AGRICULTURE, NUTRITION, AND GENDER LINKAGES (ANGeL)

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In collaboration with
Data Analysis and Technical Assistance

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BANGLADESH POLICY RESEARCH & STRATEGY SUPPORT PROGRAM
IFPRI

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Contents

Tables

Figures

ACRONYMS

5DE	Five domains of empowerment
ANCOVA	Analysis of covariance
ANGeL	Agriculture, Nutrition, and Gender Linkages
APK	ANGeL Pushti Kormi
APSU	Agricultural Policy Support Unit
A-WEAI	Abbreviated WEAI
BCC	Behavior change communication
BIHS	Bangladesh Integrated Household Survey
BRRI	Bangladesh Rice Research Institute
DAE	Department of Agricultural Extension
DATA	Data Analysis and Technical Assistance
DID	Difference-in-differences
FPMU	Food Planning and Monitoring Unit
FCS	Food Consumption Score
FTF	Feed the Future
GAAP2	Gender, Agriculture, and Assets Project – Second Phase
GOB	Government of Bangladesh
HIES	Household Income and Expenditure Survey
HKI	Helen Keller International
IEC	Information, education, and communication
IFPRI	International Food Policy Research Institute
MOA	Ministry of Agriculture
NGO	Nongovernmental organization
PRSSP	Policy Research and Strategy Support Program
RCT	Randomized controlled trial
SAAO	Sub-assistant agriculture officer
SDI	Simpson Diversification Index
TOT	Training of trainers
USAID	U.S. Agency for International Development
WEAI	Women's Empowerment in Agriculture Index
ZOI	Zone of Influence

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EXECUTIVE SUMMARY

The relationships between agricultural diversity, dietary diversity, and gender norms are complex and multi-dimensional. To better understand these links, and how to most effectively promote nutrition- and gender-sensitive agriculture in Bangladesh, the International Food Policy Research Institute (IFPRI) designed the Agriculture, Nutrition, and Gender Linkages (ANGeL) pilot project, implemented by the Ministry of Agriculture, Government of the People's Republic of Bangladesh. ANGeL aimed to identify actions and investments in agriculture that will help increase farm household income, improve nutrition, and empower women.

Using rigorous research, namely, a randomized controlled trial design, IFPRI assessed impacts of the ANGeL project interventions on various outcomes. Over the 17-month implementation period, with no inputs provided to participating farm households besides knowledge from trainings, ANGeL generated useful lessons on strengthening the agriculture-nutrition-gender nexus in the country.

Both men and women benefited from agricultural trainings, yet women learned more from the same trainings. Crop diversity increased substantially in homestead gardens, mainly due to ANGeL's emphasis on homestead food production from nutritious crops. Farmers also adopted improved production practices. We consistently found that women were more likely to apply knowledge gained from agricultural production trainings to adopt various types of improved agriculture production practices, such as pest disease and control, seed production and care, and use of quality fertilizer.

Similarly, improvements in nutrition knowledge were far greater for women and when trainings were combined. These improvements in knowledge had impacts on nutrition outcomes, with increases in household diet quality and child dietary diversity over the project period.

The strongest improvements in empowerment came when agriculture, nutrition, and gender sensitization trainings were combined. ANGeL's household approach empowered women and men in unique ways: while women became more empowered in asset ownership and income decisions, men became more empowered in production and income decisions in select interventions. Attitudes related to gender of both women and men also improved, with more women recognizing that they make important contributions to their communities.

ANGeL is the first ministry-led initiative that uses a rigorous impact evaluation to develop an evidence base to design and implement a national program. The ANGeL project is a significant step towards filling critical knowledge and action gaps in the country on promoting nutrition- and gender-sensitive agriculture.

1. INTRODUCTION

1.1 Background

Bangladesh has made commendable progress in domestic food production through public investments in agricultural research and extension, public and private investments in irrigation, and liberalization of agricultural input markets. In the early 1970s, Bangladesh was a food-deficit country with a population of about 75 million people. Today, the population has more than doubled, and the country is nearly self-sufficient in rice production, which has tripled over the past three decades.

However, Bangladesh's performance in improving child and maternal nutrition has been less satisfactory. Despite its success in reducing child stunting, the rate of stunting in Bangladesh (36 percent in 2014) remains high (NIPORT 2015). Bangladesh also continues to struggle with deficiencies in micronutrients such as iron, zinc, iodine, and vitamin A. Such deficiencies reflect poor diets that are rice-dominated, monotonous, and lacking diversity (Ahmed et al. 2013). Anemia (in part due to iron deficiency) is estimated to affect 26 percent of nonpregnant, non-lactating women, whereas 42 percent suffer from iodine deficiency. About 28 percent women of reproductive age are underweight (NIPORT 2015). In preschool children, the rates of anemia, iodine, and vitamin A deficiencies are 33 percent, 40 percent, and 20 percent, respectively (icddr,b 2013). Therefore, government policies and strategies underscore the importance of strengthening the linkage between agriculture and nutrition.

Agriculture provides a source of food and nutrients, contributes to income, and affects food prices. Exploring agriculture and nutrition linkages in Bangladesh using data from a multi-round district level panel, a study finds that rice yields are associated with earlier introduction of complementary foods to young children, as well as increases in their weight-for-height (Heady and Hoddinott 2016). Agriculture can also have effects on women's health, nutrition, empowerment and time allocation, which can have important consequences for their ability to care for family members. Given these links, agriculture has the potential to be a strong driver of nutrition. However, that potential is not being fully realized in Bangladesh because, traditionally, nutrition and agricultural policies have been uncoordinated.

Low status of women and gender gaps in health and education contribute to chronic child undernutrition (Smith et al. 2003) and food insecurity (von Grebmer et al. 2009), even when other determinants of food security, such as per capita incomes, improve. According to an IFPRI study, women are key actors within the food system, but are historically disempowered in Bangladesh in terms of leadership in the community, control of resources, and control of

income (Sraboni, Quisumbing, and Ahmed 2014a). The lack of women's empowerment weakens the links between agriculture and nutrition. Despite increases in women's participation in agriculture in Bangladesh in recent years (Asaduzzaman 2010), women face persistent obstacles, particularly due to social and economic constraints, which limit their further inclusion in agriculture. Women have limited control over agricultural assets, as well as limited mobility to go to markets to sell agricultural produce, often relying on husbands and sons to take produce to market.

1.2 Motivation for the Study

IFPRI research in Bangladesh, using data from a nationally representative household survey conducted by IFPRI, reveals that women's empowerment plays a key role in improving household food security and dietary diversity of children, women, and other household members (Sraboni et al. 2014b; Malapit et al. 2015). The study also shows that agricultural production diversity is associated with dietary diversity (Sraboni et al. 2014b). Further, IFPRI research in Bangladesh shows that nutrition behavior change communication (BCC) training imparted to women and men in rural households leads to significant improvements in child nutrition and complementary feeding practices (Ahmed et al. 2016; Menon et al. 2016).

Motivated by this research-based evidence, IFPRI researchers developed a concept note to strengthen the agriculture-nutrition-gender nexus in Bangladesh and presented it to the Ministry of Agriculture (MOA), Government of the People's Republic of Bangladesh in June 2014. Based on the concept note, an inter-ministerial committee of the Government of Bangladesh approved a pilot research project entitled, "Orienting Agriculture Toward Improved Nutrition and Women's Empowerment", also known as "Agriculture, Nutrition, and Gender Linkages" (ANGeL), for implementation by the MOA, with technical assistance from IFPRI and Helen Keller International (HKI), and an evaluation led by IFPRI. The Minister of Agriculture officially launched the pilot project in October 2015. The project is jointly funded by the Government of Bangladesh and the U.S. Agency for International Development (USAID).

1.3 Organization of the Evaluation Report

This report presents the results of the ANGeL evaluation. It is organized in 10 sections. Section 2 presents conceptual issues, objectives, and the research design of the ANGeL project. Section 3 discusses the analytical methodology. Section 4 describes the data used for the evaluation. Section 5 describes the ANGeL implementation process and assesses various aspects of participation in the ANGeL. Section 6 gives a profile of survey households. Section 7 presents the impact of the ANGeL on agricultural knowledge and practices and crop diversity. Section 8 shows impact of the ANGeL project on food consumption. Section 9 provides impacts on women's empowerment. Section 10 summarizes the main findings and provides conclusions.

2. DESCRIPTION OF THE ANGEL PROJECT

2.1 Project Objectives

The overall objective of the ANGeL pilot project is to identify actions and investments in agriculture that can leverage agricultural growth to improve nutrition, and to enhance women's empowerment in Bangladesh.

The specific objectives of the ANGeL Project's evaluation research are to measure the impact of the project's interventions on the following outcomes:

1. Farm household income
2. Agricultural production diversity
3. Dietary diversity of pre-school children, child-bearing-age women, all household members
4. Infant and young child feeding practices
5. Intakes of calorie, protein, iron, zinc, and vitamin A
6. Nutritional status of pre-school children and child-bearing-age women
7. Women's empowerment and gender parity between adult male and female.

2.2 Impact Pathways

As part of the ANGeL Project's evaluation research, three impact pathways will examine the agriculture-nutrition-gender nexus:

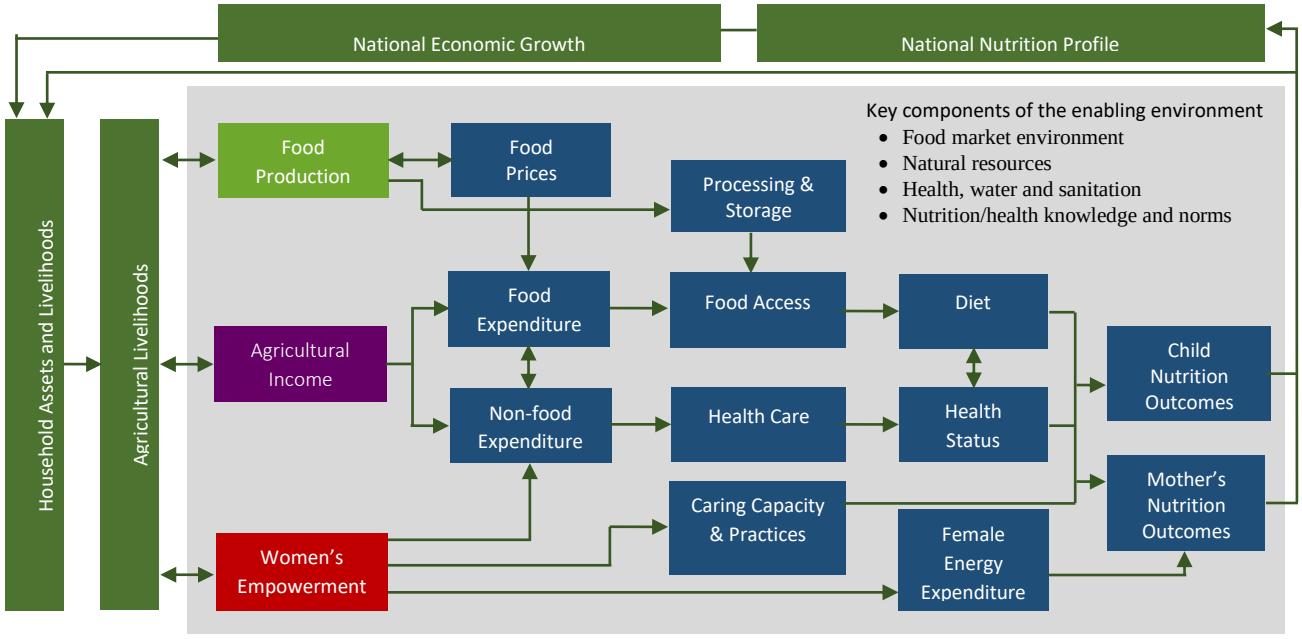
1) *Food Production*: Food production affects nutrition through food availability, quality, and pricing of food; information about the nutritional value of food produced; and marketing—that is, how certain foods are being promoted for sale and consumption. Farm household's production practices can improve the diversity, nutrient quality, and quantity of foods available to the household year-round. Diversified and efficient commercial agriculture can provide a variety of foods with high nutrient content to urban and rural non-farm consumers at affordable prices. Soil quality, agricultural practices, and technologies such as biofortification, influence this pathway.

2) *Agricultural Income:* Overall, income and nutrition are related. Agriculture is an important source of income for agricultural workers as well as producers. Agricultural production and prices also influence consumers' purchasing power, as well as incomes of food processors and food value chain actors. Child nutrition is usually more adequate in wealthier households than in poorer ones. However, the correlation is not always as strong or inevitable as might be expected.

3) *Women's Empowerment:* The pathway from women's empowerment to improved nutrition is influenced by various factors, including social norms, knowledge, skills, and the shared power of decision-making within households.

Figure 2.1 illustrates the potential pathways from food production, agricultural income, and women's empowerment to improved nutritional status.

Figure 2.1 Steps toward improved nutrition: Food production, agricultural income, and women's empowerment pathways



Source: Herforth, A. and J. Harris 2014.

2.3 Design of the ANGeL Project

In order to achieve the objectives, IFPRI researchers in consultation with MOA partners and USAID have designed a project that implements and evaluates the impact of three alternative intervention modalities for promoting nutrition and gender sensitive agriculture. The modalities are:

1) *Agriculture Production:* Facilitating the production of the high-value food commodities that are rich in essential nutrients. The focus would be on diversifying agricultural production (fruits and vegetables; pulses; oilseeds; and poultry, dairy, fish, livestock).

2) *Nutrition Knowledge:* Conducting high-quality behavior change communication (BCC) training to improve nutrition knowledge of women and men.

3) *Gender Sensitization:* Undertaking gender sensitization activities that lead to the improvement in the status/empowerment of women and gender parity between women and men.

IFPRI uses a randomized controlled trial design to evaluate ANGeL's impact (see Section 3 for details on the impact evaluation). The evaluation design has five treatment arms (T) and one control arm (C):

T1: Nutrition BCC-1 training delivered to women and men by Sub-Assistant Agriculture Officers (SAAO) from the Department of Agricultural Extension (DAE) of the MOA.

T2: Nutrition BCC-2 training delivered to women and men by female community nutrition workers, referred to as "ANGeL *Pushti Kormi*" (APK), hired by the ANGeL project

T3: Agricultural Production training delivered to women and men by SAAOs

T4: Agricultural Production + Nutrition BCC training delivered to women and men by SAAOs

T5: Agricultural Production + Nutrition BCC training delivered to women and men by SAAOs + gender sensitization activities for women and men conducted by HKI

C: Control

The five treatment arms of the research represent the three alternative modalities of interventions of the project: agricultural production, nutrition knowledge, and gender sensitization. T4 combines the production and nutrition knowledge modalities, and T5 combines all three modalities.

Men are the primary buyers of food in rural Bangladesh, as women have limited mobility and are not generally permitted to go to the market unaccompanied. Educating both men and women about nutrition in the four treatment arms of ANGeL (T1, T2, T4, and T5) may lead to joint decisionmaking for smart purchasing of nutritious foods at the market, thereby improving overall nutrition in the family. This may also improve gender parity.

In Bangladesh, agricultural extension agents (SAAOs) of the DAE provide services mostly to male farmers to facilitate the adoption of agricultural technologies and modern agricultural production practices; women are seldom reached by the extension agents. In three treatment arms of ANGeL (T3, T4, and T5), SAAOs deliver extension messages and training to both women and men. The study tests the hypothesis that women's access to agricultural extension services would empower them in terms of sole or joint decisionmaking over farming and autonomy in agricultural production and marketing (for example, what inputs to buy, what crops to grow, what livestock to raise, what and how much produce to sell, etc.).

Since most SAAOs of the DAE are male, *does the gender of the trainer make a difference in the effectiveness of nutrition training*? T2 addresses this research question. Women who completed at least secondary schooling are hired from each of the 25 blocks under T2 and HKI provides them with the same training on nutrition BCC methods.

2.4 Collaborative Approach to Project Implementation

IFPRI researchers in Bangladesh work closely with the officials of the Agricultural Policy Support Unit (APSU) of the MOA for building long-term analytical capacity within the Ministry. The APSU and the DAE jointly implement the ANGeL Project. Other agencies of the MOA— Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Bangladesh Institute of Research and Training on Applied Nutrition (BIRTAN), and Bangladesh Agricultural Development Corporation (BADC)—provide support as needed to implement the project.

IFPRI researchers evaluate the impacts of the ANGeL Project on various outcomes. HKI developed the training manuals for diversified agricultural production in consultation with scientists from BARI and BRRI, and training manuals for nutrition BCC in consultation with BIRTAN scientists and IFPRI. HKI provides the necessary training of the trainers (SAAOs and APKs) on modern practices for producing high-nutritive value food commodities, nutrition BCC, and gender sensitization.

2.5 Way Forward

The project seeks to draw on the large, nationwide agricultural extension network that already exists in the country, and attempts to 'top-up' its current portfolio with nutrition activities and messages.

Using the impact results presented in this report, the ANGeL experimental research will identify which interventions most effectively increase agricultural diversity, improve nutrition, and promote women's empowerment. The Ministry of Agriculture plans to use the research-based evidence to scale up the most effective interventions all over Bangladesh. In fact, ANGeL is the first ministry-led initiative that uses a rigorous impact evaluation, the randomized controlled trial, to develop an evidence base to design and implement a national program.

3. IMPACT EVALUATION DESIGN

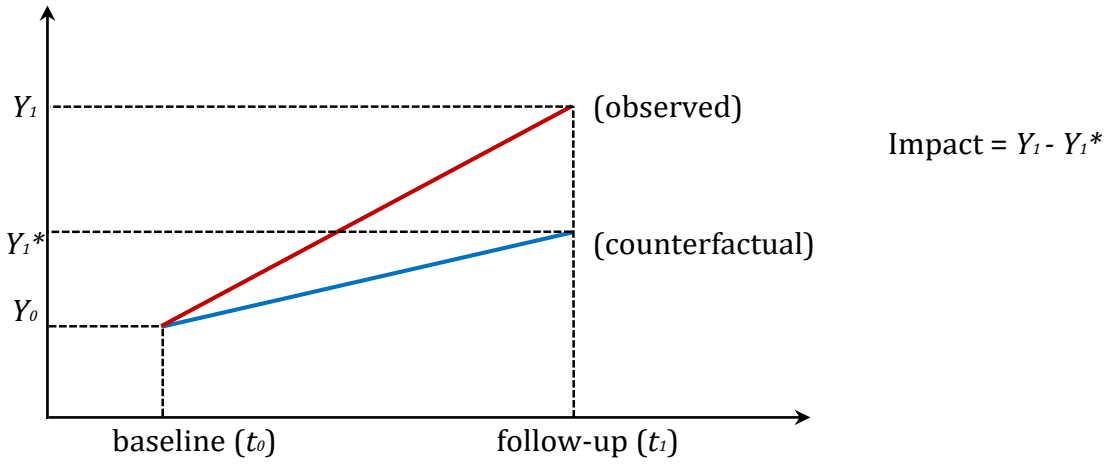
3.1 Designing an Impact Evaluation: An Overview

In order to design an effective impact evaluation, it is necessary to understand how the evaluation demonstrates impact. The purpose of an impact evaluation is to compare outcomes for beneficiaries in a particular program (observed outcomes) with the beneficiaries' outcomes had they not participated in the program (counterfactual outcomes). The difference between the observed outcomes for beneficiaries and the counterfactual outcomes represent the causal impact of the program. The fundamental challenge of an impact evaluation is that it is not possible to observe the exact same beneficiaries both participating in the program and not participating in the program at the exact same time; therefore, the counterfactual outcomes for beneficiaries are unknown. All evaluation strategies are designed to find a method for constructing a proxy for these counterfactual outcomes.

Most evaluations measure counterfactual outcomes for beneficiaries by constructing a comparison group of similar households from among non-beneficiaries. Collecting data on this comparison group makes it possible to observe changes in outcomes for people not participating in the program and to control for some other factors that affect outcomes, which reduces bias in the impact estimates.

Figure 3.1 shows how information on a comparison group can be used to measure program impact by removing the counterfactual from the observed outcome for beneficiaries. In the figure, the outcome variable is represented on the Y axis, and time is represented on the X axis. A household survey is conducted to measure the outcome in two periods: the baseline at t_0 and the follow-up at t_1. In the figure, at baseline the average outcome for both the households benefiting from the program and those in the comparison group is at the level of Y_0. After the program is completed, the follow-up survey (t_1), demonstrates that the group participating in the program has an outcome level of Y_1 while the comparison group has an outcome level of Y_1^*. The impact of the program is measured as $Y_1 - Y_1^*$. If a comparison group had not been included, the impact might have been misrepresented (and overstated) as the observed change in the outcome for the beneficiary group: $Y_1 - Y_0$.

Figure 3.1 Measuring impact based on outcomes from beneficiary and comparison groups



In constructing a comparison group for the evaluation, it is important to ensure that the group is as similar as possible to the program group *before the start of the program*. To understand why, consider estimating the impact of introducing a new agricultural technology among smallholder farmers on rice yields as the difference in average rice yields between beneficiaries and a random sample of non-beneficiary farmers. The problem with this approach is that non-beneficiaries are different from program beneficiaries in ways that make them an ineffective comparison group. If the evaluation does not control for these differences prior to initiating the program, impact estimates will be biased. The most common sources of bias are targeting or program placement bias and bias due to self-selection by beneficiaries concerning the decision to participate.

3.1.1 Evaluation Methods

The major difference between impact evaluation methodologies concerns their method for developing a comparison group to construct the counterfactual outcomes needed for the impact estimates. The most commonly used methodologies include randomized controlled trial (RCT), propensity score matching (PSM) or covariate matching, and regression discontinuity design (RDD). We will discuss only the RCT method because it is the design used by the ANGeL study for evaluating impacts.

RCT is widely considered the most convincing approach to constructing a comparison group for an evaluation. The method involves designing a field experiment by randomly assigning

participants in the program among comparably eligible communities or households. Those that are randomly selected out of the program form a control group, while those selected for the program are the treatment group. When RCT is properly implemented, differences in outcomes between the treatment and control groups should be free of bias and can reliably be interpreted as causal impacts of the program. The logic is as follows: because assignment into the treatment or control groups is randomly determined and not correlated with the outcome variables, differences in outcomes over time must be a result of the program.

With the RCT, estimates can be improved by measuring outcomes for treatment and comparison groups before and after the program begins. This makes it possible to construct "difference-in-differences" (DID) estimates of program impact. DID estimates are defined as the average change in the outcome in the treatment group (*T*) minus the average change in the outcome in the comparison group (*C*). Mathematically, this is expressed as:

$$\Delta_{DID}^{ATT} = \left(Y_1^T - Y_0^T\right) - \left(Y_1^C - Y_0^C\right)$$

The main strength of DID estimates for program impact is that they remove the effect of any unobserved variables that represent persistent (time-invariant) differences between the treatment and comparison groups. This helps to control for the fixed component of various contextual differences between treatment and comparison groups, including depth of markets, agro-climatic conditions, and any persistent differences in infrastructure development. As a result, DID estimates can lead to a substantial reduction in selection bias of estimated program impacts.

3.2 Impact Evaluation Design

For the ANGeL evaluation research, IFPRI uses a cluster-randomized controlled trial (RCT) design using blocks of the DAE as clusters. The evaluation includes a sample of 160 blocks in 16 rural upazilas (sub-districts) out of the 484 rural upazilas in the country. The selected upazilas are agro-ecologically suitable for crop diversification and have good market connectivity. These upazilas belong to 16 districts in eight divisions of Bangladesh.[1] Table 3.1 provides the list of upazilas, districts, and divisions where the ANGeL Project is implemented. Figure 3.2 shows the locations of project upazilas on the map of Bangladesh.

The selected 160 blocks were randomly assigned to five treatment arms and one control group. Simple cluster-level randomization was used, with no stratification. Random assignment of clusters (blocks) helped to assure that, on average, farm households would have similar

[1] The administrative structure of Bangladesh consists of divisions, districts, upazilas, and unions, in decreasing order by size. There are 8 divisions, 64 districts, 484 upazilas, and 4,498 unions (all rural). There are 87,320 villages in rural Bangladesh.

baseline characteristics across treatment and control groups. Such a design minimizes systematic differences between treatment and control households and reduces the risk of bias in the impact estimates due to "selection effects."

A total of 4,000 farm households were selected, of which 3,125 farm households belonged to the five treatment arms in 125 blocks, and 875 farm households belonged to the control group in 35 blocks (see Section 4 for details on sampling).

The quantitative impact evaluation involved two rounds of comprehensive household surveys to collect data addressing the objectives of the evaluation research. The baseline survey collected information before the project interventions started (November 2015–January 2016); the endline survey was conducted shortly after the project activities were complete (January–March 2018). The IFPRI research uses the longitudinal dataset produced from the two rounds of surveys to estimate impacts of the ANGeL project.

For all outcomes for which we are able to use both rounds of data, our preferred approach to estimating the impacts of ANGeL relies on the analysis of covariance (ANCOVA) method. ANCOVA allows a household's outcome at follow-up to depend on the same household's outcome at baseline, as well as on the household's treatment status and an error term (which captures any omitted observable or unobservable factors). It is a variant on the difference-in-differences method—in which the difference is calculated between the change in the treatment group and the change in the control group between the beginning and end of the project. In cases of low autocorrelation between an outcome at baseline and follow up, as we expect for several of our primary outcomes, ANCOVA estimates are preferred over difference-in-difference estimates (McKenzie 2012), as they lead to improvements in statistical power. Intuitively, if autocorrelation is low, then difference-in-difference estimates will overcorrect for baseline imbalances. ANCOVA estimates, on the other hand, will adjust for baseline imbalances according to the degree of correlation between baseline and follow-up, as the specification allows estimating autocorrelation rather than imposing it to be unity. The ANCOVA model is specified as follows:

$$Y_h = \propto + \beta_1 T_{1h} + \beta_2 T_{2h} + \beta_3 T_{3h} + \beta_4 T_{4h} + \beta_5 T_{5h} + \gamma Y_{h,base} + \varepsilon_h \ ,$$

where Y_h is the outcome of interest for farm household h at follow-up; $Y_{h,base}$ is the outcome of interest at baseline; $T_{1h}, T_{2h}, T_{3h}, T_{4h}, T_{5h}$ are indicators for whether household h is in each of the treatment groups T1, T2, T3, T4, T5 respectively (= 1 if in the respective treatment group, = 0 if in the control group or another treatment group), and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are the corresponding ANCOVA impact estimators. In other words, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ represent the amount of change in outcome, *Y*, which is due to household h being assigned to the respective treatment group.

Throughout the report, for outcomes where two rounds of data can be used, we estimate both the "base" ANCOVA specification above, with standard errors adjusted for clustering at the block level, and what we refer to as an "extended" ANCOVA specification. The extended specification includes additional baseline covariates, in order to improve precision as well as to further address any baseline imbalances between arms. We choose a parsimonious list of baseline covariates for the extended specification, roughly following two criteria (Bruhn and McKenzie 2009): (1) we believe the covariates "matter" for our outcomes of interest, meaning they are likely to be significantly associated with key outcomes; (2) differences in the baseline covariates between intervention arms appear "large." We also choose baseline covariates with non-missing values in our data, so that including them does not cause us to drop household observations from our estimation. The final list of baseline covariates included in the extended specifications – covering geography, basic male and female characteristics, and basic household demographic and socioeconomic characteristics at baseline – is as follows:

- Dummy variables for the upazila in which the household lived at baseline
- Male household head's years of schooling at baseline
- Wife of the household head's years of schooling at baseline
- Whether the household is female-headed at baseline
- Whether the household owns less than 0.5 acre of cultivable land at baseline
- Whether the household has a connection to electricity at baseline

For outcomes where we are able to use only the endline round of data for impact estimation, we use single-difference estimation. The single-difference model is specified as follows:

$$Y_h = \propto + \beta_1 T_{1h} + \beta_2 T_{2h} + \beta_3 T_{3h} + \beta_4 T_{4h} + \beta_5 T_{5h} + \varepsilon_h \ ,$$

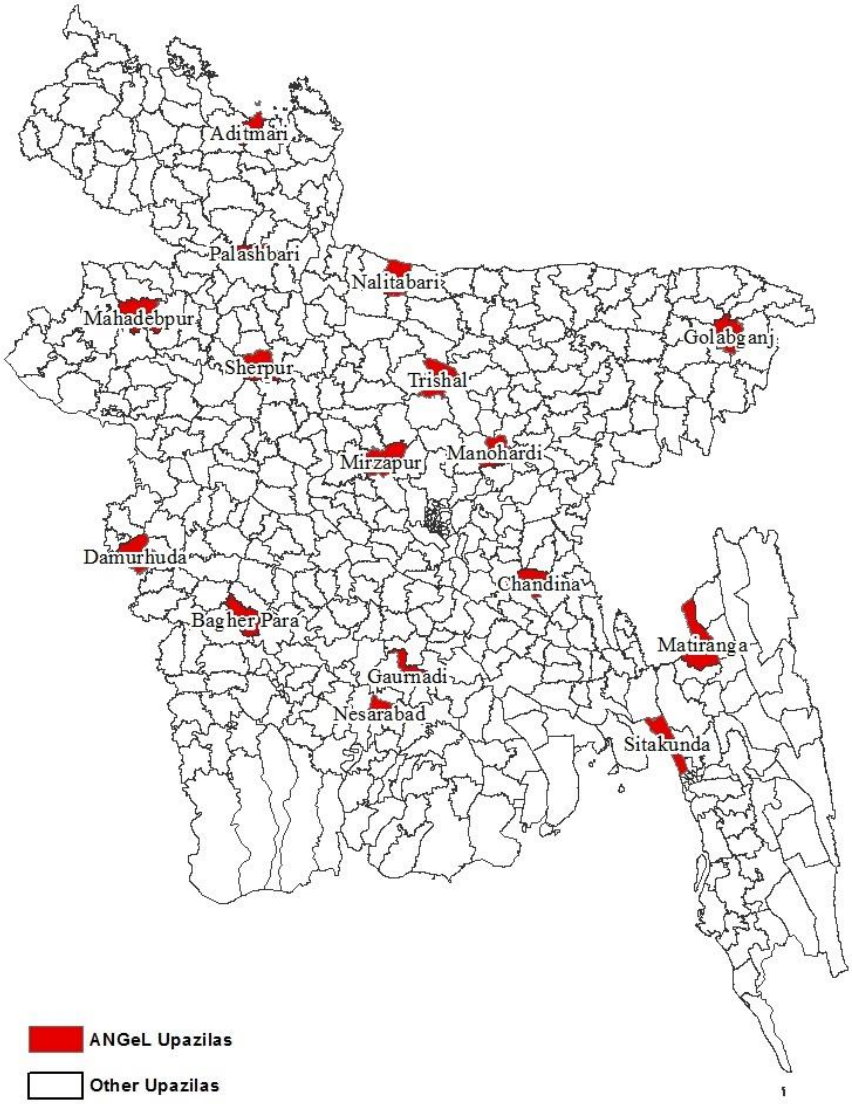
where Y_h is the outcome of interest for farm household h at follow-up; $T_{1h}, T_{2h}, T_{3h}, T_{4h}, T_{5h}$ are indicators for whether household h is in each of the treatment groups T1, T2, T3, T4, T5 respectively (= 1 if in the respective treatment group, = 0 if in the control group or another treatment group), and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are the corresponding single-difference impact estimators. As with ANCOVA, we estimate "base" single difference specifications, with standard errors adjusted for clustering at the block level, as well as "extended" single difference specifications that also include the baseline covariates listed above.

Table 3.1 List of upazilas purposively selected for the ANGeL Project

Division	District	Upazila
Dhaka	Narsingdi	Monohardi
Dhaka	Tangail	Mirzapur
Mymensingh	Mymensingh	Trishal
Mymensingh	Sherpur	Nalitabari
Chittagong	Comilla	Chandina
Chittagong	Chittagong	Sitakunda
Chittagong	Khagrachari	Matiranga
Rajshahi	Naogaon	Mahadebpur
Rajshahi	Bogra	Sherpur
Rangpur	Lalmonirhat	Aditmari
Rangpur	Gaibandha	Palashbari
Khulna	Jessore	Bagherpara
Khulna	Chuadanga	Damurhuda
Barisal	Pirojpur	Nesarabad
Barisal	Barisal	Gaurnadi
Sylhet	Sylhet	Golabganj

Source: Constructed by authors.

Figure 3.2 Map of Bangladesh showing locations of 16 upazilas for the ANGeL project



Source: Constructed by authors.

4. DATA FOR THE EVALUATION

The information collection approach used to evaluate the ANGeL project involved combining quantitative surveys and qualitative semi-structured key informant interviews and focus group discussions. This mixed method of data collection provided a rich pool of data and powerful analysis that would not have been available with any of these methods on their own. Gender disaggregated information was collected wherever it was meaningful.

The required quantitative data for impact evaluation mostly came from two household surveys. A baseline survey was carried out in November 2015–January 2016. An endline survey was conducted in January–March 2018 to assess the impacts of the interventions.

The surveys included ANGeL participants and non-participant control households. IFPRI has extensive experience in the design and implementation of similar surveys in Bangladesh and many other countries.

4.1 Baseline Survey

4.1.1 Survey Questionnaires

The ANGeL baseline survey questionnaires included modules that, together, provide an integrated data platform to answer the research questions. The questionnaire has two parts—one for female respondents and the other for male respondents. The modules of the questionnaires are listed below:

- Household demographic composition, education attainment, occupation and employment, and dwelling characteristics
- Acquisition of productive and consumption assets
- Detailed food and nonfood expenditures
- Individual level dietary intake data from 24-hour recall
- Health and morbidity, child care, water and sanitation
- Anthropometric measurements of children under age five and all household members
- Savings and loans
- Household food security indicators
- Women's status (mobility, work, earnings and expenses decisions, reproductive decisions, domestic violence, abuse and threats, women's assets at marriage and ownership/control of current assets)
- Shocks and coping strategies
- Data for measuring Women's Empowerment in Agriculture Index (WEAI)

4.1.2 Training

For implementing the baseline household survey, IFPRI contracted Data Analysis and Technical Assistance (DATA), a Bangladeshi consulting firm with expertise in conducting complex surveys and data analysis. DATA worked under the supervision and guidance of senior IFPRI researchers. DATA's capacity to conduct surveys that collect high quality data was largely built by IFPRI over the past two decades.[2]

IFPRI researchers prepared a draft baseline survey questionnaire. The draft questionnaire was peer-reviewed and revised to address comments and suggestions. After pre-testing in the field, the baseline survey questionnaire was finalized.

For the baseline household survey, DATA provided experienced survey enumerators and supervisors to administer the survey; most of the enumerators and supervisors hold master's degrees in social science, nutrition, or home economics. From October 11–November 15, 2015, IFPRI researchers and DATA experts trained 96 experienced enumerators (48 females and 48 males) and 16 supervisors (2 females and 14 males). The survey enumerators' training consisted of a formal classroom component as well as closely monitored practice fieldwork. In the formal training, IFPRI researchers briefed the enumerators and supervisors on the objectives and methods of the survey, the sampling design, and the responsibilities of the enumerators. They were trained on how to carry out the interviews, including line-by-line explanation and interpretation of the questionnaires, the flow and skip-patterns, definitions, and explanations of how to handle unusual cases and when to contact the supervisor for assistance.

Field supervisors received additional training related to their supervisory and editing role. In particular, they were trained on the quality control process, cross checking, editing and coding of the questions, security and confidentiality issues, and the delivery of the completed questionnaires to the DATA office in Dhaka for simultaneous data entry.

The questionnaires were field tested in Belabo Upazila in Narsingdi District and Trishal Upazila in Mymensigh District. The field testing determined the appropriate distribution of questionnaire modules among the male and female questionnaires, identified problems with

[2] DATA carried out all IFPRI surveys in Bangladesh, including more than 50 household surveys and several market, school, and other institutional surveys. In addition, DATA has conducted numerous surveys for various international organizations, such as the World Food Programme (WFP)-Bangladesh, the World Bank, the European Union, the U.S. Department of Agriculture, CARE-Bangladesh, World Vision-Bangladesh, the Population Council–New York, Save the Children (USA), Tufts University School of Nutrition Science and Policy, and the IRIS Center at the University of Maryland.

the questionnaires or additional rules that were needed to address difficult cases. The field testing resembled the actual implementation of the survey in order to test the full range of survey activities, including questionnaire completion, delivery, and data entry. An additional function of the field testing was to provide practical training to the enumerators in administering the questionnaire.

4.1.3 Survey Administration

DATA carried out the baseline household survey from November 16, 2015–January 30, 2016 under the supervision and guidance of IFPRI researchers. Going into the field, the teams of enumerators were equipped with various documents (for example, survey manual, serial numbered questionnaires, and identification cards), weight and height scales for anthropometric measurements, and GPS units for geo-referencing.[3] The APSU Research Director, Ministry of Agriculture, Government of Bangladesh issued letters of authorization to conduct the survey.

The enumerators conducted the interviews one-by-one and face-to-face with the respondents assigned to him or her. The enumerators were supervised by the field supervisors who accompanied them to the village. Each field supervisor was responsible with his/her defined region. All field staff reported their activities to their supervisors using a standard progress report form. Completed questionnaires were delivered to the DATA central office on a regular basis for further quality control and validation during data entry.

4.1.4 Quality Control

IFPRI and DATA worked diligently to ensure the quality of the baseline household survey data. In the field, survey supervisors routinely oversaw interviews conducted by enumerators, and verified all questionnaires completed by enumerators on a daily basis. If inconsistencies in responses were detected in completed questionnaires, then the supervisors visited the relevant respondents to find out the reasons and corrected the responses as needed. In addition, the supervisors made random checks of about 10 percent of the completed questionnaires by revisiting the sample households. IFPRI researchers made frequent field visits to supervise the fieldwork.

4.1.5 Data Entry and Cleaning

The data entry was carried out at the DATA office in Dhaka from January 31–March 27, 2016. DATA carried out data entry of the baseline survey using a specialized software (Microsoft Access) that was programmed to identify values that are out of range or inconsistent with other

[3] Health O' Meter weighing scales and GPSs were imported from the USA for the household survey.

responses in the questionnaire. After cleaning, DATA delivered the baseline survey dataset to IFPRI on May 3, 2016.

4.2 Sampling Design

4.2.1 Sample Size Calculation

One important facet of designing an impact evaluation is to ensure that the sample size is sufficiently large for treatment impacts to be feasibly detected in the outcomes of interest. While increasing sample size requires devoting additional resources, having too small a sample is a serious danger that can undermine the purpose of undertaking the evaluation in the first place. In particular, if the sample is too small, even a substantial treatment impact in a key outcome may be indistinguishable from inherent variability in the outcome. In effect, the analysis may erroneously conclude there were no impacts when, in fact, there were.

Sample size calculations allow for formal analysis of which program design elements are strongest in detecting a specified minimum change in a given outcome. These calculations can also be used to consider implications of known limitations in study design. For example, if there are specific constraints on sample size (for practical/logistical reasons), the minimum detectable effect in each outcome can be calculated, given the constraints. If the minimum detectable effect in a particular outcome is unreasonably large to expect as a treatment impact, this insight can then guide the choice of outcomes considered to be the focus of the study, which can in turn guide the research questions that are posed and shape the design of the survey questionnaire. To summarize—and to be clear on this point—sample size calculations do not indicate what the sample size must be. Rather, they indicate what magnitude of effects we can reasonably expect to observe, given the design of the intervention.

4.2.1.1 Sample Size Calculations for the ANGeL Evaluation

For a minimum sample size calculation, researchers need to consider several factors: (1) the outcomes that are of the greatest interest to program managers and policymakers; (2) the minimum size of change in those outcomes that program managers would like to observe; (3) the degree of variability in those outcomes; (4) the extent to which there is correlation in outcomes within localities; (5) the desired level of statistical power; and (6) the level of desired statistical significance. Sample sizes increase inversely with the size of change that the evaluation is attempting to uncover; greater variability in outcomes; increased correlation of outcomes; and higher statistical power.

In the context of the ANGeL project evaluation, the calculations should take into account that the evaluation followed a randomized designed, not at the level of households, but at the block (cluster) level. In sample size calculations for cluster-randomized studies, not only the number

of households and the number of clusters matter, but also the inherent similarity of households within a cluster. The measure that captures this similarity for each outcome is referred to as its "intracluster correlation" – that is, in the absence of any treatment, a measure of the extent to which the outcome varies across households within a cluster relative to how much it varies across clusters.

The value of the intracluster correlation for any outcome is likely to depend on the context of the data. Since it is necessary to conduct sample size calculations prior to collecting the data, the accepted approach to estimating intracluster correlations for sample size calculations is to use values calculated from existing comparable datasets.

For the ANGeL evaluation, we used parameters derived from the nationally representative Bangladesh Integrated Household Survey (BIHS) conducted by IFPRI in 2011/2012. We use per capita daily calorie availability and the WEAI score as the outcome indicators.

We followed the standard practice of finding the sample size that gives an 80 percent chance (the "power of the test") of rejecting the null hypothesis of zero change in outcome indicators at the 0.05 level of significance.

To detect a minimum, statistically significant increase in per capita calorie availability of 12 percent between treatment and control groups, a minimum sample size of 25 clusters (blocks) and 473 households for each of the 5 treatment arms and the control are required. For women's empowerment in agriculture as an outcome indicator, 25 clusters and 500 households are required to detect a 10 percent increase in empowerment. For the ANGeL impact evaluation, we used 25 clusters/blocks and 625 farm households for each treatment arm and 35 clusters and 875 farm households for the control group. Thus, each cluster included 25 households.

4.2.2 ANGeL Sampling Design

The cluster-randomized evaluation method (using blocks of the DAE as clusters) for ANGeL uses a sample of intervention blocks belonging to each of the five treatment groups and a sample of non-intervention blocks belonging to the control group. The sampling process for the treatment and the control groups includes the following steps:

- For the ANGeL project, we purposively selected 16 rural upazilas (sub-districts) from all 484 rural upazilas in the country that are agro-ecologically suitable for crop diversification and have good market connectivity.

- There are 525 blocks in the 16 selected upazilas (33 blocks per upazila on average). From the list of all blocks, we randomly selected 10 blocks from each of the 16 upazilas (160 blocks selected).

- We randomly assigned 160 blocks to the five treatment arms and one control group of the RCT as follows:
    - 25 blocks to each of the 5 treatment arms (25 x 5 = 125 blocks), and 35 blocks to the control group.

- We randomly selected one village from each block, then conducted a 100 percent census of households in each of the 160 selected villages. Thereafter, we listed all farm households with at least one child under 24 months from the village census lists.

- We randomly selected 25 farm households for each of the 160 blocks from village census lists of farm households with at least one child under 24 months, which gave:

    - 625 farm households for each of the 5 treatment arms (25 farmers x 25 blocks) and 875 farm households (25 farmers x 35 blocks) for the control group.

3,125 farm households belong to the 5 treatment arms (625 x 5) in 125 blocks, and 875 farm households belong to the control group in 35 blocks. Therefore, we selected a total of 4,000 farm households for the quantitative impact evaluation.

4.3 Endline Surveys and Other Data Collection

IFPRI conducted the endline survey from January-March 2018 after completion of farmers' training. The survey was administered to all ANGeL participating households and control households included in the baseline survey sample, which created a two-round panel survey. The endline survey questionnaire included all modules of the baseline survey questionnaire and two additional modules—one on program participation and the other on agricultural and nutrition knowledge and practice by the participants who received agricultural production and nutrition BCC training.

Besides the baseline and the endline surveys, IFPRI carried out a survey of SAAOs and APKs who delivered training to ANGeL participants.

In addition to data from household surveys, the evaluation of ANGeL was supplemented by monitoring data routinely collected by APSU and IFPRI staff. Moreover, each of the two rounds of household surveys were accompanied by community or village surveys.

4.4 Attrition

The baseline survey successfully completed interviews of all 4,000 target households in the ANGeL study. Table 4.1 shows their interview status at endline.

Table 4.1 Household interview status

	Sample
Number households interviewed, baseline	4,000
Number households interviewed, endline	3,898
Percentage of baseline households not interviewed at endline	2.6
Reason for attrition	
Migration	76 (1.9%)
Dropped out of study, refused to be interviewed, could not be found	26 (0.7%)

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Attrition in the ANGeL studyover a two-year period is low: 2.6 percent. Virtually all attrition is due to household migration. Only 26 households dropped out of the study, refused to be interviewed, or could not be found. Probit regressions were run on the impact of the treatment arms on attrition. The null hypothesis that participation in the treatment arms affected attrition was not rejected; further, the coefficients on treatment status are small, typically less than one percentage point. Selective attrition is unlikely to affect the results.

4.5 Qualitative Field Research

IFPRI conducted qualitative field research in April-May 2018. The qualitative research collected information on farmers' participation in the ANGeL project. Open-ended questions were asked in key informant interviews and focus group discussions. Further, key informant interviews were carried out with ANGeL trainers (SAAOs and APKs) and DAE officials who monitored the field-level trainings.

The qualitative research enabled researchers to explore issues more suited to open-ended than closed questions, and those less obvious and unanticipated. It has the benefit of capturing informants' perceptions and knowledge in their own words. It enabled researchers to probe responses and gather respondents proposed solutions to problems. It also enabled researchers to consider the significance of local social context.

5. ANGEL PROJECT DEVELOPMENT AND IMPLEMENTATION

5.1 Formalizing the ANGeL Project Concept

Motivated by research findings from IFPRI's Bangladesh Integrated Household Survey (BIHS) data, IFPRI-PRSSP researchers developed and presented a concept note to the MOA in June 2014. Shortly thereafter, an interministerial committee approved the ANGeL Project for implementation across 16 districts.

The Minister of Agriculture officially launched the ANGeL Project on October 29, 2015 at the APSU. Various ministry officials and heads of MOA agencies attended, as well as the USAID Mission Director and other USAID officials. The IFPRI Country Representative for Bangladesh presented the motivation, design, sampling, evaluation framework, and implementation process.

5.2 Training

5.2.1 Training Materials

IFPRI collaborated closely with Helen Keller International (HKI) and APSU to develop field-level training packages for the agriculture production and nutrition BCC modules. IFPRI and HKI developed comprehensive training packages for agriculture, nutrition, and gender trainings, which included key messages, facilitator guidelines, festoons, and other visual aides (for example, food plates, food cards, and posters).

HKI's gender sensitization module, *Nurturing Connections*, was designed to complement nutrition and homestead agriculture production programming. *Nurturing Connections* uses a participatory approach, and its activities focus on challenging gender norms, building equality, and developing constructive communication skills. IFPRI and APSU worked with HKI to adjust the module to fit the project context.

In December 2016, IFPRI developed a brochure on key nutrition messages in Bangla and distributed to all treatment households and trainers.

5.2.2 Training of Trainers

Under T2, 25 female community nutrition workers, known as *ANGeL Pushti Kormis* (APKs), were selected to train households on nutrition BCC. All APKs completed high school, were married, and lived in the same union and preferably same block as training participants. As government agriculture extension services are male-dominated, incorporating female community nutrition workers enables researchers to see whether the trainer's gender affects behavior change.

Government agriculture extension officials and APKs were trained as trainers from April 19–May 31, 2016. Below are the training of trainers (TOT) details for the respective treatment arms:

- 25 sub-assistant agriculture officers (SAAOs) from the DAE under T3 received agricultural production training from April 19–23, 2016.
- 24 SAAOs under T1 received nutrition BCC training from May 3–5, 2016.
- 26 SAAOs under T5 received agricultural production and nutrition BCC trainings from May 8–12, 2016.
- 25 SAAOs under T4 received agricultural production and nutrition BCC trainings from May 15–19, 2016.
- 25 APKs under T2 received nutrition BCC training from May 29–31, 2016.

All trainings were conducted at the Mushroom Development Institute, an MOA facility, in Savar (outside Dhaka city) except APK training, which was conducted at the Rural Development Academy in Bogra, northern Bangladesh.

From November 14–28, 2016, HKI trained individuals they hired as trainers on the *Nurturing Connections* gender sensitization module at HKI's project office in Dhaka.

5.2.3 Field-Level Trainings

In July 2016, field-level trainings were launched for agriculture production and nutrition BCC. In December 2016, gender sensitization trainings were launched in 25 blocks under T5, which will continue through March 2017. Over the project period, there were 17 agriculture production trainings, 19 nutrition BCC, and 8 gender sensitization sessions total.

Throughout the project period, key implementation challenges across all treatment arms included training absenteeism, particularly for males, and training quality. Absentee rates varied across the five treatment arms, between 3-12 percent. Reasons for absenteeism included ad hoc contractual work of male participants, male participants were busy harvesting during the agriculture planting season, heavy rains during the monsoon season, lack of child care, travel time to reach training site, and some comparatively more well-off households were not as incentivized to attend the trainings.

5.2.4 Refresher Trainings

In August 2016, field-level trainings were initiated for agriculture production and nutrition BCC. In December 2016, gender sensitization trainings were launched in 25 blocks under T5, which continued through March 2017.

In January 2017, IFPRI and HKI organized refresher trainings at the Mushroom Development Institute, Savar, which reviewed training content and training delivery techniques. Below are the refresher training details:

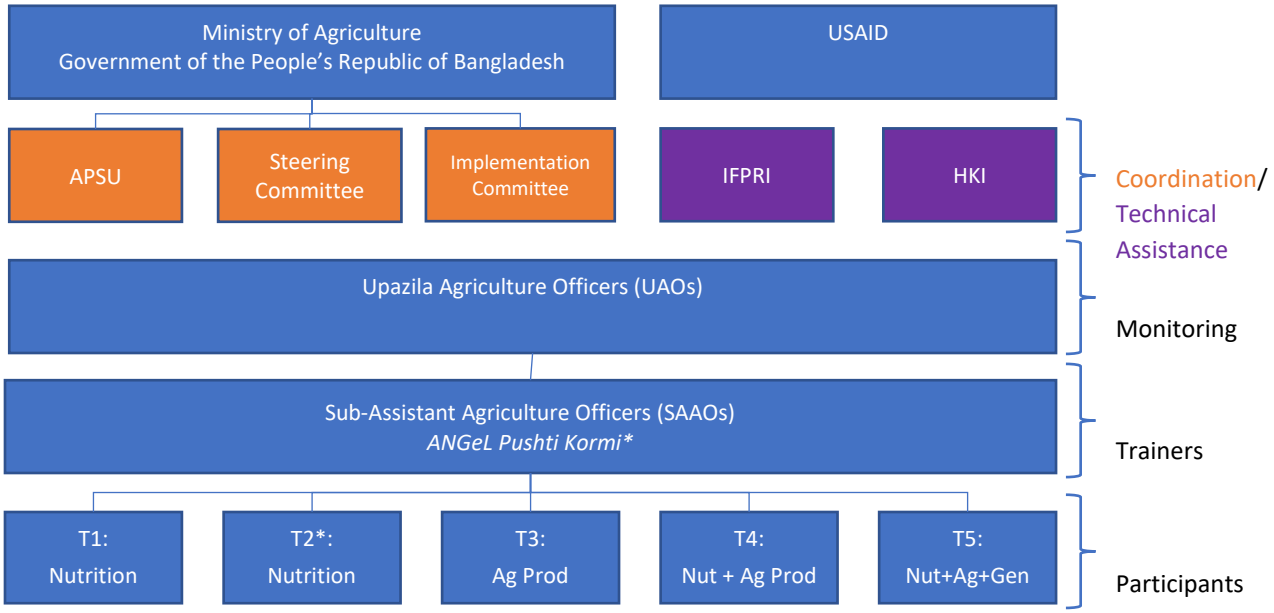
- 25 APKs under T2 and 1 SAAO received refresher training from November 1–3, 2016.
- 25 SAAOs under T3 received agriculture production refresher training on January 19, 2017.
- 24 SAAOs under T4 received nutrition and agriculture production refresher training from January 22–23, 2017.
- 24 SAAOs under T5 received nutrition and agriculture production training from January 24–25, 2017.
- 25 SAAOs under T1 received nutrition refresher training on January 29, 2017.

IFPRI designed brochures on nutrition key messages to be used at the household-level to reinforce nutrition messages from trainings. IFPRI distributed the brochures at the refresher trainings to SAAOs under the treatment arms that deliver nutrition training (T1, T2, T4, and T5), who then distributed the resources to 2,450 farm households total.

5.3 Monitoring

As a ministry-led project, government ownership and involvement were critical to ANGeL. Figure 5.1 illustrates the implementation and monitoring structure of the ANGeL project, which relied heavily on the national agriculture extension network to impart and monitor trainings to farm households across five interventions. Each intervention received trainings from sub-assistant agriculture officers (SAAOs) from the DAE, who were, in turn, monitored by upazila agriculture officers (UAOs) from the DAE, except treatment arm-2, where trained community women (APKs) provided trainings to select farm households.

Figure 5.1 ANGeL implementation and monitoring structure



Source: Constructed by authors.

Prior to implementation of field-level trainings, various workshops were organized to familiarize government officials from the DAE with the ANGeL Project, and their respective monitoring roles and expectations. On February 8, 2016, IFPRI and APSU jointly organized an orientation workshop to familiarize upazila- (that is, subdistrict) and district-level agricultural extension officials from the DAE on the project's operations in their respective project areas. Additionally, a project monitoring workshop was organized on June 5, 2016 for 13 upazila-level DAE officials to review the monitoring roles and expectations immediately before field-level implementation. IFPRI's Country Representative for Bangladesh presented, "ANGeL Project Monitoring: Concept and Indicators."

Since field-level trainings were initiated in July 2016, the DAE, APSU, and IFPRI have been continuously monitoring field-level implementation. Monitoring materials such as attendance registers, field-level training work plans, and a monitoring checklist were developed to consistently gauge training quality across all districts.

Continuous field-level monitoring and constant communication between project partners strengthened training delivery during the project period. For example, frequent monitoring noted that some SAAOs were being transferred out of their catchment area, which compromised training continuity. In response, a Project Steering Committee meeting on September 6, 2016 chaired by the MOA Secretary enabled the project team to communicate directly with the Director General (DG), DAE to request all DAE Deputy Directors to stop

transferring ANGeL trainers during the project period. Additionally, government officials and IFPRI identified an urgent need to improve the training quality of select trainers, which resulted in refresher trainings, previously mentioned in sub-section 5.2.4.

On October 17, 2016, a Project Implementation Committee meeting was held at APSU, presided over by the DG-APSU. Committee members proposed solutions to address implementation challenges. On December 22, 2016, a meeting to review project progress was held at the DAE, Ministry of Agriculture. During the meeting, it was agreed that ANGeL project materials would be shared to inform other DAE training programs. Another ANGeL monitoring findings workshop was convened at APSU on 24 April 2017 for 16 UAOs. An interministerial field visit was held around the same time (25-27 April 2017) to Golapganj Upazila.

Overall, there were several touchpoints throughout the project period when project partners–government representatives at various levels, IFPRI, HKI, and technical committees–came together to discuss and reconcile key design and implementation issues, which helped maintain smooth implementation of the project.

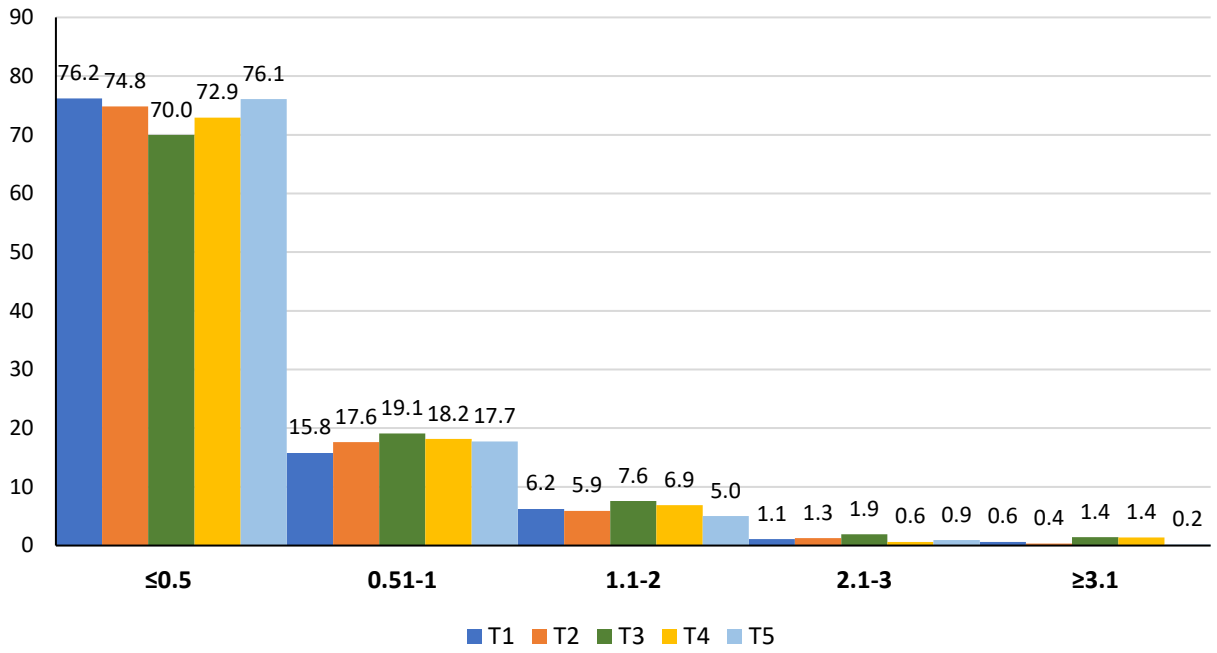
5.4 Program Participation

Using data from the 2018 endline survey, we examine key factors that may have facilitated or acted as barriers to program participation for ANGeL treatment households during the project period.

IFPRI's sampling criteria for the study aimed to smooth out major differences that could affect the comparability of the results. Nonetheless, there was still variation in ground conditions between training sites across the selected 16 upazilas in the country, which could have affected program participation.

Our survey results suggest that distance to training was not a barrier for program participation for most participants. Nearly all males and females (95 percent and 89 percent, respectively) faced no difficulty traveling to the training sessions, with up to 40 percent of ANGeL participants stating that it took less than five minutes to reach the training venue. Figure 5.2 shows that nearly three-fourths (74 percent) of males and females reported that the distance to the training venue was less than or equal to 0.5 kilometers away. This is unsurprising, given that IFPRI sampled 25 farm households at the block-level, which usually consists of 6-9 nearby villages. This sampling method enabled trainings to be conducted close to home for convenience. There were no substantial differences in distance to training venue across treatment arms.

Figure 5.2 Average distance from ANGeL participants' home to training venue (kms)



Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Nearly one-half (47 percent) of training sessions took place inside a closed ventilated space, whereas the majority of sessions (51 percent) were situated in open courtyards. There was a marginal share of remaining households who reported that trainings were organized in a closed damp room or other type of environment.

Most ANGeL participants had a positive experience with their trainers. Nearly all participants (93 percent of males and 98 percent of females) reported that their trainers repeated the contents happily when asked. Furthermore, 97 percent of males and females thought the ANGeL training materials used at the trainings and distributed for household reference (for example, festoons, brochures, and posters) were very helpful for retaining the training knowledge.

Our endline results support our hypothesis: training husbands and wives, together, may provide a mutually reinforcing environment for learning. It was nearly universal that husbands and wives reported discussing lessons learned from ANGeL trainings together (94 percent of men and 97 percent of women, respectively). These findings suggest that providing mixed-gender trainings on traditionally gendered domains—agriculture and nutrition—may have contributed to breaking down gendered silos and opening up lines of communication at the household-level.

Furthermore, our results indicate that many ANGeL participants shared knowledge gained from the program beyond the household. Encouragingly, almost all participating women and men (90 percent and 96 percent, respectively) shared knowledge they gained from trainings to relatives, neighbors, or other community members. These are positive findings, possibly suggesting that program benefits such as improved agriculture and nutrition knowledge may spill over to non-participating households, too. Follow-up research on knowledge spillovers in the community would be necessary to determine this with certainty.

6. PROFILE OF SURVEY HOUSEHOLDS

Using the 2016 baseline household survey data collected for the ANGeL evaluation, this chapter provides the profile of households belonging to the five treatment (participating) groups and the comparison (control, or non-participating) group.

The findings in this chapter portray the scenario of households just before they started participating in the ANGeL project and the control households. Since a randomized controlled trial design was used to assign households to treatment and control groups, similarity in household characteristics are expected across all groups at the start of the program.

6.1 Household Characteristics, Expenditures, and Assets

Table 6.1 shows household characteristics of the ANGeL sample. The average household size is 5.5. The dependency ratio is the ratio (expressed as a percentage) of the number of people in the household ages 0-14 and above 60 to the number of working age household members (15-60 years). The dependency ratio does not vary significantly across treatment arms, ranging between 96.0 to 102.4 percent. The average dependency ratio in the ANGeL sample (98.1 percent) is higher than the 2011/12 BIHS national rural average (94.4 percent), which means that adults of working age in the ANGeL sample have more children to support than the national rural average. This is probably because the ANGeL sample selection criteria required sample households to have at least one child under 24 months (Ahmed et al. 2013).

Although 65 percent of households own cultivable land less than half an acre, farming is by far the most common occupation of the household head across all households (62 percent), followed by business and trade (10 percent).

Males and females older than age 15 have an average of 5.1 years of schooling compared to the 2011/12 BIHS national rural average of 4.3 years for males and 3.9 years for females (Ahmed et al. 2013). Adult males and females with no schooling make up 28.5 and 28.4 percent of the sample, respectively. This suggests comparable educational achievement between adult male and female household heads.

Only about 5 percent of households with primary school-age children do not send their children to school; however, 32 percent of households with secondary school-age children (ages 12-18) do not send their children to school.

Table 6.1 Characteristics of survey households

Item	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
Household size (number)	5.6	5.3	5.3	5.7	5.4	5.5	5.5
Dependency ratio* (percent)	96.1	98.0	96.0	102.4	95.5	99.7	98.1
Primary school-age children (6-11 years) who do not go to school (percent)	4.4	4.2	6.4	4.9	3.4	5.4	4.8
Secondary-school-age children (12-18 years) who do not go to school (percent)	32.1	28.6	37.8	31.0	34.3	28.8	31.9
Years of schooling, male household head	4.6	4.4	4.4	3.9	4.6	4.5	4.4
Years of schooling, wife of household head	4.9	5.1	5.1	4.2	4.9	4.9	4.9
Years of schooling, adult male aged 15 and above	5.4	5.0	5.1	4.7	5.2	5.1	5.1
Years of schooling, adult female aged 15 and above	5.2	5.2	5.4	4.7	5.2	5.1	5.1
No schooling, adult male (percent)	25.5	26.8	29.4	32.1	26.0	30.1	28.5
No schooling, adult female (percent)	27.6	26.0	27.4	32.4	27.6	29.2	28.4
Female-headed household (percent)	3.8	3.4	3.8	4.3	5.3	3.3	4.0
Less than 0.5 acre of cultivable land owned (percent)	59.7	67.8	65.1	69.1	68.2	62.5	65.2
Principal occupation of household head (percent)							
Agricultural day laborer	7.7	10.4	8.2	8.5	10.2	4.7	8.1
Nonagricultural day labor	2.9	4.2	2.2	2.7	6.6	3.0	3.6
Salaried	2.2	3.0	3.7	4.5	2.9	4.2	3.5
Self employed	10.4	6.1	7.5	6.9	8.0	7.7	7.8
Rickshaw/van puller	3.0	1.4	2.1	1.6	2.2	3.0	2.3
Business/trade	11.2	9.1	10.4	9.1	12.0	9.8	10.3
Production business	0.6	0.8	0.2	0.2	0.3	0.0	0.3
Livestock-related work	0.2	0.0	0.5	0.0	0.0	0.1	0.1
Farming	60.0	63.0	63.8	64.0	55.8	66.1	62.4
Non-earning occupations	1.8	1.8	1.4	2.6	1.9	1.5	1.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: 2016 ANGeL Baseline Survey, IFPRI.

*Dependency ratio=number of dependents (under age 15 or over 60 years of age) divided by number of working age people (15 – 60 years).

[1]Treatment arms:

T1: Nutrition BCC training delivered to women and men by agricultural extension agents from the DAE

T2: Nutrition BCC training delivered to women and men by local community women hired by the project

T3: Agricultural production training delivered to men and women

T4: Agricultural production training delivered to men and women + BCC training

T5: Agricultural production training delivered to men and women + BCC training + gender sensitization to women and men

This study uses consumption expenditures as the principal indicator of household welfare, and uses per capita expenditure as a proxy for income for two reasons. First, expenditures are likely

to reflect permanent income and, hence, are a good indicator of consumption behavior (Friedman 1957). Second, data on expenditures are generally more reliable and stable than income data. Since expenditures are intended to serve as a proxy for income, the terms "expenditure" and "income" are used interchangeably.

The measure of total consumption expenditure is quite extensive and draws upon responses to several sections of the household survey. In brief, consumption is measured as the sum of total food consumption and total nonfood (nondurable and durable) expenses. Expenditures on individual consumption items were aggregated to construct total expenditures. Quantities of goods produced by the household for home consumption were valued at the average unit market prices of commodities.

Table 6.2 provides estimates of the per capita monthly consumption expenditure of sample households at baseline in 2016, as well as their budget share of expenditure on different items. We have not included the use value of the tangible assets due to data constraints. Monthly per capita expenditure is around Taka 3,000, most of which is spent on food (59.4 percent), followed by fuel and house rent (6.3 and 5.7 percent, respectively).[4]

[4] The official exchange rate for the Taka (Tk), the currency of Bangladesh, was Tk 79.25 per US$1.00 on March 29, 2017.

Table 6.2 Per capita monthly consumption expenditure

Item	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
Monthly per capita total expenditure (taka)	2,910	2,793	3,053	3,037	3,016	2,987	2,967
Monthly per capita food expenditure (taka)	1,802	1,684	1,825	1,885	1,828	1,752	1,793
Monthly per capita nonfood expenditure (taka)	1,108	1,110	1,228	1,152	1,188	1,235	1,174
Budget share of expenditures (percent)							
Food	61.0	59.0	59.0	61.1	59.6	58.0	59.4
Fuel and lighting	6.3	5.8	6.1	6.4	6.9	6.5	6.3
Personal care	1.6	1.7	1.8	1.8	1.6	1.7	1.7
Cleaning material	1.4	1.5	1.5	1.6	1.5	1.5	1.5
Transport and communication	5.4	5.0	6.0	5.1	5.1	6.2	5.5
Adult clothing	3.3	3.3	3.3	3.3	3.2	3.5	3.3
Children clothing	1.0	1.1	1.0	1.1	1.1	1.1	1.1
Other clothing	0.9	0.9	0.8	0.9	0.9	0.9	0.9
Footwear	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Beddings	0.5	0.5	0.5	0.4	0.4	0.5	0.5
Other household expense	0.1	0.1	0.2	0.1	0.1	0.2	0.1
Medical treatment for male	2.0	2.5	2.4	2.3	2.0	2.3	2.2
Medical treatment for female	3.5	4.4	3.7	3.1	3.8	3.9	3.7
Education for male	0.7	0.7	0.6	0.7	0.8	0.8	0.7
Education for female	0.7	0.7	0.8	0.7	0.7	0.7	0.7
Remittances sent	0.4	0.4	0.3	0.4	0.3	0.1	0.3
Gifts given	0.4	0.4	0.4	0.3	0.3	0.5	0.4
Kurbani/milad	2.0	2.0	2.3	1.8	1.9	2.3	2.1
Entertainment	0.7	0.9	0.7	0.6	0.6	0.7	0.7
Legal fees	0.5	0.5	0.7	0.4	0.7	0.4	0.5
Utensils	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Furniture repair	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Personal items (bag, watch)	0.4	0.4	0.5	0.4	0.4	0.3	0.4
Lighting (bulb, etc.)	0.1	0.2	0.1	0.1	0.1	0.1	0.1
House rent	5.2	5.8	5.6	5.5	5.7	6.4	5.7
Total	100	100	100	100	100	100	100

Source: 2016 ANGeL Baseline Survey, IFPRI.

[1]See footnote of Table 6.1 for description of treatment arms.

Table 6.3 shows household asset ownership. Among the selected assets in the analysis, ownership of mobile phones was the most prevalent at baseline (94 percent). This finding also indicates that delivering agricultural extension messages to farmers via mobile phones holds great promise. Overall, new information and knowledge are critical inputs for improved agricultural practices and marketing of agricultural products.

Electric fan is the second dominant household asset among the sample (68.7 percent), with ownership lower in T2 where solar panel ownership is higher compared to other treatment arms. About 34 percent of all households have color televisions.

Table 6.3 Household asset ownership

	Treatment arms[1]						
Asset	**T1**	**T2**	**T3**	**T4**	**T5**	**Control**	**All**
				(percent)			
Electric fan	69.4	56.4	70.7	71.8	70.7	72.0	68.7
Radio	1.3	0.8	0.8	1.1	0.5	0.9	0.9
Audio cassette/CD player	1.2	1.3	2.3	3.4	1.5	2.8	2.1
Television (B/W)	3.6	5.2	5.1	3.8	4.0	3.4	4.1
Television (color)	36.9	25.1	35.1	34.0	32.5	36.7	33.6
Sewing machine	8.2	7.9	9.2	7.0	7.4	8.2	8.0
Bicycle	35.1	33.6	42.8	33.7	31.1	44.8	37.4
Rickshaw	1.2	0.5	0.8	0.8	1.3	1.2	1.0
Boat	4.1	5.2	1.1	1.1	2.5	1.2	2.5
Engine boat	1.2	0.5	0.5	0.0	0.2	0.2	0.4
Motorcycle	6.6	6.1	9.3	5.7	4.1	7.3	6.6
Mobile phone set	95.9	93.0	93.8	93.8	95.9	92.3	94.0
Fishing net	42.3	39.5	42.5	33.6	28.8	39.8	37.9
Solar energy panel	8.7	18.7	7.9	8.3	8.4	9.1	10.1

Source: 2016 ANGeL Baseline Survey, IFPRI.
[1]See footnote of Table 6.1 for description of treatment arms.

Table 6.4 provides information on electricity and dwelling types of surveyed households. In addition to being an indicator of wealth, an electricity connection has important beneficial impacts on education, communication, and general lifestyle; thus, it is encouraging that 72 percent of sampled households have electricity. This is consistent across all treatment arms except T2, where 18.7 percent of households have solar energy panels (Table 6.3).

According to Table 6.4, about 75 percent of households have permanent wall structures, which consist of tin, brick, and cement. Nonpermanent materials include bamboo, mud, jute sticks, plastic sheets, and thatch. Out of all households, most roofs use tin (47.6 percent), followed by concrete/brick (24.5 percent).

Table 6.4 Electricity and structure of dwelling

Characteristics	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
	(percent)						
Household has electricity	70.4	59.5	73.6	72.2	79.2	75.5	72.0
Structure of walls[a]							
Permanent	84.0	69.8	73.8	68.8	74.1	77.1	74.8
Nonpermanent	16.0	30.2	26.2	31.2	25.9	22.9	25.3
Roofing material							
Concrete/brick	26.1	21.8	26.1	21.9	22.7	27.1	24.5
Tin	53.6	44.3	45.9	46.4	47.2	47.9	47.6
Thatching	10.4	6.4	8.0	13.3	20.2	11.8	11.7
Other	9.9	27.5	20.0	18.4	9.9	13.3	16.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: 2016 ANGeL Baseline Survey, IFPRI.

[a] Permanent materials include field bricks, concrete, wood, and tin sheets.

[1]See footnote of Table 6.1 for description of treatment arms.

6.2 Agriculture

6.2.1 Land Tenancy

Table 6.5 presents the land tenure arrangement of the sample households. About 37 percent of the ANGeL sample farm households are pure tenants – that is, they do not own any cultivable land. About 31 percent of sample farmers cultivate only their own land. The proportion of mixed-tenant farmers—those who cultivate their own land and also take land in as sharecroppers and/or leaseholders—is 32 percent.

The dominant land-tenure arrangement among the sample households is sharecropping, where the crop produced is shared between the cultivator and the landowner in different proportions that have been agreed upon prior to cultivation. About 50 percent of the farmers are sharecroppers. This group of sharecroppers includes those who do not own any cultivable land (that is, “pure tenant”), as well as those who own land and sharecrop other people’s land. About 14 percent of the farmers have cash-lease arrangements either as pure tenants or as those with their own land plus cash-leased land. The proportion of farmers operating both sharecropped and cash-leased land (either as tenants or landowners) is about 5 percent.

Table 6.5 Land tenure arrangement

Item	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
	(percent)						
Pure tenant	30.7	39.5	37.1	39.2	39.0	35.3	36.7
Sharecropping	81.3	65.2	87.1	70.9	61.1	75.4	73.2
Cash lease	12.5	27.1	6.9	20.1	31.2	14.9	18.9
Both	6.3	7.7	6.0	9.0	7.8	9.7	7.9
Own land only	35.8	27.2	30.4	31.6	28.8	31.9	31.0
Mixed tenant (own land + land taken in)	33.4	33.3	32.5	29.2	32.2	32.8	32.3
Sharecropping	69.4	60.6	72.9	72.5	60.7	80.8	70.2
Cash lease	21.5	29.8	18.7	16.5	31.3	15.3	21.9
Both	9.1	9.6	8.4	11.0	8.0	3.8	8.0

Source: 2016 ANGeL Baseline Survey, IFPRI.
[1]See footnote of Table 6.1 for description of treatment arms.

6.2.2 Farm Size Groups

Table 6.6 shows the distribution of farm households according to their operated farm size, divided into marginal (operating less than 0.5 acres of land); (2) small (operating 0.5 to 1.49 acres of land); (3) medium (operating 1.5 to 2.49 acres of land); and (4) large (operating 2.5 acres or more land). The four farm size groups match the cut-off points of the six operated farm size groups presented in the 2010 Household Income and Expenditure Survey (HIES) report of the Bangladesh Bureau of Statistics (BBS 2011) by aggregating the smallest two HIES farm size groups under the marginal farm category and the largest two groups under the large farm category (Ahmed et al. 2013).

Almost half of the farm households belong to the small farmer group, followed by marginal farmers at 30 percent. Only 12 and 8 percent households are medium and large famers, respectively.

Table 6.6 Farm size groups

Farm size group	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
	(percent)						
Marginal farmer (<0.5 acres)	31.5	32.0	27.5	31.0	32.5	28.9	30.5
Small farmer (0.5-1.49 acres)	44.2	48.0	51.7	49.9	51.2	51.0	49.4
Medium farmer (1.5-2.49 acres)	14.2	11.5	11.7	11.4	11.4	12.6	12.2
Large farmer (≥2.5 acres)	10.1	8.5	9.1	7.7	5.0	7.5	8.0

Source: 2016 ANGeL Baseline Survey, IFPRI.
[1]See footnote of Table 6.1 for description of treatment arms.

6.2.3 Patterns of Crops Grown

Table 6.7 shows the share of individual crops on total cropped land by treatment arms and control group. Overall, rice dominates the share of cropped land (82 percent), followed by vegetables (5 percent). The share of rice in the ANGeL sample is higher than the 2011/12 BIHS national rural average of 77 percent (Ahmed et al. 2013), indicating a lower level of crop diversity in the ANGeL sample compared to the national average incidence.

Table 6.7 Percent of total cropped area under these crops

	Treatment arms[1]						
Crop	**T1**	**T2**	**T3**	**T4**	**T5**	**Control**	**All**
				(percent)			
Aus local	7.0	3.4	0.3	1.7	4.9	1.8	3.1
Aus (HYV+Hybrid)	3.0	5.6	2.5	6.4	7.4	4.0	4.8
B. Aman local	1.4	1.2	0.3	0.4	2.7	1.4	1.2
T. Aman local	6.0	6.2	4.2	2.1	4.5	2.4	4.1
T. Aman (HYV+Hybrid)	28.4	31.7	36.3	38.1	28.1	37.3	33.6
Boro (HYV)	30.8	29.5	38.1	26.8	27.1	34.7	31.4
Boro (Hybrid)	7.6	3.6	3.6	4.2	3.1	2.4	4.0
Wheat	0.3	0.6	0.4	0.5	0.6	0.4	0.4
Maize	0.8	3.5	1.3	1.3	2.3	0.9	1.6
Jute	2.6	1.8	1.5	2.3	2.5	2.2	2.2
Pulses[a]	1.6	0.5	1.0	2.9	2.1	2.9	1.9
Oilseeds[b]	1.4	1.5	0.9	1.5	1.5	1.3	1.3
Spices[c]	0.2	0.5	0.5	0.6	0.6	0.5	0.5
Non-leafy vegetables[d]	2.8	3.4	3.0	8.4	9.0	3.8	5.0
Leafy vegetables[e]	0.2	0.3	0.3	0.4	0.4	0.3	0.3
Bananas	1.4	2.0	1.1	0.1	1.9	0.6	1.1
Potatoes	1.1	1.6	1.0	0.8	0.2	1.3	1.0
Sweet potato	0.1	0.0	0.1	0.0	0.0	0.2	0.1
Sugarcane	0.1	0.1	0.0	0.2	0.3	0.2	0.2
Tobacco	1.6	1.7	1.1	0.5	0.3	0.2	0.9
Betel leaf	1.3	0.6	2.2	0.5	0.2	0.7	0.9
Other crops	0.3	0.8	0.2	0.4	0.5	0.7	0.5

Source: 2016 ANGeL Baseline Survey, IFPRI.

[a]Pulses include lentil, mung, blackgram, chickpea, fieldpea, and other pulses.

[b]Oilseeds include soybean, sesame, mustard, groundnut, and other oilseeds.

[c]Spices include chili, garlic. turmeric, and coriander.

[d]Non-leafy vegetables include onions, eggplant, *potol*, okra, bitter gourd, arum, cucumber, cowpea, *danta*, green banana, cauliflower, water gourd, sweet gourd, tomato, radish, turnip, *kakrol*, bean, cabbage.

[e]Leafy vegetables include Indian spinach, spinach, *lalshak*.

[1]See footnote of Table 6.1 for description of treatment arms.

6.2.4 Irrigation

Table 6.8 summarizes the source of irrigation for HYV and hybrid boro rice cultivation. Nearly 79 percent of farmers who produce boro rice use groundwater irrigation compared to only 19 percent who use surface water.

Table 6.8 Source of irrigation for HYV/hybrid boro rice cultivation

Source of irrigation	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
	(percent of farmers)						
Rainfed	0.2	4.5	0.6	2.3	3.1	0.4	1.7
Surface water	29.2	12.3	13.2	22.8	19.8	17.4	18.8
Groundwater	70.4	83.6	85.7	75.4	77.3	80.9	79.3
Groundwater and surface water	0.4	0.5	0.8	0.0	0.5	1.2	0.6

Source: 2016 ANGeL Baseline Survey, IFPRI.
[1]See footnote of Table 6.1 for description of treatment arms.

6.2.5 Farmers' Access to Agricultural Extension Services

Table 6.9 shows agricultural extension services, disaggregated by farm size groups and areas of agricultural extension support. Medium and large farmers consulted agriculture extension service the most during the 12 months preceding the survey (30 and 37 percent, respectively), whereas marginal farmers had significantly less contact with agricultural extension services during the same timeframe (only 13 percent). Farmers mostly consulted agriculture extension for information on pesticides, insect and disease, and fertilizer (95 percent, 92 percent, and 90 percent, respectively).

Table 6.9 Agricultural extension services by farm size groups

Item	Farm size groups				All
	Marginal	Small	Medium	Large	
			(percent)		
Farmers who consulted an agricultural extension agent during 12 months preceding survey	12.5	21.0	30.0	36.5	20.7
Areas of support by agricultural extension:					
Fertilizer-related	88.7	91.4	87.7	86.3	89.6
Seed-related	89.5	89.1	85.2	87.4	88.3
Irrigation-related	73.4	76.0	67.2	75.8	74.0
Pesticide-related	92.7	96.9	93.4	93.7	95.1
Insects- and disease-related	87.9	92.6	92.6	94.7	92.0
Sowing-related	73.4	75.4	79.5	73.7	75.5
Soil type-related	46.0	53.1	46.7	44.2	49.5

Source: 2016 ANGeL Baseline Survey, IFPRI.

6.3 Food Consumption

6.3.1 Quantity of Food Consumed

Table 6.10 presents the quantity of food consumed by the treatment and control groups. The results indicate that rice is consumed the most across all groups. The average per capita rice consumption is 24 percent lower than the national rural average of 495.5 grams/person/day, as found in 2011/12 BIHS data (Ahmed et al. 2013), which may be explained by the fact that most of the ANGeL sample households are fairly young and small, with at least one child under age two, as per the selection criteria.

Other commodities consumed in relatively large amounts included potatoes, green leafy vegetables, eggplant, and a number of vegetables (labeled as "other vegetables" in the table), although consumption of different types of fruits are not as high. Sources of protein in the diet for the households in the sample are mainly different types of big fish with chicken, beef, and eggs consumed in relatively small quantities compared to big fish.

6.3.2 Calorie Share of Food Items and Cost of Calories

Tables 6.11 summarizes the per capita daily calorie intake by different food groups in the study sample, disaggregated by treatment and control arms. The table shows that daily per capita intake of food energy in the study sample varies from 1,933 kilocalories (kcal)/person/day in T5 to 1,988 kcal/person/day in T4, and is slightly lower than the 2011/12 BIHS national rural average of 2,243 kcal/person/day (Ahmed et al. 2013). This is again reflective of the fact that most of the households in our sample are fairly young and small households with at least one child under the age of two.

For treatment and control arms, rice accounts for the largest share of total calories consumed, ranging from 66.5 percent in T5 to 69.6 percent in T2, indicating very little diversity in diet. Oils and vegetables other than leafy vegetables contribute to the next highest shares of calories, 9 percent and 7 percent, respectively, which are still very low compared to the share from rice.

Table 6.10 Quantity of food consumed

Food item	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
	(grams/person/day)						
Rice	376.7	391.8	371.2	368.3	364.1	378.7	375.3
Atta	14.8	14.2	14.9	23.7	25.6	20.8	19.1
Other cereal	6.5	8.9	12.1	9.0	9.2	8.3	8.9
Lentil	5.6	4.3	5.3	5.2	5.2	5.8	5.3
Chickpeas	0.4	0.6	0.8	0.7	0.3	0.6	0.6
Khesari	0.3	0.4	0.3	0.4	0.3	0.7	0.4
Other pulses	3.6	2.9	3.8	5.8	3.7	4.4	4.1
Soybean oil	15.4	15.0	14.8	18.1	17.3	15.9	16.1
Mustard oil	3.7	3.3	2.8	2.0	1.8	3.0	2.8
Ghee	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Other oils	0.4	0.2	0.8	0.9	0.1	0.4	0.5
Potatoes	55.0	57.5	71.0	58.5	62.2	63.3	61.4
Green leafy vegetables	40.4	38.5	34.6	37.3	32.8	39.7	37.4
Eggplants	35.8	35.8	31.3	40.3	27.7	38.2	35.0
Sweet gourd	2.4	2.4	0.5	0.4	1.0	0.4	1.1
Carrot	0.3	0.1	0.2	0.7	0.3	0.6	0.4
Other vegetables	155.7	144.6	145.9	174.7	167.8	148.1	155.6
Chicken	13.3	13.8	14.3	16.4	19.1	12.8	14.8
Beef	5.1	4.6	6.5	2.2	2.8	6.7	4.8
Goat meat	0.3	0.2	0.2	0.5	0.8	1.2	0.6
Other meats	3.2	0.5	0.7	2.0	1.2	2.0	1.6
Eggs	8.7	6.9	7.1	9.2	7.6	8.2	8.0
Milk	24.9	19.9	24.7	19.7	22.0	22.7	22.3
Milk products	1.6	3.8	4.6	3.1	2.8	2.7	3.1
Small fish	17.8	16.6	14.3	18.6	19.0	17.1	17.2
Big fish	50.4	41.5	53.1	49.2	44.2	48.8	47.9
Banana	3.0	2.6	2.5	2.6	1.8	2.7	2.5
Orange	1.9	2.2	1.9	3.2	1.2	1.8	2.0
Apple	1.9	2.3	2.5	1.7	1.5	1.8	2.0
Other fruits	3.7	5.0	3.9	3.5	3.0	4.4	4.0
Sugar	4.8	4.5	5.1	6.1	5.8	5.6	5.3
Gur	1.6	3.5	3.7	1.3	1.1	1.3	2.0
Salt	10.1	9.8	9.5	9.8	9.1	10.2	9.8
Spices	5.4	5.5	5.2	6.1	5.9	6.6	5.8
Prepared foods	13.5	12.0	15.5	17.0	17.3	14.8	15.0

Source: 2016 ANGeL Baseline Survey.

[1]See footnote of Table 6.1 for description of treatment arms.

Table 6.11 Calorie intake and share of food items consumed

Food item	Treatment arms[1]					Control	All
	T1	T2	T3	T4	T5		
Daily per capita calorie intake (kcal/person/day)[2]	1,933	1,963	1,943	1,988	1,933	1,986	1,960
Calorie share of food items				(percent)			
Rice	68.5	69.6	66.7	64.9	66.5	66.8	67.1
Atta	2.4	2.4	2.6	4.0	4.1	3.5	3.2
Other cereal	1.1	1.5	1.9	1.5	1.5	1.4	1.5
Pulses	1.7	1.4	1.7	1.8	1.6	1.9	1.7
Oils	8.8	8.2	8.4	9.2	8.5	8.6	8.6
Leafy vegetables	0.6	0.6	0.5	0.5	0.5	0.5	0.5
Other vegetables	6.9	6.6	7.5	7.4	7.3	7.0	7.1
Meats	1.0	0.8	0.9	0.9	0.9	1.0	0.9
Eggs	0.7	0.5	0.6	0.7	0.6	0.6	0.6
Milk and milk products	1.0	0.8	1.1	1.0	1.1	1.0	1.0
Small fish	2.0	1.7	2.2	2.0	1.8	2.0	2.0
Big fish	0.9	0.9	0.7	1.0	0.9	0.9	0.9
Fruits	0.5	0.5	0.4	0.3	0.3	0.4	0.4
Spices	0.7	0.7	0.7	0.8	0.7	0.8	0.7
Sugar and gur	1.0	1.2	1.2	1.2	1.2	1.1	1.1
Beverages	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Other prepared foods	2.3	2.4	2.8	2.7	2.5	2.6	2.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: 2016 ANGeL Baseline Survey.

[1]See footnote of Table 6.1 for description of treatment arms.

[2]Based on 24-hour individual food intake data.

7. AGRICULTURAL PRODUCTION KNOWLEDGE AND IMPACTS

7.1 Impacts on Agricultural Production Knowledge and Practice

7.1.1 Introduction

In our baseline report, we noted that farmers in our sample had limited contact with agricultural extension services. Across all households, approximately 20 percent of farmers had consulted with an agricultural agent during the 12-month period prior to the baseline survey. But this figure masks considerable heterogeneity within the sample. Approximately 36 percent of farmers with the largest land holdings had such a consultation in the previous 12 months compared to only 12 percent for farmers with the smallest holdings. Most of these consultations revolved around the use of pesticides, pest infestations, and the use of fertilizers (Ahmed et al. 2017, Table 6.9). Given this, an important component of the ANGeL study was to see whether the knowledge base of farmers could be improved through agricultural training that focused on techniques to increase the production of non-staple crops, with particular focus on homestead gardens. Improving this knowledge base is an important pre-requisite for meeting ANGeL's core objectives of enhancing production and consumption diversity.

7.1.2 Impacts on Agricultural Production Knowledge

In this chapter, we focus on overall improvements in agriculture production knowledge, not on improved understanding of select, or isolated, agriculture production practices. This is important because there are complementarities in terms of what farmers learn. In other words, if farmers have a working proficiency in a specific area, productivity—one of our primary outcomes of this study—may still be thwarted by lack of knowledge in another related area. For example, farmers' knowledge of quality of agricultural inputs like fertilizer may help increase production, but this knowledge is insufficient if farmers do not know how to control insect infestations. Therefore, we are interested in measuring to what extent ANGeL has resulted in a comprehensive, holistic understanding of agriculture production, which has the greatest potential to effectively improve productivity.

To assess whether ANGeL improved farmer knowledge of the production of non-staple crops in homestead gardens over the course of the project, we tested survey participants at endline. A series of questions was asked about the preparation of pits and beds for vegetable production, identifying quality seeds and fertilizers, seed storage, and organic methods of controlling pests (See Appendix A for more information). These were asked to participants in all treatment arms and to the control group. This test was administered separately to male and female

respondents. We define successful acquisition of knowledge where farmers score 75 percent or higher on this test.

Table 7.1 and Table 7.2 give the results of estimating the base and extended single-difference regression models for male respondents. The first result to notice is the value for the control group, 0.09. This tells us that in the control group, only 9 percent of male respondents scored 75 percent or higher on this test.

Next, Table 7.2 (the extended specification) shows that men in T1 and T2 were 8-9 percentage points more likely to score 75 percent or higher, even though there was no formal agricultural training in those treatment arms. Finally, of particular interest are the three treatment arms where training on these topics were provided, T3, T4, and T5. Relative to the control group, men in these three treatment arms were 38-40 percent more likely to do well on this test. Across all these treatment arms, these impacts are statistically significant. This indicates that where training was provided, men learned improved techniques for growing non-staple crops on homestead garden plots.

Table 7.1 Impacts on farmer knowledge of agricultural practices - base specification: Males

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Scored 75 percent or higher on test of agricultural practices	0.09	**0.10****	**0.05***	**0.41*****	**0.38*****	**0.32*****	3,613
		(0.04)	(0.03)	(0.05)	(0.05)	(0.04)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 7.2 Impacts on farmer knowledge of agricultural practices - extended specification: Males

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Scored 75 percent or higher on test of agricultural practices	0.09	**0.09*** **	**0.08*** **	**0.40*** **	**0.38*** **	**0.36*** **	3,613
		(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Next, we consider whether women learned new agricultural practices. Results from regression models are shown in Tables 7.3 and 7.4 (base and extended specifications, respectively). Note that in control households, virtually no women (only 5 percent) can answer 75 percent or more of these questions correctly. Treatment arms T1 and T2 have small effects on women's knowledge, and in the case of T2 these are not statistically significant, but this is not surprising since these treatment arms focused only on information regarding the consumption of a more diverse diet. By contrast, there are large effects in treatment arms T3, T4, and T5–increasing the likelihood that women did well on this test by 59–70 percentage points relative to the control group. These impacts are larger than the impacts observed in men. Also noteworthy is that this improved knowledge is slightly higher for the two treatment arms that combined agriculture and nutrition training (T4 and T5) compared to the treatment arm (T3) that only focused on agriculture; these differences are also statistically significant. We do not know the mechanism which underlies this. One possibility is that women who were exposed to the importance of diversifying diets via the nutrition BCC were somewhat more motivated to learn about techniques for growing a more diverse set of crops.

Table 7.3 Impacts on farmer knowledge of agricultural practices - base specification: Females

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Scored 75 percent or higher on test of ag knowledge, female	0.05	**0.05***	**-0.00**	**0.60*****	**0.71*****	**0.67*****	3,887
		(0.03)	(0.02)	(0.04)	(0.04)	(0.05)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 7.4 Impacts on farmer knowledge of agricultural practices - extended specification: Females

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Scored 75 percent or higher on test of ag knowledge, female	0.05	**0.07*****	**0.03**	**0.59*****	**0.70*****	**0.65*****	3,887
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

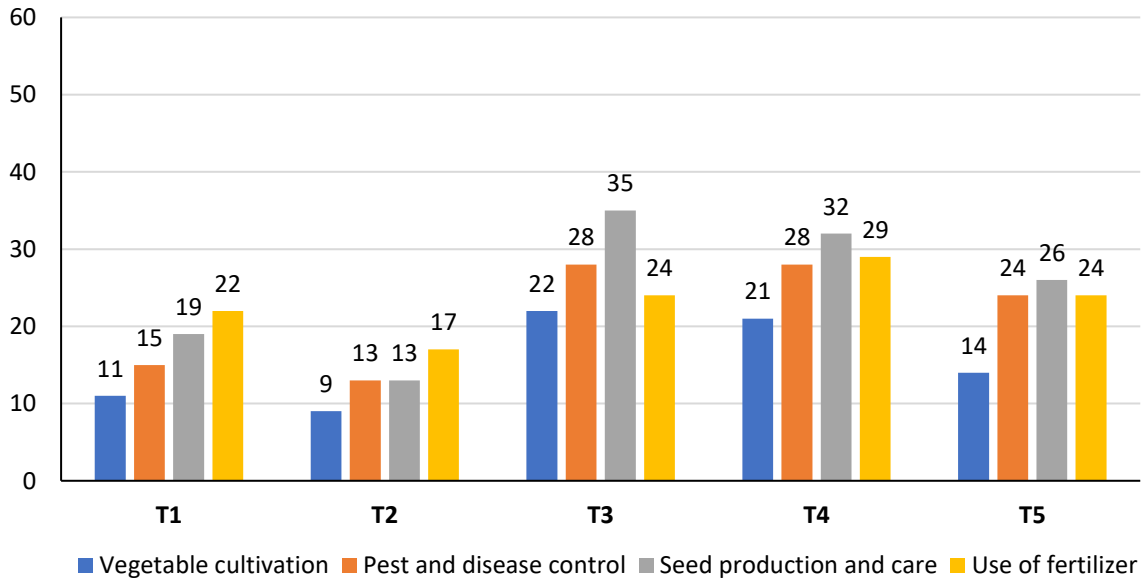
7.1.3 Impacts on Agricultural Production Practices

While improved knowledge is an important first step in efforts to improve production diversity, it has limited benefits if farmers are unwilling or unable to apply this knowledge. At endline, therefore, we asked farmers–separately men and women–about new agricultural production practices that they had adopted. This included questions on the use of: beds and heaps/pits for vegetable production; improved methods for pest and disease control; improvements in the production, care, and transplanting of seeds; and fertilizer use.

We begin with some descriptive statistics shown in Figure 7.1 and Figure 7.2. Figure 7.1 shows, not surprisingly, that in treatment arms that focused solely on nutrition BCC (T1 and T2), only a small percentage of men adopted improved vegetable production. However, a higher percentage of men in T3 and T4, between 14 and 22 percent, reported adopting these practices. Larger effects are seen for improved seed production and care and pest and disease control. Improved fertilizer practices are seen in T3, T4, and T5 (24-29 percent), but this is also seen in T1, which was also delivered by SAAOs.

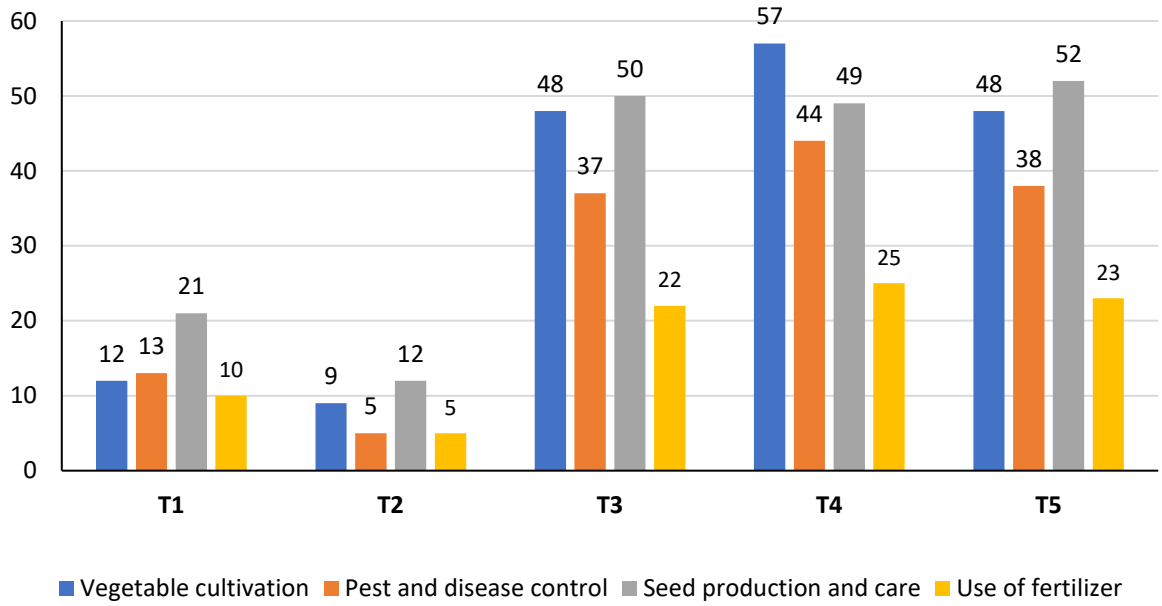
Figure 7.2 shows comparable figures for women. As with men, we see limited adoption of vegetable production practices in T1 and T2. But there are large effects on the adoption of vegetable production using either the bed or the heap and pit method with between 48 and 57 percent of women in T3, T4, and T5 doing so. In these three treatment groups, women were 37-44 percent more likely to apply pest and disease control as described in their training and 49-52 percent were more likely to follow the improved seed production and care practices.

Figure 7.1 Adoption of improved agricultural production practices, male respondents, by treatment arm



Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Figure 7.2 Adoption of improved agricultural production practices, female respondents, by treatment arm



Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Table 7.5 (base) and Table 7.6 (extended specification) give the results of our impact estimates from regression models on the take up of these improved practices by men. Relative to the control group, all treatment arms have a statistically significant effect on the likelihood that these are adopted with the effects larger for T3, T4 and T5.

Table 7.5 Impacts on improved non-staple crop production practices, male - base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Improved vegetable production	0.04	**0.07*** **	**0.04** **	**0.18*** **	**0.17*** **	**0.10*** **	3,613
		(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	
Seed production and care	0.06	**0.14*** **	**0.08*** **	**0.29*** **	**0.26*** **	**0.20*** **	3,613
		(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	
Pest and disease control	0.07	**0.08*** **	**0.07** **	**0.21*** **	**0.21*** **	**0.17*** **	3,613
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	
Use of fertilizer	0.06	**0.16*** **	**0.11*** **	**0.28*** **	**0.23*** **	**0.18*** **	3,613
		(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 7.6 Impacts on improved non-staple crop production practices, male - extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Improved vegetable production	0.04	**0.05****	**0.05*****	**0.18*****	**0.17*****	**0.14*****	3,613
		(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	
Seed production and care	0.06	**0.13*****	**0.09*****	**0.30*****	**0.25*****	**0.24*****	3,613
		(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	
Pest and disease control	0.07	**0.05****	**0.06*****	**0.22*****	**0.19*****	**0.17*****	3,613
		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	
Use of fertilizer	0.06	**0.14*****	**0.11*****	**0.27*****	**0.21*****	**0.22*****	3,613
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 7.7 (base) and Table 7.8 (extended specification) give the results of our impact estimates from regression models on the take up of these improved practices by women. The most striking result is the increased likelihood that women in T3, T4, and T5 adopted improved vegetable production practices, such as using the bed or heap and pit method. The magnitude of these effects is large. Relative to the control group, the increased take up of these practices ranged from 44 to 53 percent across these three groups. Women in one of the treatment groups that combined agriculture and nutrition training (T4) were more likely to use these practices compared to the treatment arm (T3) that only focused on agriculture; this difference is statistically significant.

Table 7.7 Impacts on improved non-staple crop production practices, female - base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Improved vegetable production	0.03	**0.09*** **	**0.06*** **	**0.45*** **	**0.55*** **	**0.45*** **	3,887
		(0.03)	(0.02)	(0.03)	(0.03)	(0.04)	
Seed production and care	0.11	**0.10** **	**0.01**	**0.39*** **	**0.38*** **	**0.40*** **	3,887
		(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	
Pest and disease control	0.06	**0.07*** **	**-0.01**	**0.32*** **	**0.38*** **	**0.32*** **	3,887
		(0.03)	(0.02)	(0.03)	(0.03)	(0.04)	
Use of fertilizer	0.08	**0.01**	**-0.03**	**0.14*** **	**0.17*** **	**0.15*** **	3,887
		(0.04)	(0.02)	(0.03)	(0.03)	(0.04)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 7.8 Impacts on improved non-staple crop production practices, female – extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Improved vegetable production	0.03	**0.09*** **	**0.03**	**0.45*** **	**0.53*** **	**0.44*** **	3,887
		(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	
Seed production and care	0.11	**0.08*** **	**0.03**	**0.39*** **	**0.36*** **	**0.38*** **	3,887
		(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	
Pest and disease control	0.06	**0.08*** **	**0.01**	**0.32*** **	**0.39*** **	**0.33*** **	3,887
		(0.02)	(0.02)	(0.02)	(0.03)	(0.04)	
Use of fertilizer	0.08	**0.01**	**-0.01**	**0.13*** **	**0.17*** **	**0.15*** **	3,887
		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Again, as we saw the results on agricultural knowledge, we do not know the mechanism which underlies this. One possibility is that women who were exposed to the importance of diversifying diets via the nutrition BCC were somewhat more motivated to learn about techniques for growing a more diverse set of crops. Women in groups T3, T4, and T5 were more likely to adopt improved seed and pest control practices by 30 to 40 percentage points and these impacts were both statistically significant and larger than observed for men.

7.2 Impacts on Production Diversity

In this section, we assess the impact of ANGeL on production diversity, one of the primary outcomes of this study. We begin by measuring production diversity using the Simpson Diversity Index. We then consider other measures of production diversity before discussing next steps.

7.2.1 Impacts on Production Diversity: Simpson Diversity Index

When assessing the impact of ANGeL on the diversity of crop production, we want to take into account both the number of different crops that the household grows and the intensity, or acreage, devoted to different crops. One measure that allows us to do so is the Simpson Diversity Index (SDI). It captures both the number of different crops a household grows and the amount of land devoted to each crop. It ranges in value from 0 to 1. A value of zero means that the household devotes all its land to one crop. Higher values (values closer to 1) imply greater crop diversity. Note that our SDI estimates represent only crops produced in the field plots, because information on area for homestead crop production is not available in the surveys.

Table 7.9 and Table 7.10 show our ANCOVA impact estimates based on the SDI. No treatment arm has a statistically significant effect on this measure of diversity and the point estimates are very small in all cases.

Table 7.9 ANCOVA impacts on SDI indicators - base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Simpson Diversification Index	0.17	**-0.02**	**0.01**	**-0.01**	**0.01**	**0.02**	3,488
		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 7.10 ANCOVA impacts on SDI indicators - extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Simpson Diversification Index	0.17	**0.01**	**0.01**	**0.00**	**-0.00**	**-0.01**	3,488
		(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

7.2.2 Impacts on Production Diversity: Count Measures

While we see no impact on production diversity based on the SDI measure for crops produced on field plots, this does not mean that ANGeL had no effect on the diversity of crop production. We know that much of the ANGeL agricultural training focused on homestead crop production. However, since information on area under homestead crop production is not available in the surveys, the SDI measure cannot be used for home gardens. Given this data limitation, we consider an alternate measure of production diversity, the number of non-staple crops grown by the household. We consider this in terms of crops grown in the field plots, in homestead plots and in both.[5]

Results are shown in Table 7.11 (base) and 7.12 (extended specification), with the extended specification result also shown visually in Figure 7.3. These show that there is no impact on the number of non-rice crops grown in fields. But T3, T4, and T5 increase the diversity (as measured by number of crops) of production in homestead gardens. This is an 11.9 – 18.6 percent increase relative to the endline mean for the control group (mean = 1.36). Homestead garden plots are small relative to fields; this is why we see this "count" measure increase but not the SDI, which incorporates both the number of crops and the land allocated to them.

[5] We exclude permanent trees from these estimates.

Table 7.11 ANCOVA impacts on number of non-rice crops indicators - base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Number, non-rice field crops	0.78	**-0.07**	**0.09**	**-0.07**	**0.09**	**0.21**	3,488
		(0.11)	(0.12)	(0.10)	(0.13)	(0.16)	
Number, homestead crops	1.36	**0.08**	**0.34**	**0.50*** **	**0.47** **	**0.38***	3,488
		(0.18)	(0.22)	(0.18)	(0.24)	(0.20)	
Number, non-rice field and homestead crops	2.36	**0.11**	**0.35**	**0.56*** **	**0.45***	**0.35**	3,488
		(0.19)	(0.25)	(0.21)	(0.26)	(0.24)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

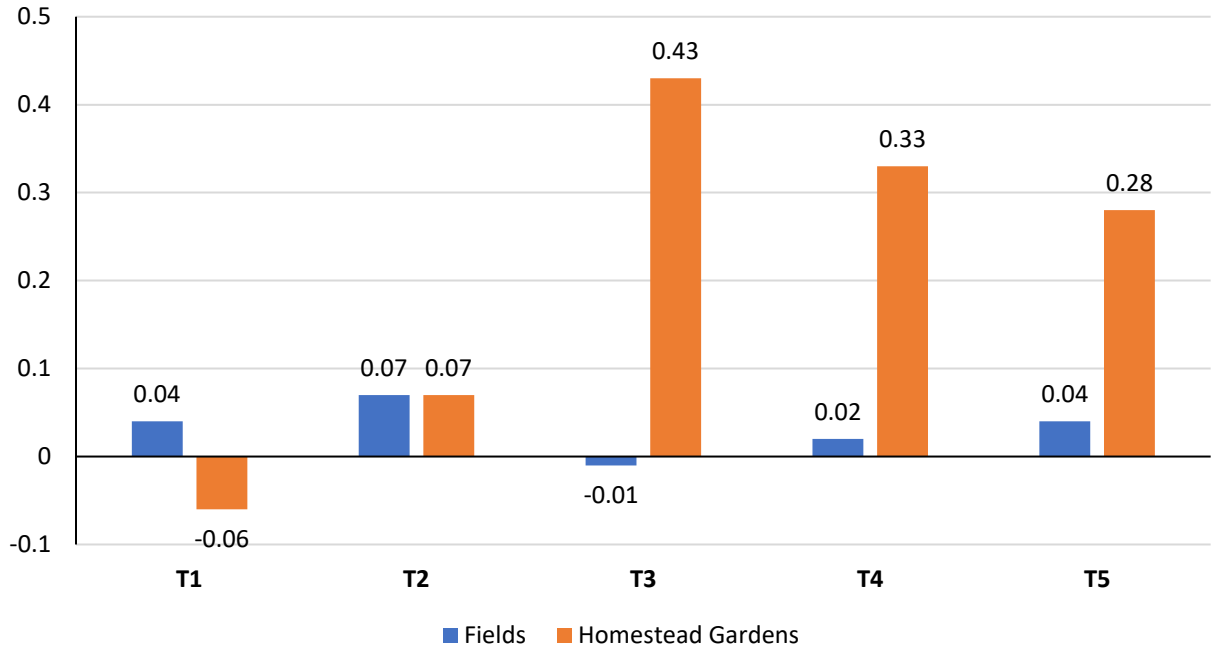
Table 7.12 ANCOVA impacts on number of non-rice crops indicators - extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Number, non-rice field crops	0.78	**0.04**	**0.07**	**-0.01**	**0.02**	**0.04**	3,488
		(0.09)	(0.10)	(0.07)	(0.09)	(0.12)	
Number, homestead crops	1.36	**-0.06**	**0.07**	**0.43*** **	**0.33*** **	**0.28*** **	3,488
		(0.15)	(0.11)	(0.11)	(0.12)	(0.10)	
Number, non-rice field and homestead crops	2.36	**-0.10**	**0.03**	**0.44*** **	**0.30** **	**0.28** **	3,488
		(0.15)	(0.12)	(0.11)	(0.12)	(0.11)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Figure 7.3 Impacts on number of non-rice field and homestead crops by treatment arm, extended specification



Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

7.2.3 Future Work

In looking at results from earlier chapters, it is useful to note that while some of the ANGeL training focused on the advantages of growing a more diverse set of crops, other components stressed techniques (such as seed selection, pest control, use of fertilizers) that would improve productivity of non-staple crop production. This suggests that future work on the impact of ANGeL should assess whether there have been increases in yields and production of non-staple crops, with particular attention paid to those crops produced in homestead garden plots.

8. NUTRITION KNOWLEDGE AND IMPACTS

As we did with our chapter on production diversity, we begin by examining whether the nutrition knowledge base of ANGeL participants has improved. Next, we assess the impact of ANGeL on consumption diversity. We first analyze the Food Consumption Score to learn how one of the primary outcomes of the study—consumption diversity—changed over the project period at the household-level. We then present the results of our impact analysis for dietary diversity of children, who were 6-24 months of age at the beginning of the ANGeL project.

8.1 Impacts on Nutrition Knowledge

To assess whether ANGeL improved participants' knowledge of nutrition through behavior change communication (BCC) trainings, delivered either by agriculture extension agents or trained community women, we tested survey respondents on a series of questions related to child feeding, food nutrients, food preparation, and hand washing at endline. These were topics that were covered during ANGeL's nutrition BCC trainings. Table 8.1 presents the list of questions asked to participants in all treatment arms and the control group, administered separately to male and female respondents. We define successful acquisition of knowledge when respondents score 75 percent or higher on this test.

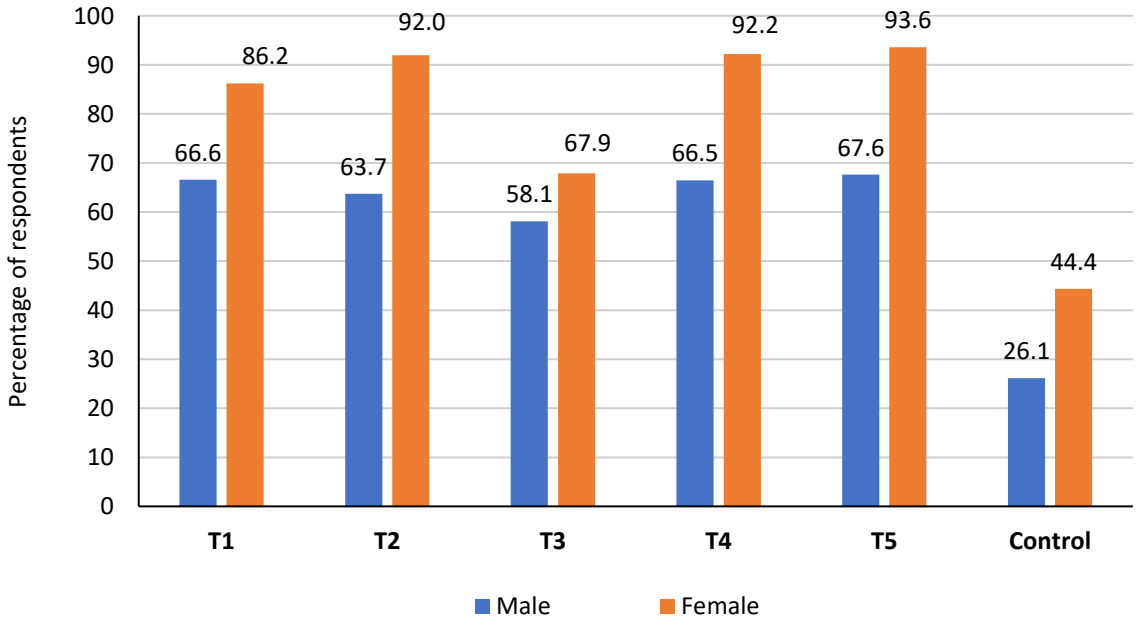
Table 8.1 Questions asked to test nutrition knowledge at endline

Questions
1. How many times should a child (aged 7-8 months of age) be fed in a day?
2. How many times should a child (aged 9-11 months of age) be fed in a day?
3. How many times should a child (aged 12-24 months of age) be fed in a day?
4. Which types of food are a good source of Vitamin A (good for eyes)?
5. Which types of food are a good source of iron (blood-building foods)?
6. What types of food should you take in a daily diet?
7. What types of food should we take to get zinc (help to build the body)?
8. How should vegetables be washed?
9. What is the most appropriate method for vegetable cutting?
10. Why should we use oil while cooking?
11. How should the heat be in the stove during cooking?
12. When should you wash your hands with soap?
13. When do you think it is important to wash hands?
14. What benefits come from washing hands with soap?
15. What is Tippy Tap?
16. What are the benefits of using Tippy Tap?

Source: Adapted from ANGeL Nutrition Training Manual

Figure 8.1 shows the results from the nutrition knowledge tests for all interventions and the control group. All differences between interventions and control are statistically significant. Interestingly, T3—the only ANGeL intervention that did not deliver any nutrition BCC trainings—still had statistically significant improvements in nutrition knowledge compared to the control group, albeit less than the other interventions that included nutrition BCC trainings. We speculate that this is because the ANGeL agriculture production curriculum integrated nutrition, and focused on building competencies in identifying and cultivating nutrient-dense crops for household consumption and sale. Therefore, ANGeL's findings may show that the intersection of agriculture training and nutrition can enhance farm families' nutrition knowledge. While nutrition knowledge improved for participants of all interventions, women consistently outperformed men in correctly answering at least 75 percent of the questions.

Figure 8.1 Single difference impacts on nutrition knowledge acquisition



Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

8.2 Impacts on Household-Level Consumption Diversity: The Food Consumption Score

When assessing the impact of ANGeL on household-level consumption diversity, we want to take into account both the number of different food groups that the household consumes as well as the frequency of the consumption of those different groups. We also want to take into account the fact that certain foods are of greater nutritive value than others. One measure that meets these criteria is the Food Consumption Score (FCS), developed by the UN World Food Programme (WFP). The FCS combines information on the frequency of consumption of different food groups in the past seven days, weighting these by their nutritive value. It ranges

in value from 0 to 117 with values below 42 representing poor household food security. Table 8.2 describes the components of the FCS and the weights assigned to the eight food groups.

Table 8.2 Components of the Food Consumption Score

Group	Food items include	Food Group	Weight
1	Rice, bread, maize, pasta, cassava, yucca, plantain	Staples	2
2	Pulses, beans, peas, peanuts, cashews	Pulses	3
3	Vegetables	Vegetables	1
4	Fruit	Fruit	1
5	Meat, poultry, fish, eggs	Meat and fish	4
6	Milk, dairy, cheese, yogurt	Dairy	4
7	Sugars	Sugars	0.5
8	Cooking oil, lard	Oils and fats	0.5

Source: World Food Programme (WFP)

The FCS was only measured at endline, so we estimate the impact of ANGeL on this measure of consumption diversity using single difference regression models. Tables 8.3 and 8.4 give the results of estimating the base and extended specifications of the regression models. The base specification results shown in Table 8.3 are not statistically significant.

Table 8.4 (extended specification) shows that when we account for baseline household characteristics, three treatment arms improved consumption diversity, as measured by the FCS: (1) T2, when trained community women delivered nutrition BCC trainings; (2) T4, when nutrition BCC and agriculture production trainings were combined; and (3) T5, when all three trainings–agriculture production, nutrition BCC, and gender sensitization–were packaged together. The mean value for control households is relatively high (69.38); therefore, the T2, T4, and T5 impacts are equivalent to a 4.8-5.3 percent increase in consumption diversity.

Table 8.3 Single difference impacts on FCS indicators - base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
FCS	69.38	**1.92**	**0.70**	**1.81**	**3.86**	**1.13**	3,898
		(2.64)	(2.21)	(2.37)	(2.40)	(2.01)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 8.4 Single difference impacts on FCS indicators - extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
FCS	69.38	**1.64**	**3.38****	**1.66**	**3.63*****	**3.69*****	3,898
		(1.38)	(1.34)	(1.19)	(1.07)	(1.30)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

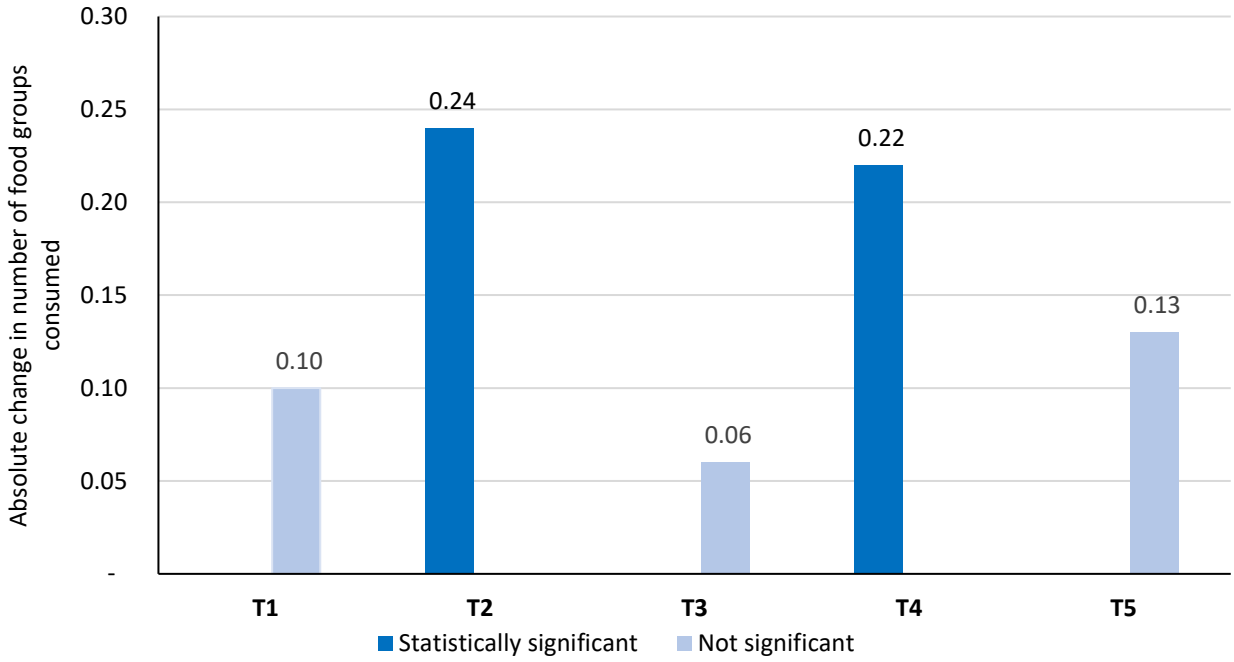
8.3 Impacts on Child Dietary Diversity

Although ANGeL aimed to diversify diets of *all* household members, promoting diverse diets for young children—during the "critical window of opportunity"—was a major thrust of the program in order to have a positive impact on children's cognitive and physical development.

We estimate the impact of the treatment arms on child dietary diversity using data on children who were 6-23.9 months old at the time of the baseline survey. These children were between 24 and 48 months at the time of the endline survey. We use the WHO-recommended seven food group classification of food groups, and estimate impacts using the ANCOVA specification. The cut-off of four out of seven food groups is used because it is associated with better quality diets. The seven food groups are: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) flesh foods (meat, fish, poultry, and liver/organ meats); (5) eggs; (6) vitamin-A rich fruits and vegetables; and (7) other fruits and vegetables (WHO 2010). Since all children from the baseline sample had aged out of the 6-23.9 months window at the time of the endline survey, we do not classify the dietary diversity score to ascertain the proportion achieving minimum dietary diversity. Rather, we report results simply as an impact on the mean number of food groups in each treatment arm, relative to the control arm.

As shown in Figure 8.2 below, there was a statistically significant impact on child-level dietary diversity in arms T2 and T4. It was higher in T3 and T5 as well, but not statistically significant.

Figure 8.2 Impacts of ANGeL on child dietary diversity – extended specification



Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Table 8.5 shows that endline dietary diversity was higher in these groups (T2 and T4), despite improvements across all groups over time. This is expected due to increases in child age over the project period.

Table 8.5 Endline dietary diversity among children who were 6-23 months old at baseline

		Dietary diversity			
Household type	**Number of children**	**Endline**		**Baseline**	
		Mean	SD	Mean	SD
T1: BCC-1_SAAO	427	4.83	1.03	3.82	1.48
T2: BCC-2_Female	435	4.84	1.01	3.72	1.42
T3: AgProd	426	4.77	0.88	4.00	1.43
T4: AgProd+BCC	434	5.04	1.01	3.91	1.49
T5: AgProd+BCC+Gen	421	4.95	0.97	3.96	1.43
C : Control	591	4.68	1.00	3.84	1.45
Total	2,734	4.84	0.99	3.87	1.45

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

8.4 Future Work

Several ANGeL treatment arms improved consumption diversity. Strikingly, two of the interventions (T4 and T5) combine both nutrition BCC and agriculture production training aimed

at diversifying household food production. However, a striking feature of the FCS is the relatively high value of the control group, suggesting that there is more of a limited scope for improving this outcome than was realized when ANGeL was launched. In turn, this suggests that future work on this outcome should focus on two related issues. One is how increased consumption diversity is distributed within the household–do all household members experience increased dietary diversity or is this benefit concentrated among selected household members? A second is to assess impacts in terms of quantities of consumption of non-staple foods rather than whether they consume these foods or not.

With respect to child-level dietary diversity, it is interesting that impacts on child dietary diversity are seen in the arm with female nutrition workers and the arm with additional agricultural production interventions, but not the arm with the gender training. Further analysis will examine impacts on consumption of specific food groups, especially those promoted by the nutrition BCC interventions, and on individual-level dietary intakes.

9. WOMEN'S EMPOWERMENT IMPACTS

Previous IFPRI work in Bangladesh has shown that women's empowerment plays a key role in improving household food security and dietary diversity of children, women, and other household members (Sraboni et al. 2014b; Malapit et al. 2015). Agricultural diversity is also found to increase if the primary woman in a household is empowered (Ahmed 2015), and technical efficiency in agriculture is higher, the smaller is the empowerment gap between spouses (Seymour 2017). Thus, women's empowerment is hypothesized to be one of the pathways of impact to improve both nutrition and agricultural outcomes, and is influenced by a number of factors, including social norms, knowledge, skills, and the shared power to make decisions within households (Ahmed et al. 2017: 4). This chapter presents preliminary estimates of the different treatment arms of the ANGeL project on women's and men's empowerment, measured using indicators derived from the Abbreviated Women's Empowerment in Agriculture Index (A-WEAI). It also investigates changes in women's and men's attitudes towards gender and relationships as one of the factors that could directly affect women's empowerment.

The chapter is organized as follows. We begin by describing our primary outcome indicators of women's and men's empowerment, based on the A-WEAI. For context, we present descriptively how the aggregate percentages of empowered women and men (headcount of empowered women and men) based on the A-WEAI have evolved in the sample over the study period. We then attempt to unpack the underlying indicators of the A-WEAI and estimate the impact of the intervention on each of these indicators using ANCOVA. Next, we describe indicators of women's and men's attitudes towards gender and relationships, before proceeding to examine whether the intervention has affected these attitudes. Throughout, we identify limitations of our analysis and possible next steps.

9.1 Primary Outcome: Women's and Men's Empowerment

9.1.1 Outcome indicators: Five domains of empowerment (5DE) based on the Abbreviated Women's Empowerment in Agriculture Index (A-WEAI)

Our primary indicators of empowerment derive from the five domains of empowerment (5DE) that are defined in the Women's Empowerment in Agriculture Index (WEAI), as well as in the streamlined Abbreviated WEAI (A-WEAI).[6] The WEAI and A-WEAI – developed by IFPRI, the Oxford Poverty and Human Development Initiative (OPHI), and USAID – are used to measure the empowerment, agency, and inclusion of women in the agriculture sector. For the impact

[6] A-WEAI was developed by IFPRI, in consultation with USAID and OPHI, in response to partners' requests to reduce interview time and eliminate modules that were time-consuming, sensitive, and difficult to understand. The A-WEAI takes about 30 percent less time to administer than the original WEAI. See Malapit et al (2015) for details on how the WEAI and A-WEAI differ in terms of sub-domains and indicators.

evaluation of ANGeL, the A-WEAI was administered at both baseline and endline to track empowerment within the sample over the course of the project.

The overall A-WEAI is an aggregate index composed of two sub-indices. These sub-indices use individual-level data on the primary adult male and female within the same household, or, in households with no adult male, use data only on the primary adult woman. The first of A-WEAI's two component sub-indices is the 5DE – our focus in this section – which measures empowerment in five areas, calculated for women. The second sub-index – which we do not analyze in this section – is the gender parity sub-index (GPI), which measures relative equality in empowerment of men and women within the same households. The 5DE contributes 90 percent of the weight to the A-WEAI, and the GPI contributes 10 percent of the weight.

For the purposes of our impact evaluation, we calculate the empowerment score based on the individual's achievements in the 5 domains, both for women and for men. These individual-level scores, based on the scores of the primary male and female in the household, are better suited to impact evaluation than the aggregate index measured at the program or treatment arm level. The empowerment score assesses whether individuals are empowered across the following five domains: (1) Production, (2) Resources, (3) Income, (4) Leadership, (5) Time. In the WEAI, each domain is weighted equally, as are each of the indicators within a domain. In the A-WEAI, each indicator takes the full weight of the domain, with the exception of the Resources domain. Definitions of the five domains under the A-WEAI, the corresponding indicators, and their weights for the 5DE are presented in Table 9.1 (Malapit et al. 2017); definitions of the cut-offs for adequacy are in Appendix Table B.1.

Table 9.1 The Five Domains of Empowerment in the A-WEAI

Domain (each weighted 1/5 of 5DE sub-index)	Definition of domain	Indicators	Weight of indicator in 5DE sub-index
Production	Sole or joint decision-making over food and cash crop farming, livestock, fisheries	Input in productive decisions	1/5
Resources	Ownership, access to, and decision-making power over productive resources such as land, livestock, agricultural equipment, consumer durables, and credit	Ownership of assets	2/15
		Access to and decisions on credit.	1/15
Income	Sole or joint control over income and expenditures.	Control over use of income.	1/5
Leadership	Membership in economic or social groups	Group membership	1/5
Time	Allocation of time to productive and domestic tasks	Workload	1/5

Source: Adapted from Malapit et al. 2017.

The individual's empowerment score based on the five domains of empowerment (5DE) ranges from zero to one, where higher values indicate greater empowerment. The individual's empowerment scores are then aggregated to construct the 5DE sub-index, using a robust multidimensional methodology known as the Alkire Foster Method.[7] At the aggregate level, the 5DE sub-index has two components. First, it reflects the percentage of individuals who are empowered (He). An individual is defined as empowered in the 5DE if he/she reaches the threshold of empowerment in 80 percent or more of the weighted indicators. Second, it reflects the percentage of domains in which those individuals who are not yet empowered (Hn) still have adequate achievements (Aa). Thus, the 5DE formula is as follows: 5DE = {He + (Hn x Aa)), where He + Hn= 100% and 0 <Aa< 80%.

For our analysis, we construct several empowerment variables at the household level. First, each respondent is classified as having adequate (=1) or inadequate (=0) achievement in each of the A-WEAI indicators. We then define the weighted sum of these indicators as the empowerment score for the primary male or primary female, which is a continuous variable ranging between zero and one. We also define a binary variable "whether empowered" for the primary male and female as follows: the individual is defined as empowered in the five

[7] See http://www.ophi.org.uk/research/multidimensional-poverty/alkirefoster-method/ for information on the method.

domains if he/she reaches the threshold of empowerment in 80 percent or more of the weighted indicators.

In sum, our primary analysis focuses on the following continuous and binary household-level variables:

- Empowerment score for male and for female (continuous)
- Difference between the empowerment scores of the male and female in the same household (continuous)
- Whether male and female are each classified as empowered, empowerment score >=80 percent (binary)
- Whether male and female are each classified as having adequate achievement in each of the 5DE component indicators (where each component indicator is defined to capture empowerment rather than disempowerment – e.g., the workload indicator is defined as being "not time poor") (binary):
    - Input in productive decisions
    - Ownership of assets
    - Access to and decisions on credit.
    - Control over use of income.
    - Group membership
    - Workload

Because the A-WEAI was implemented in both the baseline and endline, and thus these indicators can be constructed in both rounds, we use ANCOVA specifications for impact estimation. Although some questions were re-worded in the endline round based on cognitive testing of the survey questionnaires, ANCOVA allows the flexibility for modifications in the questions between rounds.

9.1.2 Descriptive Results: Empowerment Headcounts in Baseline and Endline

For context, we first show descriptively how the percentages of empowered women and men (headcount of empowered women and men) based on the 5DE evolved over the study period in our sample. Table 9.2 presents the percentages of empowered men and women based on the 5DE at baseline and endline. We observe that, across all treatment arms and the control arm, the percentage of empowered men and women have increased between baseline and endline.

Table 9.2 Percentage of empowered women and men based on 5DE, baseline and endline

Percentage of empowered women							
	T1	**T2**	**T3**	**T4**	**T5**	**Control**	**All**
Baseline	31.0	29.7	26.2	30.4	36.8	29.5	30.6
Endline	48.6	50.9	50.3	46.6	56.7	49.0	50.3
Percentage of empowered men							
	T1	**T2**	**T3**	**T4**	**T5**	**Control**	**All**
Baseline	35.3	43.1	39.3	39.6	44.3	46.0	41.6
Endline	53.1	55.8	48.2	49.1	54.9	52.1	52.2

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.
Note: An individual is defined as empowered with respect to 5DE if he or she reaches the threshold of empowerment in 80 percent or more of the weighted indicators.

As noted above, mean comparisons–though useful for understanding trends–do not allow attributing impacts of the project. Moreover, the household-level indicators and their components are better suited to impact evaluation than the aggregated indicator that averages observations within a treatment arm. Thus, the following section proceeds to unpack the underlying indicators and estimates the impact of the treatments on the key household-level indicators using ANCOVA. We estimated both base and extended ANCOVA regressions; our preferred specification, the extended specification, is discussed here. Base specification results are in Appendix B.

9.1.3 Impact Estimates on 5DE and Component Indicators

Table 9.3 presents ANCOVA estimates of program impact on A-WEAI indicators. We note that since we estimate impacts for the overall empowerment scores as well as the component indicators, it would be useful to adjust for multiple hypothesis testing. We intend to explore this in the next round of analysis.[8]

[8] We also note that all ANCOVA estimations in this section include a dummy variable for a missing baseline indicator. This dummy variable is included because in a substantial share of the original sample design of 4000 households, either we do not have a successfully re-interviewed household with the same baseline and endline female respondent (15.5 percent of the original sample design), or we do not have a successfully re-interviewed household with the same baseline and endline male respondent (22.3% of the original sample design). Because baseline and endline indicators should only be compared for the same respondent, the baseline indicator is characterized as missing for these household observations. Dropping these observations from the estimations would lead to sample attrition that significantly differs by arm, which complicates impact estimation; female attrition for the ANCOVA sample would be significantly higher in T2 (p=.02), T3 (p=.01), and T5 (p<.01), while male attrition for the ANCOVA sample would be weakly significantly higher in T2 (p=.07). However, including the dummy variable retains the observations where the baseline indicator is characterized as missing, such that only observations with no endline respondent drop out of the estimation. With the dummy variable included, sample attrition no longer meaningfully differs by arm; there is approximately 5.3% sample attrition for female respondents and approximately 12.9% sample attrition for male respondents relative to the original sample design, neither significantly differing by intervention arm.

The estimates in Table 9.3 do not show any significant impact of the intervention on the empowerment scores or on the difference between men's and women's empowerment scores. However, this is not an unexpected result. Because the overall empowerment score is a weighted average, some of the component indicators could be affected in offsetting ways by the intervention. For example, if ANGeL increases a woman's involvement in agriculture, potentially increasing her input in productive decisions, it may also increase her workload and make her more time-poor. Our previous analysis using the WEAI and its variants suggests that an indicator-by-indicator analysis is better suited for understanding the domains of empowerment that contribute to agriculture and nutrition outcomes (Sraboni et al. 2014, Malapit et al. 2015, Malapit and Quisumbing 2015).

We do detect significant impacts of ANGeL on some of the A-WEAI component indicators across treatment arms. For clarity and ease of interpretation, we present the estimates for only these component indicators in Figure 9.1, expressed in terms of the percentage increase from the endline control (EL C) mean.

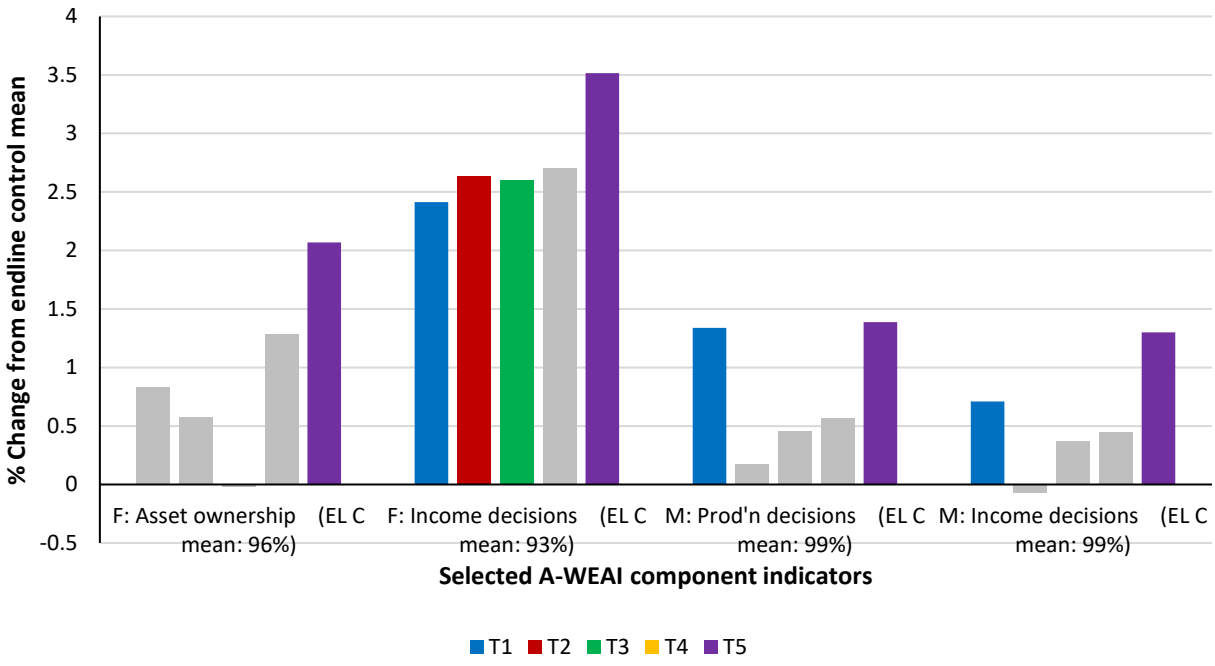
Table 9.3 ANCOVA impacts on A-WEAI indicators - extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
F: Empowerment score	0.77	**0.00**	**-0.00**	**0.01**	**0.01**	**0.01**	3,786
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
M: Empowerment score	0.74	**0.00**	**0.00**	**0.00**	**-0.00**	**0.00**	3,486
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
Diff in empowerment scores: M-F	-0.02	**0.00**	**0.01**	**-0.00**	**-0.01**	**-0.00**	3,429
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
F: Whether empowered	0.49	**-0.02**	**-0.02**	**0.03**	**0.01**	**0.03**	3,786
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	
F: Prod'n decisions	0.97	**-0.00**	**-0.01**	**0.00**	**0.01**	**0.01**	3,786
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
F: Asset ownership	0.96	**0.01**	**0.01**	**-0.00**	**0.01**	**0.02****	3,786
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
F: Credit decisions	0.57	**-0.03**	**-0.03**	**0.02**	**-0.03**	**0.03**	3,786
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	
F: Income decisions	0.93	**0.02***	**0.02***	**0.02****	**0.03**	**0.03****	3,786
		(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	
F: Group member	0.54	**-0.01**	**-0.02**	**0.03**	**0.04**	**0.05**	3,786
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	
F: Not time poor	0.80	**-0.03**	**-0.03**	**-0.01**	**-0.01**	**-0.04**	3,786
		(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	
M: Whether empowered	0.52	**-0.01**	**-0.01**	**-0.01**	**-0.03**	**-0.01**	3,486
		(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	
M: Prod'n decisions	0.99	**0.01****	**0.00**	**0.00**	**0.01**	**0.01****	3,486
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
M: Asset ownership	1.00	**0.00**	**0.00**	**-0.00**	**-0.00**	**-0.00**	3,486
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
M: Credit decisions	0.75	**-0.03**	**-0.01**	**0.00**	**-0.01**	**-0.00**	3,486
		(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	
M: Income decisions	0.99	**0.01***	**-0.00**	**0.00**	**0.00**	**0.01*****	3,486
		(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	
M: Group member	0.54	**-0.01**	**-0.00**	**0.00**	**-0.02**	**-0.01**	3,486
		(0.03)	(0.02)	(0.03)	(0.04)	(0.03)	
M: Not time poor	0.66	**-0.00**	**-0.01**	**-0.01**	**-0.02**	**-0.02**	3,486
		(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the baseline outcome, a dummy for a missing baseline outcome, treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Figure 9.1 ANCOVA impacts of ANGeL treatment arms on selected A-WEAI component indicators (where significant impacts are found)



Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note that the control mean of these variables is already high at endline, leaving very little room for improvement. Nevertheless, ANGeL has increased women's adequacy with respect to asset ownership (in T5) and decisionmaking power with respect to income (in all treatment arms except T4). Notably, the impact is largest in T5—the treatment arm that combines agricultural extension, nutrition BCC, and gender sensitization. ANGeL has also improved men's decisionmaking in production in T1 and T5, and their decisionmaking over income, also in T1 and T5. The fact that T1, in which agricultural extension officers provide nutrition BCC, affects men's production and income decisions is an interesting finding; analysis elsewhere in the report touches on whether it shifts production choices towards more nutritious crops.

9.2 Secondary Outcome: Attitudes Towards Gender and Relationships

9.2.1 Outcome Indicators: Agreement with Statements on Attitudes

Because one of the treatment arms (T5) explicitly aimed to change attitudes towards gender and relationships through its gender sensitization programming, and because men's and women's attitudes could also have changed simply through participating in agricultural or nutrition training with their spouses, a module was added to the endline survey that aimed to capture men's and women's degree of agreement with statements related to attitudes. These statements were formulated by the IFPRI team and were based on the content of the *Nurturing Connections* curriculum (Helen Keller International Bangladesh 2017) (Table 9.4). Respondents

were asked, using a five-point scale, about their extent of agreement with the statements. Statements in English were phrased so that they did not always reveal "positive" gender attitudes; specifically, from the researchers' viewpoint, the statements were written so that agreement would be "better" for statements 1, 2, 4, 7, 8, and 9, while disagreement would be "better" for statements 3, 5, 6, and 10.

Table 9.4 Questions regarding men's and women's attitudes towards gender and relationships

Question number	Statements
1.	Even when I disagree with my spouse, I usually think he/she has valid things to say.
2.	I make important contributions to my family.
3.	Some of the adults in my family do not make important contributions to the family.
4.	I make important contributions to my community.
5.	I sometimes refrain from voicing my opinion because I fear being ignored or ridiculed.
6.	I have a hard time saying positive things about myself.
7.	Women should stand up for themselves to get what they want.
8.	Women are usually very busy with work that benefits the household.
9.	Husbands should help their wives with household chores like cooking and taking care of children.
10.	Girls' and boys' behavior is mostly something they are born with.
11.	We can change our culture and traditions about what men and women do and how they relate to each other.
Response options	1=Strongly disagree, 2=Slightly disagree, 3=Neither agree nor disagree, 4=Slightly agree, 5=Strongly agree

Source: Helen Keller International Bangladesh, 2017.

However, upon examining the responses, we suspected that translation led to ambiguity on 1 (possibly interpreted as "even *though* I disagree with my spouse") and 10 (possibly interpreted as "*Children's* behavior is mostly something they are born with," relating more to allowing children their individuality than to gender roles being biological). To account for the possible ambiguity, we constructed indicators to summarize responses from men and women in several ways:

1. **total "v1"** (a version that imposed researchers' initial assumptions): assume **agreement is "better" on all but statements 3, 5, 6, and 10**; recode each item so that a higher number on each item is better; aggregate v1 codings
2. **total "v2"** (a version that reversed researchers' initial assumption on statements 1 and 10): assume **agreement is "better" on all but statements 1, 3, 5, and 6**; recode each item so that a higher number on each item is better; aggregate v2 codings
3. **1st component from principal components analysis** over original statement responses (a version that did not rely on researchers' assumptions about how to interpret the statements).

9.2.2 Impacts on Attitudes Towards Gender and Relationships

Because the questions on attitudes towards gender were only asked at endline, we estimate single-difference impacts. Tables 9.5 and 9.6 present impact estimates for women and men,

respectively. Given that baseline outcome indicators are not included in these estimates, our preferred estimates are the extended specification estimates that include other baseline covariates; we focus below on discussing estimates from these extended specifications. As above, given the number of different indicators tested, we note that it would be useful to adjust for multiple hypothesis testing and intend to explore this in the next round of analysis.[9]

Focusing on the extended specifications for women, we find significant positive impacts of the ANGeL project on total gender attitudes scores (Table 9.5). Whether we use the "Total gender attitudes score v1," "Total gender attitudes score v2," or "PCA component1 of gender attitudes responses," it appears that the largest positive impacts come from T5. Specifically, for the "Total gender attitudes score v1" a weakly significant impact is detected only from T5 (about 1.2 percent increase from the endline control mean); for the "Total gender attitudes score v2", significant impacts are found from T2, T4, and T5 (about 1.8 percent to 2.6 percent increase from the endline control mean); and for the "PCA component1 of gender attitudes responses", significant impacts are found from T2, T4, and T5 although magnitudes are less straightforward to interpret. Overall, while the strongest impacts appear in T5, which includes gender sensitization, some significant impacts are also found in T2 and T4, the treatment arms with nutrition BCC. This could occur because nutrition BCC also emphasizes the caregiver's agency and decisionmaking power over resources needed for child nutrition.

Moving to the extended specifications for men, analysis indicates significant positive impacts of the ANGeL project on total gender attitudes scores as well (Table 9.6)–although these emerge in "Total gender attitudes score v1" and "Total gender attitudes score v2," but not in "PCA component1 of gender attitudes responses." Again, the largest positive impacts appear to come from T5. For the "Total gender attitudes score v1", significant impacts are observed from T1, T4, and T5 (about 1.1 percent to 1.6 percent increase from endline control mean); for the "Total gender attitudes score v2", significant impacts are also observed from T1, T4, and T5 (about 1.1 percent to 1.4 percent increase from endline control mean, $p<.05$ for T5). Again, the significant impacts from T5 could be attributed to the gender sensitization component. It is also notable that T1 and T4 both show positive impacts on attitudes towards gender and relationships. These treatment arms are providing information that men would typically not have received in the past—nutrition BCC. Perhaps, exposing men to key practices involved in good nutrition has also changed their attitudes towards women's roles within the family.

Finally, it is also interesting to examine which specific statements are most affected by the ANGeL project. Among women, T5 significantly affects responses for the following statements:

[9] With single-difference estimation, only observations with non-response at endline drop from the estimation. There is about 10% sample attrition relative to the original sample design for males, but with no significant difference by arm. There is a small significant difference in sample attrition from the original sample design for females in T4 only, but the overall sample attrition of <3% is low enough for this to be largely negligible.

"Even when I disagree with spouse, I usually think he/she has valid things to say";
"I make important contributions to my community";
"Women should stand up for themselves to get what they want";
"Women are usually very busy with work that benefits the household";
"Husbands should help their wives with household chores like cooking and taking care of children";
"Girls' and boys' behavior is mostly something they are born with";
"We can change our culture and traditions about what men and women do and how they relate to each other."

In fact, all treatments significantly increase women's average agreement with "I make important contributions to my community." For men, there are uneven and scattered impacts from various treatments (including T1, T3, T4, and T5) on responses to individual statements.

Table 9.5 Single difference impacts on women's attitudes towards gender and relationships: extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Total gender attitudes score v1	41.01	**0.11**	**0.42**	**0.05**	**0.46**	**0.48***	3,898
		(0.24)	(0.29)	(0.26)	(0.29)	(0.27)	
Total gender attitudes score v2	39.92	**0.35**	**0.72****	**0.19**	**0.81*****	**1.05*****	3,898
		(0.25)	(0.28)	(0.27)	(0.25)	(0.25)	
PCA component1 of gender attitudes responses	-0.12	**0.12**	**0.14***	**0.04**	**0.19****	**0.30*****	3,898
		(0.09)	(0.08)	(0.09)	(0.09)	(0.08)	
Even when I disagree with spouse, I usually think he/she has valid things to say	4.39	**-0.04**	**-0.13****	**0.01**	**-0.08**	**-0.15****	3,902
		(0.06)	(0.06)	(0.05)	(0.06)	(0.07)	
I make important contributions to my family	4.66	**0.06***	**0.01**	**-0.02**	**0.02**	**0.05**	3,902
		(0.03)	(0.04)	(0.04)	(0.04)	(0.05)	
Some adults in my family do NOT make important contributions to the family	2.41	**-0.04**	**-0.13**	**0.00**	**-0.14**	**-0.11**	3,901
		(0.09)	(0.10)	(0.10)	(0.10)	(0.10)	
I make important contributions to my community	3.22	**0.12****	**0.16*****	**0.18*****	**0.28*****	**0.24*****	3,899
		(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	
I sometimes refrain from voicing my opinion b/c I fear being ignored/ridiculed	3.44	**0.11**	**-0.10**	**-0.01**	**-0.08**	**-0.07**	3,902
		(0.07)	(0.08)	(0.07)	(0.07)	(0.08)	
I have a hard time saying positive things about myself	3.50	**0.03**	**-0.08**	**0.06**	**0.03**	**0.09**	3,902
		(0.07)	(0.08)	(0.07)	(0.08)	(0.07)	
Women should stand up for themselves to get what they want	4.69	**0.03**	**0.05**	**0.02**	**0.03**	**0.07****	3,902
		(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	
Women are usually very busy with work that benefits the household	4.74	**-0.00**	**0.03**	**0.00**	**0.05**	**0.09****	3,902
		(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	
Husbands should help wives with HH chores like cooking & taking care of children	4.62	**0.04**	**0.05**	**-0.00**	**0.07****	**0.11*****	3,902
		(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	
Girls' and boys' behavior is mostly something they are born with	3.84	**0.08**	**0.02**	**0.08**	**0.10**	**0.13****	3,902
		(0.06)	(0.07)	(0.06)	(0.06)	(0.06)	
We can change culture/tradition re what men/women do & how relate to each other	3.89	**0.08**	**-0.04**	**-0.03**	**0.00**	**0.12***	3,903
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table 9.6 Single difference impacts on men's attitudes towards gender and relationships: extended specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Total gender attitudes score v1	40.76	**0.46***	**0.09**	**0.29**	**0.51****	**0.67*****	3,591
		(0.25)	(0.23)	(0.27)	(0.23)	(0.24)	
Total gender attitudes score v2	40.24	**0.45***	**0.10**	**0.21**	**0.47***	**0.58****	3,591
		(0.25)	(0.23)	(0.29)	(0.24)	(0.27)	
PCA component1 of gender attitudes responses	-0.03	**0.06**	**-0.10**	**-0.07**	**0.04**	**0.05**	3,591
		(0.09)	(0.09)	(0.11)	(0.08)	(0.08)	
Even when I disagree with spouse, I usually think he/she has valid things to say	4.30	**-0.02**	**-0.07**	**-0.04**	**-0.02**	**-0.00**	3,591
		(0.06)	(0.05)	(0.05)	(0.05)	(0.06)	
I make important contributions to my family	4.60	**0.08****	**0.05**	**0.10*****	**0.04**	**0.05**	3,591
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	
Some adults in my family do NOT make important contributions to the family	2.47	**-0.14**	**-0.04**	**-0.12**	**-0.20****	**-0.12**	3,591
		(0.09)	(0.08)	(0.07)	(0.09)	(0.08)	
I make important contributions to my community	3.76	**0.11***	**-0.06**	**0.01**	**0.07**	**-0.04**	3,591
		(0.06)	(0.07)	(0.05)	(0.05)	(0.07)	
I sometimes refrain from voicing my opinion b/c I fear being ignored/ridiculed	3.17	**-0.03**	**-0.08**	**-0.09**	**-0.11***	**-0.24*****	3,591
		(0.08)	(0.07)	(0.07)	(0.07)	(0.08)	
I have a hard time saying positive things about myself	3.36	**-0.01**	**-0.05**	**-0.04**	**0.03**	**-0.07**	3,591
		(0.07)	(0.07)	(0.08)	(0.08)	(0.08)	
Women should stand up for themselves to get what they want	4.45	**-0.07**	**-0.06**	**-0.08**	**-0.01**	**-0.01**	3,591
		(0.05)	(0.06)	(0.06)	(0.05)	(0.05)	
Women are usually very busy with work that benefits the household	4.52	**-0.02**	**-0.06**	**-0.06**	**0.02**	**0.02**	3,591
		(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	
Husbands should help wives with HH chores like cooking & taking care of children	4.44	**0.04**	**0.00**	**-0.00**	**0.01**	**0.07***	3,591
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	
Girls' and boys' behavior is mostly something they are born with	4.05	**-0.02**	**-0.07**	**-0.08**	**-0.04**	**-0.05**	3,591
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	
We can change culture/tradition re what men/women do & how relate to each other	3.73	**0.13***	**0.05**	**0.04**	**0.09**	**0.11**	3,591
		(0.07)	(0.07)	(0.07)	(0.06)	(0.07)	

Source: 2018 Endline Survey for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Extended specification includes as independent variables the treatment indicators, baseline covariates for geography, male and female characteristics, household demographic and socioeconomic characteristics. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

10. SUMMARY AND CONCLUSIONS

Summary

The ANGeL pilot project aimed to stimulate agricultural productivity by providing practical, hands-on agricultural production trainings through officials of the Department of Agricultural Extension (DAE). Encouragingly, all interventions that included agriculture trainings were successful in boosting knowledge of production techniques relevant for high-value vegetable and fruit production. Although both men and women benefitted from these trainings, women's gains in knowledge were far more substantial.

This improved agriculture knowledge contributed to the adoption of improved agriculture production practices. While both men and women's adoption of improved agricultural production practices increased, women's adoption rates were greater than men's, indicating that women were more likely to act on the knowledge they gained from ANGeL trainings.

There were significant improvements in the number of crops grown in home gardens over the project period. ANGeL's focus on homestead food production is instructive for promoting women's inclusion and agency in agriculture, particularly in producing non-rice crops, which are more nutrient-dense and profitable compared to rice.

Another objective of the ANGeL project was to diversify diets and improve nutritional status through nutrition behavior change communication (BCC) trainings, delivered either by agriculture extension agents or trained community women. Through practical instruction, ANGeL's nutrition BCC trainings aimed to provide essential nutrition knowledge and instill self-confidence in farm households, leading husbands and wives to make informed, healthy decisions for themselves and their families.

Similar to agriculture, improvements in nutrition knowledge and impacts show a positive story. Household diet quality improved over the project period. Child dietary diversity also increased, especially for interventions that delivered nutrition trainings by trained community women, and when agriculture and nutrition trainings were combined.

One intervention of the ANGeL project incorporated gender sensitization trainings designed by Helen Keller International (HKI) called *Nurturing Connections*, which were delivered by local facilitators hired by the project. These highly interactive sessions explored gender relations, power dynamics, communication, and empowerment through games and role plays, and the training sessions brought together husbands, wives, and mothers-in-law, who are typically key household decisionmakers in Bangladesh.

ANGeL's results on empowerment are promising for women and men, showing that women and men both enjoyed gains in empowerment in unique ways. Specifically, ANGeL improved

women's asset ownership and decisionmaking over income, and improved men's agricultural decisionmaking and decisionmaking over income.

Although there were positive and significant impacts in several interventions, the greatest improvement in empowerment emerged when trainings on agriculture, nutrition, and gender sensitization were combined.

Significant impacts are also found when trained community women delivered nutrition BCC and when agriculture and nutrition trainings were delivered by agriculture extension agents. This could occur because nutrition BCC emphasizes the caregiver's agency and decisionmaking power over resources needed for child nutrition.

Attitudes on gender and relationships of both men and women also improved. For men, the strongest positive changes in attitudes toward gender and relationships are observed when agriculture, nutrition, and gender sensitization trainings are combined, which could be attributed to the gender component. Moreover, positive impacts on men's attitudes towards gender and relationships were observed in two other interventions—nutrition BCC delivered by DAE, and when agriculture and nutrition BCC trainings were delivered by DAE. These interventions both provided information that men would typically not have received in the past—nutrition. Perhaps exposing men to key practices involved in good nutrition also changed their attitudes towards women's roles within the family. The most consistent improvement was women's recognition that they make important contributions to the community, observed in all interventions.

Conclusions

ANGeL's positive findings on agriculture production knowledge and impacts, nutrition knowledge and impacts, and women's empowerment reinforce the potential of the Department of Agricultural Extension to effectively deliver knowledge that positively shapes behaviors.

ANGeL evidence shows that women consistently surpassed men in terms of agriculture knowledge and adoption of improved agriculture practices due to project participation. This demonstrates the value of improving women's contact with agricultural extension services, and bringing women and men together for agriculture production trainings.

While isolated, stand-alone trainings on agriculture and nutrition had impacts, combining trainings on agriculture, nutrition, and gender had much greater impacts. ANGeL's results also show that women consistently had higher achievements than men in terms of agriculture and nutrition knowledge gained, and adoption of improved agriculture production practices. ANGeL's household approach, whereby husbands and wives participated in trainings together, could be an effective vehicle for improving agricultural productivity, nutritional status within the household, and empowerment.

The research suggests that ANGeL's integrated programming that includes gender sensitization is effective in empowering women, an effect that goes beyond the positive impact of providing nutrition BCC to women. Including men in the delivery of nutrition messages may also change their attitudes towards gender roles within the family, and possibly improve their support to women in their productive and reproductive roles.

Besides the knowledge provided during training, ANGeL households did not benefit from any inputs (for example, agricultural inputs like seeds or fertilizer, or cash transfers). In this view, ANGeL provides compelling evidence that knowledge, on its own, can be a remarkably effective tool for stimulating practical action and change, even more so when it is 'layered' with appropriate, complementary nutrition-sensitive interventions.

Moving forward, IFPRI will continue to analyze the ANGeL data to learn more about what changes took place and why as a result of the pilot project. Using these results, IFPRI and the Ministry of Agriculture will work together to make informed, relevant operational and policy decisions for expanding the program.

APPENDIX A: TEST AND ANSWERS ON FARMER KNOWLEDGE

- Using bed and pit method for homestead vegetable production, what are the correct dimensions of the:

  Correct answer. Pit (1.5' x 1.5')

  Correct answer. Bed (3' wide x 0.5' high)

- How do you distinguish between good and bad seeds?

  Correct answer. Good seeds sink to bottom when placed in water. (Bad seeds have dried out and because they are lighter, float in water)

- Identify the benefits of using a composite heap?

  Correct answer. Either use to fertilize plants/land; or Dispose of household waste

- What is the best method of dealing with pests in the homestead garden?

  Correct answer. Use organic pesticides

- What should you use for bio pesticides?

  Correct answer. Any of the following: Neem seeds; Neem leaf; Leaf of Bakain; Leaf of custard apple; Seeds of custard apple; Bis katali; Tobacco; Chili; Mixture of kerosene and soap; Garlic; Onion; Wood Ash; Pudina Leaf; Marygold Flower leaf

- Identify characteristics of good seeds:

  Correct answer. Good seeds are: (1) Mature; (2) Dry and bright color; (3) Hard and strong if bitten; or (4) Sink when placed in water

- How do you store seeds?

  Correct answer. Store in: (1) air tight pot or (2) polythene sack

- What do you need to keep seeds good?

  Correct answer. Any of: (1) Neem leaf; (2) Wooden coal; (3) Sand; or (4) Napthalene

- How do you test for urea fertilizer quality?

  Correct answer. Heat it. It should produce a smell then dissolve

- How do you test for TSP fertilizer quality?

  Correct answer. Any of: (1) Test it for hardness or (2) Dissolve in water

- How do you test for MOP (potassium chloride) fertilizer quality?

  Correct answer. Any of: (1) Test it for hardness or (2) Dissolve in water

- Are you aware of pheromone trap for insects?

  Correct answer. Yes

APPENDIX B: WOMEN'S EMPOWERMENT

Table B.1: The domains, indicators, survey questions, aggregation method, inadequacy cut-offs, and weights in the A-WEAI

Dimension	Indicator name	Survey questions	FTF Variables	Aggregation method	Inadequacy cut-off	Weight
Production	Input in productive decisions	How much input did you have in making decisions about: food crop farming, cash crop farming, livestock raising, fish culture? |To what extent do you feel you can make your own personal decisions regarding these aspects of household life if you want(ed) to: food crop farming, cash crop farming, livestock raising, fish culture?	G2.03 A-C, F G2.04 A-C, F	Achievement in two	Inadequate if individual participates BUT does not has not at least some input in decisions; or she does not make the decisions nor feels she could.	1/5
Resources	Ownership of assets	Does anyone in your household currently have any [ITEM]? Do you own any of the [ITEM]?Agricultural land, Large livestock, Small livestock, Chicks etc; Fish pond/equip; Farm equip (non-mech); Farm equip (mechanized) Nonfarm business equipment House; Large durables; Small durables; Cell phone; Non-ag land (any); Transport	G3.01 – G3.02 A-N	Achievement in any if not only one small asset (chickens, non-mechanized equipment and no small consumer durables)	Inadequate if household does not own any asset or if household owns the type of asset BUT she/he does not own most of it alone	2/15
	Access to and decisions on credit	Has anyone in your household taken any loans or borrowed any cash/in-kind from [SOURCE] in the past 12 months? Who made the decision to borrow/what to do with money/item borrowed from [SOURCE]? Non-governmental organization (NGO); Informal lender; Formal lender (bank); Friends or relatives; ROSCA (savings/credit group)	G3.06 – G3.08 A-F	Achievement in any	Inadequate if household has no credit OR used a source of credit BUT she/he did not participate in ANY decisions about it	1/15
Income	Control over use of income	How much input did you have in decisions on the use of income generated from: Food crop, Cash crop, Livestock, Non-farm activities, Wage& salary, Fish culture? | To what extent do you feel you can make your own personal decisions regarding these aspects of household life if you want(ed) to: Non-farm economic activities? Your own wage or salary employment? Major and minor household expenditures?	G2.05 A-F G2.04 D-E, G-H	Achievement in any if not only minor household expenditures	Inadequate if participates in activity BUT has no input or little input in decisions about income generated, or does not feels she/he can make decisions regarding wage, employment and major household expenditures	1/5
Leadership	Group membership	Are you a member of any: Agricultural / livestock/ fisheries producer/mkt group; Water; Forest users'; Credit or microfinance group; Mutual help or insurance group (including burial societies); Trade and business association; Civic/charitable group; Local government; Religious group; Other women's group; Other group	G5.03 – G5.04 A-J	Achievement in any	Inadequate if is not part of AT LEAST ONE group; inadequate if no groups reported in community	1/5
Time	Workload	Worked more than 10.5 hours in previous 24 hours.	G4.01	NA	Inadequate if works more than 10.5 hours a day	1/5

Source: Malapit et al. (2017), adapted from Alkire et al. (2012)

Table B.2: ANCOVA impacts on A-WEAI indicators - base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
F: Empowerment score	0.77	**0.00**	**0.00**	**0.00**	**-0.00**	**0.02**	3,786
		(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	
M: Empowerment score	0.74	**0.01**	**0.01**	**-0.01**	**0.00**	**0.02**	3,486
		(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	
Diff in empowerment score: M-F	-0.02	**0.01**	**0.01**	**-0.01**	**0.01**	**-0.00**	3,429
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
F: Empowered	0.49	**-0.01**	**0.01**	**0.01**	**-0.03**	**0.05**	3,786
		(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	
F: Prod'n decisions	0.97	**0.00**	**0.00**	**0.01**	**0.00**	**-0.01**	3,786
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
F: Asset ownership	0.96	**0.01**	**0.00**	**-0.01**	**0.01**	**0.02***	3,786
		(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	
F: Credit decisions	0.57	**-0.02**	**0.00**	**0.01**	**-0.07****	**0.03**	3,786
		(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	
F: Income decisions	0.93	**0.04****	**0.03****	**0.03***	**0.02**	**0.02**	3,786
		(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	
F: Group member	0.54	**-0.00**	**0.02**	**0.02**	**0.01**	**0.06****	3,786
		(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	
F: Not time poor	0.80	**-0.04**	**-0.04**	**-0.03**	**-0.03**	**0.01**	3,786
		(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	
M: Empowered	0.52	**0.02**	**0.04**	**-0.03**	**-0.02**	**0.03**	3,486
		(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	
M: Prod'n decisions	0.99	**0.01****	**0.00**	**0.01**	**0.01**	**0.01****	3,486
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
M: Asset ownership	1.00	**-0.00**	**0.00**	**-0.00**	**-0.00**	**-0.00**	3,486
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
M: Credit decisions	0.75	**-0.02**	**0.02**	**-0.01**	**-0.05**	**-0.00**	3,486
		(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	
M: Income decisions	0.99	**0.01***	**0.00**	**0.00**	**0.00**	**0.01****	3,486
		(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	
M: Group member	0.54	**0.03**	**0.05**	**-0.02**	**-0.01**	**0.04**	3,486
		(0.05)	(0.04)	(0.04)	(0.05)	(0.05)	
M: Not time poor	0.66	**0.01**	**0.02**	**-0.02**	**0.00**	**0.03**	3,486
		(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the baseline outcome, a dummy for a missing baseline outcome, and treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table B.3: Single-difference impacts on women's attitudes towards gender and relationships: base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Total gender attitudes score v1	41.01	**0.03**	**0.63**	**-0.10**	**0.41**	**0.27**	3,898
		(0.46)	(0.44)	(0.48)	(0.43)	(0.42)	
Total gender attitudes score v2	39.92	**0.62**	**0.99****	**0.20**	**0.99****	**1.04****	3,898
		(0.49)	(0.47)	(0.52)	(0.44)	(0.43)	
PCA component1 of gender attitudes responses	-0.12	**0.16**	**0.30****	**0.03**	**0.17**	**0.13**	3,898
		(0.16)	(0.13)	(0.15)	(0.13)	(0.13)	
Even when I disagree with spouse, I usually think he/she has valid things to say	4.39	**-0.06**	**-0.10**	**0.00**	**-0.12**	**-0.30*****	3,902
		(0.07)	(0.07)	(0.06)	(0.09)	(0.08)	
I make important contributions to my family	4.66	**0.02**	**0.05**	**-0.04**	**-0.03**	**-0.04**	3,902
		(0.05)	(0.06)	(0.06)	(0.05)	(0.07)	
Some adults in my family do NOT make important contributions to the family	2.41	**0.01**	**-0.24**	**0.07**	**-0.06**	**0.01**	3,901
		(0.17)	(0.15)	(0.17)	(0.15)	(0.14)	
I make important contributions to my community	3.22	**-0.00**	**0.15**	**0.16**	**0.20**	**0.19***	3,899
		(0.12)	(0.11)	(0.11)	(0.12)	(0.11)	
I sometimes refrain from voicing my opinion b/c I fear being ignored/ridiculed	3.44	**0.00**	**-0.06**	**-0.03**	**-0.17**	**-0.17**	3,902
		(0.12)	(0.12)	(0.14)	(0.13)	(0.13)	
I have a hard time saying positive things about myself	3.50	**-0.02**	**-0.07**	**0.04**	**-0.04**	**-0.02**	3,902
		(0.11)	(0.12)	(0.13)	(0.12)	(0.10)	
Women should stand up for themselves to get what they want	4.69	**0.04**	**0.11*****	**0.01**	**0.03**	**0.01**	3,902
		(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	
Women are usually very busy with work that benefits the household	4.74	**-0.00**	**0.08***	**0.01**	**0.01**	**0.03**	3,902
		(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	
Husbands should help wives with HH chores like cooking & taking care of children	4.62	**0.06**	**0.09***	**0.01**	**0.07**	**0.06**	3,902
		(0.06)	(0.05)	(0.06)	(0.05)	(0.05)	
Girls' and boys' behavior is mostly something they are born with	3.84	**0.24****	**0.08**	**0.16**	**0.17**	**0.09**	3,902
		(0.11)	(0.13)	(0.11)	(0.12)	(0.14)	
We can change culture/tradition re what men/women do & how relate to each other	3.89	**0.21***	**-0.03**	**-0.04**	**0.14**	**0.22***	3,903
		(0.12)	(0.14)	(0.13)	(0.14)	(0.13)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

Table B.4: Single-difference impacts on men's attitudes towards gender and relationships: base specification

	Endline mean C	Impact T1	Impact T2	Impact T3	Impact T4	Impact T5	N
Total gender attitudes score v1	40.76	**0.44**	**0.27**	**0.40**	**0.61****	**0.84*****	3,591
		(0.31)	(0.33)	(0.29)	(0.29)	(0.31)	
Total gender attitudes score v2	40.24	**0.54**	**0.40**	**0.30**	**0.75****	**0.67****	3,591
		(0.35)	(0.35)	(0.36)	(0.30)	(0.32)	
PCA component1 of gender attitudes responses	-0.03	**0.06**	**0.06**	**-0.09**	**0.13**	**0.07**	3,591
		(0.14)	(0.12)	(0.12)	(0.13)	(0.13)	
Even when I disagree with spouse, I usually think he/she has valid things to say	4.30	**-0.07**	**-0.04**	**-0.05**	**-0.06**	**-0.04**	3,591
		(0.08)	(0.08)	(0.07)	(0.07)	(0.06)	
I make important contributions to my family	4.60	**0.06**	**0.10***	**0.11****	**0.05**	**0.04**	3,591
		(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	
Some adults in my family do NOT make important contributions to the family	2.47	**-0.08**	**-0.19**	**-0.12**	**-0.24***	**-0.11**	3,591
		(0.14)	(0.14)	(0.11)	(0.13)	(0.14)	
I make important contributions to my community	3.76	**0.13**	**0.00**	**0.01**	**0.08**	**-0.09**	3,591
		(0.09)	(0.09)	(0.09)	(0.09)	(0.10)	
I sometimes refrain from voicing my opinion b/c I fear being ignored/ridiculed	3.17	**-0.07**	**-0.01**	**-0.15**	**-0.12**	**-0.26****	3,591
		(0.12)	(0.11)	(0.09)	(0.12)	(0.12)	
I have a hard time saying positive things about myself	3.36	**-0.03**	**0.01**	**-0.09**	**-0.00**	**-0.15**	3,591
		(0.13)	(0.11)	(0.11)	(0.12)	(0.12)	
Women should stand up for themselves to get what they want	4.45	**-0.04**	**-0.08**	**-0.09**	**0.02**	**0.04**	3,591
		(0.07)	(0.06)	(0.08)	(0.06)	(0.06)	
Women are usually very busy with work that benefits the household	4.52	**0.01**	**-0.02**	**-0.05**	**0.08**	**0.09**	3,591
		(0.05)	(0.06)	(0.06)	(0.05)	(0.05)	
Husbands should help wives with HH chores like cooking & taking care of children	4.44	**0.09***	**0.03**	**0.02**	**0.08**	**0.16*****	3,591
		(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	
Girls' and boys' behavior is mostly something they are born with	4.05	**-0.02**	**0.02**	**-0.10**	**0.01**	**-0.13**	3,591
		(0.08)	(0.08)	(0.09)	(0.09)	(0.10)	
We can change culture/tradition re what men/women do & how relate to each other	3.73	**0.06**	**0.12**	**-0.02**	**0.01**	**0.01**	3,591
		(0.10)	(0.10)	(0.10)	(0.09)	(0.10)	

Source: 2016 Baseline and 2018 Endline Surveys for ANGeL Evaluation, IFPRI.

Note: Standard errors adjusted for clustering at block level are in parentheses. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level. Base specification includes as independent variables the treatment indicators. Endline mean C = mean value of outcome for control households at endline. T1=Nutrition BCC by Sub-Assistant Agriculture Officers (SAAOs). T2=Nutrition BCC by female community nutrition workers. T3=Agricultural production training by SAAOs. T4=Ag production + Nutrition BCC by SAAOs. T5=Ag production + Nutrition BCC by SAAOs + gender sensitization. All treatments targeted to men and women.

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