (GhC)	21.747	21.635	23.842	23.496	0.498
	(18.634)	(23.633)	(25.770)	(26.227)	

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Charges phone at home	0.690	0.678	0.684	0.690	0.985
	(0.463)	(0.468)	(0.465)	(0.463)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 9.5a: Primary outcomes, household dietary diversity, by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Household Dietary Diversity Score (1-12)	5.922	5.817	-0.062	0.194	5.897	5.866	-0.018	0.729
	(1.679)	(1.705)			(1.691)	(1.748)		
Household consumed cereals	0.907	0.907	-0.002	0.954	0.901	0.923	0.079	0.093
	(0.290)	(0.291)			(0.299)	(0.266)		
Household consumed roots and tubers	0.480	0.493	0.025	0.578	0.448	0.475	0.054	0.249
	(0.500)	(0.500)			(0.498)	(0.500)		
Household consumed vegetables	0.641	0.631	-0.021	0.638	0.639	0.659	0.043	0.376
	(0.480)	(0.483)			(0.481)	(0.474)		
Household consumed fruit	0.834	0.799	-0.090	0.069	0.819	0.803	-0.041	0.444
	(0.373)	(0.401)			(0.385)	(0.398)		
Household consumed meat and organ meat	0.206	0.187	-0.049	0.346	0.200	0.209	0.021	0.641
	(0.405)	(0.390)			(0.400)	(0.407)		
Household consumed eggs	0.096	0.086	-0.037	0.456	0.092	0.090	-0.007	0.906
	(0.295)	(0.280)			(0.289)	(0.286)		
Household consumed seafood	0.818	0.816	-0.004	0.933	0.827	0.799	-0.073	0.157
	(0.386)	(0.387)			(0.378)	(0.401)		
Household consumed legumes, pulses, nuts, and seeds	0.259	0.262	0.007	0.889	0.285	0.248	-0.084	0.093
	(0.438)	(0.440)			(0.452)	(0.432)		
Household consumed dairy	0.136	0.131	-0.017	0.718	0.125	0.141	0.047	0.351
	(0.343)	(0.337)			(0.331)	(0.348)		
Household consumed oils and fats	0.413	0.395	-0.038	0.395	0.435	0.400	-0.071	0.154
	(0.493)	(0.489)			(0.496)	(0.490)		
Household consumed sweets	0.210	0.202	-0.020	0.658	0.218	0.196	-0.055	0.286
	(0.407)	(0.401)			(0.413)	(0.397)		
Household consumed condiments	0.925	0.905	-0.075	0.168	0.911	0.918	0.025	0.632
	(0.263)	(0.294)			(0.284)	(0.274)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.5b: Primary Outcomes, Household Dietary Diversity, by mNutrition sub-treatment status, Encouraged Group, test of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Household Dietary Diversity Score (1-12)	5.923	5.962	5.815	5.833	0.537
	(1.631)	(1.761)	(1.848)	(1.619)	
Household consumed cereals	0.923	0.902	0.923	0.901	0.347
	(0.266)	(0.298)	(0.266)	(0.299)	
Household consumed roots and tubers	0.486	0.431	0.466	0.465	0.355
	(0.500)	(0.496)	(0.499)	(0.499)	
Household consumed vegetables	0.667	0.654	0.653	0.623	0.559
	(0.472)	(0.476)	(0.477)	(0.485)	
Household consumed fruit	0.820	0.835	0.788	0.803	0.360
	(0.385)	(0.371)	(0.409)	(0.398)	
Household consumed meat and organ meat	0.189	0.236	0.227	0.165	0.012
	(0.392)	(0.425)	(0.419)	(0.371)	
Household consumed eggs	0.101	0.092	0.079	0.091	0.754
	(0.302)	(0.290)	(0.270)	(0.288)	
Household consumed seafood	0.817	0.819	0.783	0.835	0.239
	(0.387)	(0.385)	(0.413)	(0.371)	
Household consumed legumes, pulses, nuts, and seeds	0.238	0.285	0.256	0.285	0.387
	(0.427)	(0.452)	(0.437)	(0.452)	
Household consumed dairy	0.137	0.133	0.145	0.117	0.626
	(0.344)	(0.340)	(0.352)	(0.322)	
Household consumed oils and fats	0.416	0.433	0.385	0.437	0.439
	(0.494)	(0.496)	(0.487)	(0.497)	
Household consumed sweets	0.187	0.236	0.203	0.200	0.409
	(0.390)	(0.425)	(0.403)	(0.400)	
Household consumed condiments	0.934	0.920	0.904	0.903	0.427
	(0.248)	(0.272)	(0.295)	(0.296)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 9.6a: Primary outcomes, women's dietary diversity, by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Women's Dietary Diversity Score (1-10)	4.499	4.480	-0.012	0.797	4.516	4.484	-0.020	0.708
	(1.638)	(1.631)			(1.635)	(1.668)		
Met Minimum Dietary Diversity for Women (MDD-W)	0.524	0.532	0.018	0.719	0.520	0.532	0.025	0.633
	(0.500)	(0.499)			(0.500)	(0.499)		
Primary female consumed tubers and grains	0.959	0.961	0.015	0.714	0.961	0.953	-0.040	0.404
	(0.199)	(0.192)			(0.193)	(0.211)		
Primary female consumed pulses	0.141	0.148	0.020	0.620	0.158	0.140	-0.051	0.254
	(0.348)	(0.355)			(0.365)	(0.347)		
Primary female consumed dairy	0.089	0.095	0.020	0.581	0.089	0.096	0.024	0.595
	(0.285)	(0.293)			(0.284)	(0.294)		
Primary female consumed meat, fish, poultry	0.841	0.845	0.012	0.758	0.851	0.820	-0.085	0.136
	(0.366)	(0.362)			(0.356)	(0.384)		
Primary female consumed eggs	0.070	0.071	0.004	0.936	0.073	0.069	-0.015	0.772
	(0.256)	(0.258)			(0.260)	(0.254)		
Primary female consumed green leafy vegetables	0.605	0.602	-0.005	0.888	0.615	0.622	0.013	0.773
	(0.489)	(0.490)			(0.487)	(0.485)		
Primary female consumed vitamin A rich fruits and vegetables	0.366	0.342	-0.050	0.265	0.386	0.351	-0.072	0.165
	(0.482)	(0.475)			(0.487)	(0.478)		
Primary female consumed other vegetables	0.660	0.651	-0.019	0.724	0.638	0.659	0.044	0.417
	(0.474)	(0.477)			(0.481)	(0.474)		
Primary female consumed other fruits	0.660	0.651	-0.019	0.724	0.638	0.659	0.044	0.417
	(0.474)	(0.477)			(0.481)	(0.474)		
Primary female consumed nuts and seeds	0.087	0.094	0.022	0.660	0.088	0.094	0.021	0.628
	(0.282)	(0.292)			(0.283)	(0.292)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.6b: Primary Outcomes, Women's Dietary Diversity, by mNutrition sub-treatment status, Encouraged Group, test of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Women's Dietary Diversity Score (1-10)	4.575	4.465	4.399	4.566	0.568
	(1.653)	(1.656)	(1.679)	(1.615)	
Met Minimum Dietary Diversity for Women (MDD-W)	0.545	0.505	0.520	0.534	0.767
	(0.499)	(0.501)	(0.500)	(0.499)	
Primary female consumed tubers and grains	0.954	0.954	0.953	0.968	0.487
	(0.211)	(0.209)	(0.211)	(0.175)	
Primary female consumed pulses	0.128	0.158	0.150	0.158	0.480
	(0.335)	(0.365)	(0.358)	(0.366)	
Primary female consumed dairy	0.090	0.087	0.100	0.090	0.902
	(0.287)	(0.282)	(0.301)	(0.287)	
Primary female consumed meat, fish, poultry	0.828	0.847	0.813	0.856	0.450
	(0.378)	(0.360)	(0.391)	(0.352)	
Primary female consumed eggs	0.082	0.065	0.057	0.081	0.504
	(0.275)	(0.246)	(0.233)	(0.274)	
Primary female consumed green leafy vegetables	0.637	0.619	0.608	0.612	0.854
	(0.482)	(0.486)	(0.489)	(0.488)	
Primary female consumed vitamin A rich fruits and vegetables	0.380	0.377	0.325	0.395	0.264
	(0.486)	(0.485)	(0.469)	(0.489)	
Primary female consumed other vegetables	0.689	0.623	0.632	0.652	0.266
	(0.464)	(0.485)	(0.483)	(0.477)	
Primary female consumed other fruits	0.689	0.623	0.632	0.652	0.266
	(0.464)	(0.485)	(0.483)	(0.477)	
Primary female consumed nuts and seeds	0.090	0.080	0.097	0.095	0.828
	(0.287)	(0.272)	(0.296)	(0.294)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 9.7a: Primary outcomes, yields, and profit, by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Number of crops cultivated	3.042	2.991	-0.042	0.352	3.051	3.095	0.036	0.449
	(1.208)	(1.249)			(1.246)	(1.213)		
Farmer grows maize	0.728	0.730	0.004	0.943	0.754	0.737	-0.038	0.466
	(0.445)	(0.444)			(0.431)	(0.440)		
Farmer grows cocoa	0.265	0.256	-0.020	0.632	0.244	0.276	0.074	0.112
	(0.442)	(0.437)			(0.430)	(0.447)		
Farmer grows cassava	0.448	0.419	-0.059	0.220	0.395	0.404	0.019	0.648
	(0.498)	(0.494)			(0.489)	(0.491)		
Farmer grows groundnut	0.381	0.380	-0.000	0.958	0.424	0.388	-0.072	0.137
	(0.486)	(0.486)			(0.494)	(0.488)		
Yield of maize (kg/acre)	348.206	346.188	-0.006	0.956	340.593	373.771	0.095	0.120
	(346.625)	(341.246)			(337.560)	(361.145)		
Yield of cocoa (kg/acre)	57.253	65.896	0.084	0.394	67.548	66.846	-0.007	0.943
	(90.070)	(113.787)			(109.029)	(106.320)		
Yield of cassava (kg/acre)	1,039.803	981.865	-0.033	0.617	1,016.916	1,124.595	0.061	0.384
	(1,754.706)	(1,714.319)			(1,733.487)	(1,791.268)		
Yield of groundnut (kg/acre)	346.652	326.806	-0.082	0.356	328.119	356.028	0.114	0.170
	(249.463)	(237.198)			(241.448)	(249.640)		
Total value of production (GhC)	3,609.398	3,353.509	-0.034	0.454	3,653.933	3,857.686	0.026	0.639
	(7,813.166)	(7,047.515)			(7,551.785)	(7,915.541)		
Total value of maize produced (GhC)	723.647	652.982	-0.060	0.328	659.255	796.675	0.115	0.059
	(1,195.705)	(1,139.721)			(977.246)	(1,382.859)		
Total value of cocoa produced (GhC)	2,756.102	2,832.000	0.020	0.998	2,930.455	3,142.304	0.053	0.671
	(3,803.647)	(3,843.341)			(3,846.774)	(4,083.449)		
Total value of cassava produced (GhC)	771.019	661.132	-0.082	0.159	723.209	895.481	0.120	0.067
	(1,387.396)	(1,298.901)			(1,341.714)	(1,533.534)		
Total value of groundnut produced (GhC)	850.618	861.640	0.011	0.937	853.746	932.208	0.078	0.273
	(998.891)	(938.116)			(883.282)	(1,109.944)		

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Total input costs (GhC)	1,171.837	1,264.893	0.041	0.396	1,259.910	1,343.538	0.035	0.493
	(2,021.753)	(2,456.693)			(2,266.260)	(2,454.396)		
Input cost of maize (GhC)	527.102	510.145	-0.019	0.813	538.431	567.475	0.031	0.626
	(886.257)	(924.178)			(912.345)	(987.167)		
Input cost of cocoa (GhC)	909.531	1,058.552	0.071	0.410	1,066.358	964.119	-0.047	0.678
	(1,792.262)	(2,340.095)			(2,253.183)	(2,061.226)		
Input cost of cassava (GhC)	209.414	173.908	-0.101	0.191	186.279	200.347	0.038	0.558
	(376.536)	(321.380)			(346.946)	(383.766)		
Input cost of groundnut (GhC)	350.482	363.707	0.018	0.816	366.950	369.674	0.004	0.958
	(756.700)	(714.454)			(708.477)	(800.559)		
Total profit (GhC)	2,413.816	2,095.661	-0.044	0.357	2,349.017	2,544.181	0.026	0.638
	(7,814.909)	(6,750.854)			(7,423.189)	(7,759.613)		
Profit from maize (GhC)	171.702	146.442	-0.025	0.619	118.797	209.656	0.088	0.139
	(914.053)	(1,117.019)			(932.004)	(1,122.380)		
Profit from cocoa (GhC)	1,802.919	1,796.133	-0.002	0.824	1,858.347	2,165.009	0.083	0.449
	(3,814.092)	(3,398.928)			(3,639.871)	(3,790.298)		
Profit from cassava (GhC)	573.091	498.529	-0.056	0.318	550.482	709.283	0.112	0.112
	(1,365.699)	(1,296.962)			(1,341.554)	(1,495.626)		
Profit from groundnut (GhC)	480.427	501.535	0.019	0.822	470.662	563.642	0.083	0.255
	(1,068.001)	(1,107.018)			(977.431)	(1,255.789)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.7b: Primary Outcomes, Agriculture yields and profits, by mNutrition sub-treatment status, Encouraged Group, tests of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Number of crops cultivated	3.130	3.070	3.061	3.032	0.748
	(1.207)	(1.212)	(1.218)	(1.279)	
Farmer grows maize	0.730	0.777	0.744	0.732	0.319
	(0.444)	(0.417)	(0.437)	(0.444)	
Farmer grows cocoa	0.278	0.240	0.275	0.248	0.451
	(0.448)	(0.427)	(0.447)	(0.432)	
Farmer grows cassava	0.411	0.405	0.398	0.385	0.870
	(0.493)	(0.491)	(0.490)	(0.487)	
Farmer grows groundnut	0.391	0.419	0.386	0.429	0.496
	(0.489)	(0.494)	(0.487)	(0.495)	
Yield of maize (kg/acre)	399.101	324.766	350.893	357.186	0.122
	(394.430)	(318.480)	(327.160)	(356.232)	
Yield of cocoa (kg/acre)	55.803	72.729	77.121	62.563	0.371
	(78.343)	(111.822)	(126.436)	(106.564)	
Yield of cassava (kg/acre)	1,170.285	935.071	1,080.867	1,100.223	0.602
	(1,796.359)	(1,592.279)	(1,790.821)	(1,867.402)	
Yield of groundnut (kg/acre)	387.384	321.212	326.435	334.911	0.044
	(276.837)	(224.961)	(217.690)	(257.079)	
Total value of production (GhC)	3,904.659	3,747.422	3,814.221	3,562.166	0.874
	(7,129.993)	(8,791.091)	(8,587.035)	(6,104.467)	
Total value of maize produced (GhC)	872.569	664.365	727.859	653.967	0.225
	(1,502.175)	(913.856)	(1,263.507)	(1,040.204)	
Total value of cocoa produced (GhC)	3,194.134	2,825.620	3,093.203	3,031.334	0.942
	(3,994.624)	(3,908.780)	(4,182.888)	(3,801.983)	
Total value of cassava produced (GhC)	1,001.058	715.913	794.439	730.812	0.166
	(1,711.179)	(1,203.820)	(1,339.305)	(1,475.431)	
Total value of groundnut produced (GhC)	977.409	797.453	889.550	908.807	0.527
	(1,193.336)	(866.096)	(1,027.010)	(898.728)	
Total input costs (GhC)	1,406.230	1,107.104	1,285.473	1,408.501	0.074
	(2,321.391)	(1,841.587)	(2,572.861)	(2,607.516)	

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Input cost of maize (GhC)	607.757	521.294	531.079	556.107	0.645
	(1,062.714)	(790.182)	(913.766)	(1,024.173)	
Input cost of cocoa (GhC)	1,099.118	751.222	838.430	1,358.365	0.188
	(2,093.608)	(1,318.561)	(2,031.591)	(2,834.760)	
Input cost of cassava (GhC)	228.902	199.415	172.659	172.746	0.501
	(426.528)	(357.101)	(336.176)	(336.711)	
Input cost of groundnut (GhC)	406.494	336.957	334.912	396.440	0.724
	(890.697)	(685.660)	(706.062)	(730.936)	
Total profit (GhC)	2,547.060	2,543.216	2,541.511	2,160.212	0.702
	(7,178.094)	(8,764.174)	(8,271.068)	(5,835.792)	
Profit from maize (GhC)	212.028	141.377	207.514	95.574	0.484
	(966.032)	(875.851)	(1,248.413)	(987.289)	
Profit from cocoa (GhC)	2,086.325	1,980.898	2,239.515	1,742.732	0.809
	(4,157.083)	(3,640.797)	(3,424.075)	(3,652.490)	
Profit from cassava (GhC)	793.010	523.015	628.656	578.955	0.254
	(1,608.449)	(1,256.830)	(1,378.514)	(1,427.395)	
Profit from groundnut (GhC)	568.899	420.684	558.649	519.798	0.380
	(1,368.825)	(822.492)	(1,142.489)	(1,109.065)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 7.8a: Secondary outcomes, nutrition knowledge and behaviour (female), by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Washed hands on the day of the interview	0.978	0.973	-0.032	0.482	0.977	0.975	-0.012	0.796
	(0.148)	(0.163)			(0.149)	(0.155)		
Perishable foods should be kept in the refrigerator/cold place	0.821	0.807	-0.037	0.383	0.823	0.822	-0.002	0.968
	(0.383)	(0.395)			(0.382)	(0.383)		
Washes crops under water to remove pesticide and debris	0.701	0.719	0.039	0.469	0.733	0.693	-0.089	0.075
	(0.458)	(0.450)			(0.443)	(0.462)		
Knows when one should wash hands	0.579	0.574	-0.011	0.830	0.586	0.575	-0.022	0.677
	(0.494)	(0.495)			(0.493)	(0.495)		
Water must not be used to clean tubers because of increased susceptibility of infection	0.446	0.423	-0.048	0.430	0.414	0.451	0.075	0.137
	(0.497)	(0.494)			(0.493)	(0.498)		
Cassava leaves are more nutritious than the roots	0.535	0.532	-0.005	0.867	0.547	0.556	0.018	0.710
	(0.499)	(0.499)			(0.498)	(0.497)		
Cook potatoes immediately after peeling or keep them covered in a bowl of water	0.745	0.710	-0.079	0.098	0.716	0.739	0.052	0.319
	(0.436)	(0.454)			(0.451)	(0.439)		
Knows the health properties of ripe tomatoes	0.543	0.541	-0.004	0.904	0.572	0.526	-0.092	0.041
	(0.498)	(0.499)			(0.495)	(0.500)		
Knows food rich in vitamin A	0.595	0.625	0.061	0.209	0.617	0.624	0.014	0.778
	(0.491)	(0.484)			(0.486)	(0.485)		
Knows the health benefits of papaya	0.378	0.364	-0.030	0.487	0.403	0.371	-0.067	0.156
	(0.485)	(0.481)			(0.491)	(0.483)		
Cutting and drying mangoes can preserve and store them for later use	0.020	0.010	-0.083	0.056	0.017	0.009	-0.071	0.214
	(0.141)	(0.100)			(0.130)	(0.095)		
Avocados are an appropriate food to feed babies when first introducing solid food	0.506	0.480	-0.051	0.370	0.492	0.487	-0.010	0.841
	(0.500)	(0.500)			(0.500)	(0.500)		
Knows the benefits of consuming beans	0.563	0.562	-0.002	0.954	0.589	0.549	-0.080	0.108
	(0.496)	(0.496)			(0.492)	(0.498)		
	0.621	0.620	-0.002	0.960	0.640	0.615	-0.051	0.305

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Removed stones, damaged beans, and dry soybean to avoid the bean from getting moldy	(0.485)	(0.486)			(0.480)	(0.487)		
Adding pulse flour to porridge increases the protein content	0.744	0.706	-0.085	0.112	0.724	0.713	-0.024	0.659
	(0.437)	(0.456)			(0.447)	(0.453)		
Not safe to consume cereals that have been affected by aflatoxin	0.821	0.817	-0.012	0.812	0.818	0.833	0.040	0.436
	(0.383)	(0.387)			(0.386)	(0.373)		
Percentage of correct answers (female)	59.983	59.154	-0.054	0.276	60.419	59.637	-0.052	0.292
	(15.520)	(15.389)			(15.647)	(14.643)		
Number of correct answers (female)	9.597	9.456	-0.057	0.245	9.667	9.530	-0.056	0.244
	(2.483)	(2.470)			(2.504)	(2.353)		
Number of correct answers, standardized (female)	0.048	-0.009	-0.057	0.245	0.076	0.021	-0.056	0.244
	(0.996)	(0.991)			(1.004)	(0.944)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.8b: Secondary Outcomes, Nutrition Knowledge and Behaviour (female), by mNutrition sub-treatment status, Encouraged Group, test of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Washed hands on the day of the interview	0.973	0.984	0.978	0.971	0.625
	(0.163)	(0.126)	(0.147)	(0.169)	
Perishable foods should be kept in the refrigerator/cold place	0.831	0.824	0.814	0.822	0.950
	(0.376)	(0.381)	(0.389)	(0.383)	
Washes crops under water to remove pesticide and debris	0.710	0.707	0.677	0.758	0.137
	(0.454)	(0.456)	(0.468)	(0.428)	
Knows when one should wash hands	0.593	0.574	0.560	0.598	0.713
	(0.492)	(0.495)	(0.497)	(0.491)	
Water must not be used to clean tubers because of increased susceptibility of infection	0.464	0.419	0.439	0.409	0.443
	(0.499)	(0.494)	(0.497)	(0.492)	
Cassava leaves are more nutritious than the roots	0.557	0.551	0.554	0.542	0.973
	(0.497)	(0.498)	(0.498)	(0.499)	
Cook potatoes immediately after peeling or keep them covered in a bowl of water	0.754	0.737	0.725	0.695	0.355
	(0.431)	(0.441)	(0.447)	(0.461)	
Knows the health properties of ripe tomatoes	0.516	0.574	0.534	0.569	0.193
	(0.500)	(0.495)	(0.499)	(0.496)	
Knows food rich in vitamin A	0.628	0.595	0.620	0.639	0.670
	(0.484)	(0.491)	(0.486)	(0.481)	
Knows the health benefits of papaya	0.380	0.398	0.363	0.409	0.454
	(0.486)	(0.490)	(0.481)	(0.492)	
Cutting and drying mangoes can preserve and store them for later use	0.008	0.025	0.010	0.009	0.318
	(0.090)	(0.157)	(0.099)	(0.095)	
Avocados are an appropriate food to feed babies when first introducing solid food	0.511	0.494	0.466	0.490	0.794
	(0.501)	(0.501)	(0.499)	(0.500)	
Knows the benefits of consuming beans	0.563	0.579	0.537	0.598	0.253
	(0.497)	(0.494)	(0.499)	(0.491)	
Removed stones, damaged beans, and dry soybean to avoid the bean from getting mold	0.648	0.616	0.586	0.664	0.208
	(0.478)	(0.487)	(0.493)	(0.473)	
Adding pulse flour to porridge increases the protein content	0.743	0.721	0.686	0.727	0.445
	(0.437)	(0.449)	(0.465)	(0.446)	

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Not safe to consume cereals that have been affected by aflatoxin	0.863	0.803	0.806	0.833	0.137
	(0.344)	(0.398)	(0.396)	(0.373)	
Percentage of correct answers (female)	60.895	60.011	58.512	60.821	0.151
	(14.746)	(15.607)	(14.475)	(15.694)	
Number of correct answers (female)	9.743	9.602	9.340	9.731	0.111
	(2.359)	(2.497)	(2.334)	(2.511)	
Number of correct answers, standardized (female)	0.106	0.050	-0.055	0.102	0.111
	(0.947)	(1.002)	(0.936)	(1.007)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 7.9a: Secondary outcomes, nutrition knowledge and behaviour (male), by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Washed hands on the day of the interview	0.942	0.943	0.006	0.893	0.941	0.943	0.006	0.896
	(0.235)	(0.232)			(0.235)	(0.232)		
Perishable foods should be kept in the refrigerator/cold place	0.802	0.778	-0.059	0.219	0.787	0.792	0.012	0.796
	(0.399)	(0.416)			(0.410)	(0.406)		
Washes crops under water to remove pesticide and debris	0.579	0.597	0.035	0.547	0.599	0.579	-0.041	0.437
	(0.494)	(0.491)			(0.490)	(0.494)		
Knows when one should wash hands	0.568	0.560	-0.016	0.748	0.579	0.550	-0.059	0.250
	(0.496)	(0.497)			(0.494)	(0.498)		
Water must not be used to clean tubers because of increased susceptibility of infection	0.189	0.208	0.046	0.281	0.188	0.209	0.055	0.349
	(0.392)	(0.406)			(0.391)	(0.407)		
Cassava leaves are more nutritious than the roots	0.560	0.541	-0.039	0.460	0.537	0.561	0.048	0.338
	(0.497)	(0.499)			(0.499)	(0.497)		
Cook potatoes immediately after peeling or keep them covered in a bowl of water	0.696	0.695	-0.003	0.939	0.694	0.698	0.010	0.837
	(0.460)	(0.461)			(0.461)	(0.459)		
Knows the health properties of ripe tomatoes	0.534	0.514	-0.039	0.405	0.566	0.482	-0.170	0.000
	(0.499)	(0.500)			(0.496)	(0.500)		
Knows food rich in vitamin A	0.601	0.618	0.036	0.478	0.633	0.589	-0.090	0.088
	(0.490)	(0.486)			(0.482)	(0.492)		
Knows the health benefits of papaya	0.377	0.382	0.010	0.815	0.405	0.355	-0.103	0.035
	(0.485)	(0.486)			(0.491)	(0.479)		
Cutting and drying mangoes can preserve and store them for later use	0.014	0.006	-0.079	0.068	0.011	0.009	-0.030	0.552
	(0.117)	(0.078)			(0.107)	(0.092)		
Avocados are an appropriate food to feed babies when first introducing solid food	0.436	0.409	-0.053	0.274	0.417	0.427	0.020	0.707
	(0.496)	(0.492)			(0.493)	(0.495)		
Knows the benefits of consuming beans	0.563	0.575	0.024	0.632	0.611	0.528	-0.168	0.000
	(0.496)	(0.495)			(0.488)	(0.500)		
	0.544	0.532	-0.023	0.657	0.557	0.521	-0.074	0.152

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Removed stones, damaged beans, and dry soybean to avoid the bean from getting mold	(0.498)	(0.499)			(0.497)	(0.500)		
Adding pulse flour to porridge increases the protein content	0.645	0.651	0.012	0.843	0.666	0.633	-0.070	0.133
	(0.479)	(0.477)			(0.472)	(0.482)		
Not safe to consume cereals that have been affected by aflatoxin	0.817	0.826	0.024	0.648	0.821	0.821	-0.001	0.991
	(0.387)	(0.379)			(0.383)	(0.383)		
Percentage of correct answers (male)	55.424	55.158	-0.017	0.698	56.266	54.349	-0.119	0.013
	(16.221)	(16.005)			(16.466)	(15.708)		
Number of correct answers (male)	8.868	8.825	-0.017	0.698	9.003	8.696	-0.119	0.013
	(2.595)	(2.561)			(2.635)	(2.513)		
Number of correct answers, standardized (male)	0.021	0.006	-0.017	0.698	0.070	-0.040	-0.119	0.013
	(0.932)	(0.919)			(0.946)	(0.902)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.9b: Secondary Outcomes, Nutrition Knowledge and Behaviour (male), by mNutrition sub-treatment status, Encouraged Group, tests of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Washed hands on the day of the interview	0.939	0.944	0.947	0.939	0.943
	(0.240)	(0.230)	(0.225)	(0.240)	
Perishable foods should be kept in the refrigerator/cold place	0.814	0.788	0.772	0.786	0.496
	(0.390)	(0.409)	(0.420)	(0.411)	
Washes crops under water to remove pesticide and debris	0.615	0.546	0.547	0.653	0.044
	(0.487)	(0.499)	(0.498)	(0.477)	
Knows when one should wash hands	0.551	0.584	0.549	0.574	0.702
	(0.498)	(0.493)	(0.498)	(0.495)	
Water must not be used to clean tubers because of increased susceptibility of infection	0.199	0.179	0.219	0.196	0.506
	(0.400)	(0.383)	(0.414)	(0.398)	
Cassava leaves are more nutritious than the roots	0.579	0.538	0.544	0.536	0.595
	(0.494)	(0.499)	(0.499)	(0.499)	
Cook potatoes immediately after peeling or keep them covered in a bowl of water	0.702	0.691	0.695	0.696	0.991
	(0.458)	(0.463)	(0.461)	(0.460)	
Knows the health properties of ripe tomatoes	0.480	0.584	0.484	0.548	0.004
	(0.500)	(0.493)	(0.500)	(0.498)	
Knows food rich in vitamin A	0.592	0.610	0.586	0.656	0.156
	(0.492)	(0.488)	(0.493)	(0.476)	
Knows the health benefits of papaya	0.355	0.401	0.356	0.410	0.203
	(0.479)	(0.491)	(0.479)	(0.492)	
Cutting and drying mangoes can preserve and store them for later use	0.013	0.015	0.005	0.008	0.297
	(0.112)	(0.123)	(0.068)	(0.087)	
Avocados are an appropriate food to feed babies when first introducing solid food	0.454	0.418	0.402	0.416	0.479
	(0.499)	(0.494)	(0.491)	(0.493)	
Knows the benefits of consuming beans	0.538	0.587	0.519	0.635	0.003
	(0.499)	(0.493)	(0.500)	(0.482)	
Removed stones, damaged beans, and dry soybean to avoid the bean from getting mold	0.556	0.533	0.488	0.582	0.058
	(0.497)	(0.500)	(0.500)	(0.494)	
Adding pulse flour to porridge increases the protein content	0.673	0.617	0.595	0.714	0.001
	(0.470)	(0.487)	(0.491)	(0.452)	

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Not safe to consume cereals that have been affected by aflatoxin	0.842	0.791	0.802	0.852	0.192
	(0.365)	(0.407)	(0.399)	(0.356)	
Percentage of correct answers (male)	55.628	55.166	53.183	57.363	0.000
	(16.151)	(16.315)	(15.218)	(16.565)	
Number of correct answers (male)	8.901	8.827	8.509	9.178	0.000
	(2.584)	(2.610)	(2.435)	(2.650)	
Number of correct answers, standardized (male)	0.033	0.007	-0.107	0.133	0.000
	(0.928)	(0.937)	(0.874)	(0.951)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 7.80a: Secondary outcomes, farming knowledge (female), by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Knows what to top-dress maize with one month after planting	0.427	0.449	0.045	0.393	0.472	0.430	-0.084	0.069
	(0.495)	(0.498)			(0.500)	(0.495)		
Knows what is used to weed onion fields at regular intervals	0.497	0.496	-0.001	0.988	0.495	0.501	0.013	0.812
	(0.500)	(0.500)			(0.500)	(0.500)		
Knows maize can be stored longer when the chaff is removed	0.635	0.605	-0.062	0.252	0.605	0.660	0.115	0.019
	(0.482)	(0.489)			(0.489)	(0.474)		
Burning groundnut fields after harvest decreases crop yield	0.485	0.496	0.023	0.674	0.526	0.499	-0.054	0.279
	(0.500)	(0.500)			(0.500)	(0.500)		
Knows how plants should be spaced in order to make full use of all available sun	0.430	0.430	-0.000	0.988	0.443	0.390	-0.107	0.024
	(0.495)	(0.495)			(0.497)	(0.488)		
Oil palm fruits are red when ripe	0.930	0.923	-0.026	0.594	0.923	0.924	0.004	0.942
	(0.255)	(0.266)			(0.267)	(0.266)		
Peppers should be harvested again after a 2 week interval for maximum yield	0.327	0.338	0.023	0.637	0.339	0.323	-0.035	0.446
	(0.469)	(0.473)			(0.474)	(0.468)		
Cassava is ready for harvesting 9-18 months after planting	0.634	0.646	0.026	0.616	0.633	0.605	-0.059	0.229
	(0.482)	(0.478)			(0.482)	(0.489)		
Knows when the plantain fruit is considered mature	0.529	0.541	0.025	0.617	0.564	0.495	-0.139	0.005
	(0.499)	(0.499)			(0.496)	(0.500)		
Knows the signs of a matured soybean	0.590	0.606	0.032	0.531	0.615	0.613	-0.004	0.929
	(0.492)	(0.489)			(0.487)	(0.487)		
Pepper fields should be located far away from tobacco plantations to avoid spread of viruses	0.114	0.094	-0.064	0.162	0.112	0.107	-0.016	0.681
	(0.317)	(0.292)			(0.316)	(0.310)		
Knows what can cause post-harvest loss when storing grain crops	0.879	0.905	0.084	0.091	0.899	0.881	-0.057	0.320
	(0.326)	(0.293)			(0.302)	(0.324)		
Percentage of correct answers (female)	53.944	54.372	0.025	0.663	55.186	53.525	-0.096	0.041
	(17.829)	(17.019)			(17.432)	(17.070)		
Number of correct answers (female)	6.452	6.499	0.023	0.688	6.602	6.406	-0.095	0.045
	(2.138)	(2.043)			(2.094)	(2.052)		
Number of correct answers, standardized (female)	0.009	0.031	0.023	0.688	0.080	-0.014	-0.095	0.045
	(1.021)	(0.976)			(1.000)	(0.980)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.10b: Secondary Outcomes, Farming Knowledge (female), by mNutrition sub-treatment status, Encouraged Group, tests of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Knows what to top-dress maize with one month after planting	0.437	0.436	0.424	0.508	0.048
	(0.497)	(0.496)	(0.495)	(0.501)	
Knows what is used to weed onion fields at regular intervals	0.503	0.495	0.500	0.494	0.996
	(0.501)	(0.501)	(0.501)	(0.501)	
Knows maize can be stored longer when the chaff is removed	0.669	0.621	0.652	0.589	0.106
	(0.471)	(0.486)	(0.477)	(0.493)	
Burning groundnut fields after harvest decreases crop yield	0.492	0.532	0.505	0.519	0.650
	(0.501)	(0.500)	(0.501)	(0.500)	
Knows how plants should be spaced in order to make full use of all available sun	0.396	0.416	0.385	0.470	0.101
	(0.490)	(0.493)	(0.487)	(0.500)	
Oil palm fruits are red when ripe	0.943	0.920	0.907	0.926	0.379
	(0.233)	(0.271)	(0.291)	(0.263)	
Peppers should be harvested again after a 2 week interval for maximum yield	0.355	0.304	0.294	0.375	0.077
	(0.479)	(0.460)	(0.456)	(0.485)	
Cassava is ready for harvesting 9-18 months after planting	0.615	0.605	0.596	0.661	0.245
	(0.487)	(0.489)	(0.491)	(0.474)	
Knows when the plantain fruit is considered mature	0.473	0.566	0.515	0.562	0.034
	(0.500)	(0.496)	(0.500)	(0.497)	
Knows the signs of a matured soybean	0.594	0.612	0.629	0.618	0.841
	(0.492)	(0.488)	(0.484)	(0.487)	
Pepper fields should be located far away from tobacco plantations to avoid spread of viruses	0.115	0.126	0.100	0.099	0.595
	(0.319)	(0.332)	(0.301)	(0.299)	
Knows what can cause post-harvest loss when storing grain crops	0.877	0.870	0.885	0.928	0.032
	(0.329)	(0.337)	(0.320)	(0.259)	
Percentage of correct answers (female)	53.867	54.165	53.218	56.196	0.039
	(17.950)	(17.517)	(16.256)	(17.307)	
Number of correct answers (female)	6.451	6.484	6.365	6.718	0.046
	(2.161)	(2.102)	(1.951)	(2.081)	
Number of correct answers, standardized (female)	0.008	0.024	-0.033	0.136	0.046
	(1.032)	(1.004)	(0.932)	(0.994)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 7.11a: Secondary outcomes, farming knowledge (male), by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Knows what to top-dress maize with one month after planting	0.592	0.606	0.029	0.632	0.622	0.578	-0.091	0.068
	(0.492)	(0.489)			(0.485)	(0.494)		
Knows what is used to weed onion fields at regular intervals	0.560	0.538	-0.044	0.426	0.543	0.555	0.023	0.700
	(0.497)	(0.499)			(0.498)	(0.497)		
Knows maize can be stored longer when the chaff is removed	0.666	0.650	-0.033	0.549	0.628	0.689	0.129	0.015
	(0.472)	(0.477)			(0.484)	(0.463)		
Burning groundnut fields after harvest decreases crop yield	0.557	0.570	0.027	0.596	0.568	0.558	-0.019	0.714
	(0.497)	(0.495)			(0.496)	(0.497)		
Knows how plants should be spaced in order to make full use of all available sun	0.488	0.513	0.050	0.397	0.500	0.502	0.005	0.927
	(0.500)	(0.500)			(0.500)	(0.500)		
Oil palm fruits are red when ripe	0.914	0.921	0.027	0.615	0.908	0.927	0.069	0.181
	(0.281)	(0.270)			(0.289)	(0.260)		
Peppers should be harvested again after a 2 week interval for maximum yield	0.352	0.365	0.026	0.623	0.351	0.366	0.032	0.522
	(0.478)	(0.482)			(0.478)	(0.482)		
Cassava is ready for harvesting 9-18 months after planting	0.644	0.646	0.005	0.945	0.657	0.635	-0.046	0.295
	(0.479)	(0.478)			(0.475)	(0.482)		
Knows when the plantain fruit is considered mature	0.541	0.575	0.067	0.188	0.577	0.543	-0.068	0.146
	(0.499)	(0.495)			(0.494)	(0.498)		
Knows the signs of a matured soybean	0.603	0.662	0.123	0.021	0.639	0.628	-0.024	0.646
	(0.490)	(0.473)			(0.481)	(0.484)		
Pepper fields should be located far away from tobacco plantations to avoid spread of viruses	0.123	0.112	-0.036	0.523	0.126	0.109	-0.052	0.294
	(0.329)	(0.315)			(0.332)	(0.312)		
Knows what can cause post-harvest loss when storing grain crops	0.884	0.889	0.016	0.744	0.893	0.881	-0.038	0.488
	(0.320)	(0.314)			(0.309)	(0.324)		
Percentage of correct answers (male)	57.687	58.711	0.059	0.273	58.404	58.076	-0.019	0.686
	(17.720)	(16.895)			(17.307)	(17.275)		
Number of correct answers (male)	6.903	7.027	0.059	0.266	6.990	6.950	-0.019	0.685
	(2.130)	(2.025)			(2.079)	(2.071)		
Number of correct answers, standardized (male)	-0.013	0.046	0.059	0.266	0.029	0.010	-0.019	0.685
	(1.023)	(0.972)			(0.999)	(0.995)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.

Table 7.11b: Farming, Farming Knowledge (male), by mNutrition sub-treatment status, Encouraged Group, test of joint significance

	Agriculture script - Male targeted	Agriculture script - Female targeted	Ag+Nutrition script - Male targeted	Ag+Nutrition script - Female targeted	P-value of Test of Joint Significance
Knows what to top-dress maize with one month after planting	0.577	0.610	0.579	0.635	0.254
	(0.495)	(0.488)	(0.494)	(0.482)	
Knows what is used to weed onion fields at regular intervals	0.546	0.574	0.563	0.513	0.287
	(0.499)	(0.495)	(0.497)	(0.500)	
Knows maize can be stored longer when the chaff is removed	0.699	0.635	0.679	0.620	0.085
	(0.459)	(0.482)	(0.467)	(0.486)	
Burning groundnut fields after harvest decreases crop yield	0.543	0.569	0.572	0.566	0.878
	(0.499)	(0.496)	(0.495)	(0.496)	
Knows how plants should be spaced in order to make full use of all available sun	0.508	0.469	0.498	0.531	0.522
	(0.501)	(0.500)	(0.501)	(0.500)	
Oil palm fruits are red when ripe	0.939	0.890	0.916	0.926	0.140
	(0.240)	(0.313)	(0.277)	(0.262)	
Peppers should be harvested again after a 2-week interval for maximum yield	0.388	0.316	0.347	0.385	0.247
	(0.488)	(0.466)	(0.476)	(0.487)	
Cassava is ready for harvesting 9-18 months after planting	0.640	0.648	0.630	0.666	0.671
	(0.481)	(0.478)	(0.483)	(0.472)	
Knows when the plantain fruit is considered mature	0.523	0.561	0.560	0.592	0.253
	(0.500)	(0.497)	(0.497)	(0.492)	
Knows the signs of a matured soybean	0.577	0.630	0.674	0.649	0.047
	(0.495)	(0.484)	(0.469)	(0.478)	
Pepper fields should be located far away from tobacco plantations to avoid spread of viruses	0.102	0.145	0.116	0.107	0.371
	(0.303)	(0.353)	(0.321)	(0.310)	
Knows what can cause post-harvest loss when storing grain crops	0.880	0.888	0.881	0.898	0.869
	(0.325)	(0.316)	(0.324)	(0.303)	
Percentage of correct answers (male)	57.661	57.773	58.455	59.035	0.595
	(17.883)	(17.503)	(16.713)	(17.108)	
Number of correct answers (male)	6.901	6.913	6.995	7.066	0.585
	(2.150)	(2.103)	(1.999)	(2.054)	
Number of correct answers, standardized (male)	-0.014	-0.008	0.031	0.065	0.585
	(1.033)	(1.010)	(0.960)	(0.987)	

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample that have a primary male and female respondent. Standard deviations are in parentheses. The sample consists of 1703 households with a primary male and female.

Table 7.12a: Trust and Sources of Agriculture and Nutrition Information, by mNutrition sub-treatment status, Encouraged Group

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Government extension workers are the most important source of information about crop production	0.228	0.249	0.051	0.577	0.209	0.292	0.192	0.000
	(0.419)	(0.433)			(0.407)	(0.455)		
Community health workers are the most important source of information on nutrition	0.441	0.439	-0.004	0.889	0.486	0.370	-0.236	0.000
	(0.497)	(0.497)			(0.500)	(0.483)		
Agree they would trust agricultural information from their spouse	0.864	0.874	0.030	0.500	0.901	0.831	-0.204	0.000
	(0.343)	(0.332)			(0.299)	(0.375)		
Agree they would trust agricultural information from their other family	0.878	0.869	-0.027	0.516	0.883	0.860	-0.070	0.090
	(0.327)	(0.337)			(0.321)	(0.347)		
Agree they would trust agricultural information from their friends/neighbors	0.857	0.847	-0.028	0.771	0.848	0.851	0.010	0.824
	(0.350)	(0.360)			(0.360)	(0.356)		
Agree they would trust agricultural information from newspaper/TV/radio/posters	0.936	0.915	-0.079	0.582	0.917	0.921	0.014	0.736
	(0.245)	(0.279)			(0.275)	(0.269)		
Agree they would trust agricultural information from automated text messages	0.788	0.759	-0.070	0.538	0.754	0.781	0.063	0.231
	(0.409)	(0.428)			(0.431)	(0.414)		
Agree they would trust agricultural information from cooperative staff	0.720	0.728	0.019	0.247	0.721	0.710	-0.024	0.596
	(0.449)	(0.445)			(0.449)	(0.454)		
Agree they would trust agricultural information from government extension worker	0.919	0.909	-0.039	0.481	0.919	0.905	-0.047	0.322
	(0.272)	(0.288)			(0.274)	(0.293)		
Agree they would trust agricultural information from the community health worker	0.506	0.490	-0.033	0.483	0.525	0.462	-0.125	0.008
	(0.500)	(0.500)			(0.500)	(0.499)		
Agree they would trust nutrition information from their spouse	0.882	0.888	0.016	0.869	0.882	0.898	0.052	0.301
	(0.322)	(0.316)			(0.323)	(0.303)		
Agree they would trust nutrition information from their other family	0.826	0.827	0.004	0.789	0.850	0.800	-0.134	0.001
	(0.380)	(0.378)			(0.357)	(0.400)		
Agree they would trust nutrition information from their friends/neighbors	0.818	0.808	-0.027	0.690	0.828	0.787	-0.104	0.015
	(0.386)	(0.394)			(0.377)	(0.409)		
	0.948	0.926	-0.091	0.351	0.935	0.929	-0.022	0.583

	Full encouraged sample				Subsample of encouraged households with a primary male and female			
	Agriculture script (A)	Ag+Nutrition script (A+N)	Normalized difference between (A+N) and (A)	P-Value	Female targeted (F)	Male targeted (M)	Normalized difference between (M) and (F)	P-Value
Agree they would trust nutrition information from newspaper/TV/radio/posters	(0.222)	(0.262)			(0.247)	(0.257)		
Agree they would trust nutrition information from automated text messages	0.786	0.767	-0.045	0.924	0.752	0.787	0.084	0.101
	(0.410)	(0.423)			(0.432)	(0.410)		
Agree they would trust nutrition information from cooperative staff	0.694	0.692	-0.004	0.311	0.688	0.673	-0.032	0.483
	(0.461)	(0.462)			(0.464)	(0.469)		
Agree they would trust nutrition information from government extension worker	0.817	0.783	-0.085	0.030	0.813	0.789	-0.059	0.167
	(0.386)	(0.412)			(0.390)	(0.408)		
Agree they would trust nutrition information from the community health worker	0.962	0.942	-0.093	0.021	0.956	0.953	-0.014	0.769
	(0.191)	(0.234)			(0.204)	(0.211)		

Notes: Estimates from the mNutrition Ghana Baseline Survey Encouraged Group sample. Standard deviations are in parentheses. The full encouraged sample consists of 1979 households, while the subsample of encouraged households with a primary male and female consists of 1703 households.