Quality Diets for Better Health:

Longitudinal Baseline Report

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Abbreviations

CIP	International Potato Center
cm	Centimeters
EU	European Union
FIES	Food Insecurity Experience Scale
HBT	Healthy Baby Toolkit
HDDS	Household Dietary Diversity Score
HEW	Health Extension Worker
HEP	Health Extension Program
HHS	Household Hunger Score
HLC	Healthy Living Club
IQR	Interquartile Range
IYCF	Infant and Young Child Feeding
kg	kilograms
MAD	Minimum Acceptable Diet
MAHFP	Months Adequate Household Food Provisioning
MDD-W	Minimum Dietary Diversity for Women
mL	Milliliter
OFSP	Orange Fleshed Sweetpotato
PIN	People in Need
RDA	Recommended Dietary Allowance
RAE	Retinol Activity Equivalents
SD	Standard Deviation
SNNPR	Southern Nations, Nationalities, and Peoples Region (Ethiopia)
ToT	Training of Trainer
VAD	Vitamin A Deficiency
QDBH	Quality Diets for Better Health
WHO	World Health Organization

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Background

Undernutrition impedes child growth and development, and is a cause of 45% of deaths of children under 5 years [2]. The first 1000 days are particularly consequential, not only for immediate health and nutrition status, but also for lifelong health, education, and socioeconomic outcomes. Stunting, defined as a length- or height-for-age below -2 standard deviations from the median of the World Health Organization (WHO) Child Growth Standards [3, 4], is the most common form of undernutrition globally. Stunting indicates chronic nutrient insufficiency – either due to insufficient intake or increased, unmet nutrient demands, such as those resulting from diarrhea or other illness [5]. A majority of liner growth failure accumulates from 3 to 23.9 months [6], with limited opportunity to recover from growth failure outside of this window. Inadequate complementary feeding, which can include inadequate amounts, inappropriate types, and/or insufficient variety, is a cause of stunted growth and development [7]. Complementary feeding is the giving of foods and liquids in addition to breastmilk or breastmilk substitutes, and generally refers to child feeding between 6 and 23.9 months. Given that growth failure rapidly accumulates during this same period, assurance of appropriate complementary feeding can play an important role in supporting appropriate growth and development.

Vitamin A: Sources, Deficiency and Supplementation

Vitamin A is a fat-soluble vitamin, found in animal source foods, such as flesh foods and dairy products. Its precursor, beta-carotene, is found in a number of fruits and vegetables, such as mango, papaya, carrots, dark green leafy vegetables, orange or yellow squash, and orange fleshed sweetpotato. Vitamin A is essential for appropriate eye development and functioning, the maintenance of epithelial tissue, and healthy immunity. Vitamin A deficiency (VAD) is one of the most common micronutrient deficiencies worldwide, having a profound impact on maternal and child health. It is associated with physical and physiological ocular abnormalities, increased risk of infectious diseases, such as diarrhea and/or measles, and death. Alone, VAD is attributed with 6% of deaths of children under 5 years [8]. Deficiency is typically defined as having serum retinol less than 0.70 µmol per liter, or the presence of xerophthalmia [9]. Supplementation has been shown to reduce all-cause mortality among children [10, 11]. Currently, the WHO recommends high dose vitamin A supplementation every 6 months for children 6 to 59 months of age as an overall childhood mortality-reduction strategy in settings where VAD is of public health significance[12].

Evidence Based Interventions

Nutrition Education.

Nutrition education to promote optimal complementary feeding in food insecure populations, with or without the provision of supplemental foods, has been associated with improved child nutritional status [13].

The Healthy Baby Toolkit.

The social and behavior change strategy developed for the Quality Diets for Better Health program was implemented in all intervention kebeles by People in Need. The team is also using this opportunity to test a social and behavior change innovation for complementary feeding known as the Healthy Baby Toolkit (Figure 1,). Developed by Emory University and the Georgia Institute of Technology, the toolkit consists of a (a) feeding bowl, (b) a slotted spoon, and (c) a counseling card. The feeding bowl has graduated demarcations to denote serving sizes of 200 milliliters (mL) for infants 6 to 8 months, 275 mL for infants 9 to 11 months, 340 mL for children 12 to 23 months, and 500 mL for pregnant and lactating women. The symbols marking each line also show the recommended number of meals per day for each child group, or one symbol for pregnant and lactating women to encourage that these women receive at least one extra meal per day. The spoon is designed with slots, such that when a caregiver is preparing porridges or gruel-like complementary foods, she can check that the food does not drip through the slots. Thus, the spoon encourages the preparation of thick, nutrient dense complementary foods. The counseling card relies on pictorial messages to explain and reinforce the messages of the previous two, and to promote dietary diversity and hygienic food preparation and feeding.

This HBT has been tested for acceptability, feasibility and impacts in Kenya, Malawi, Tanzania and India. In qualitative testing, mothers found the toolkit was easy to use, and a perceived it as improving their child's health [14-16]. In quantitative testing, the HBT was also found to significantly improve children's portion sizes, food thickness, and meal frequency in Malawi [17]. The primary barrier that was cited to using the toolkit was food insecurity [17].

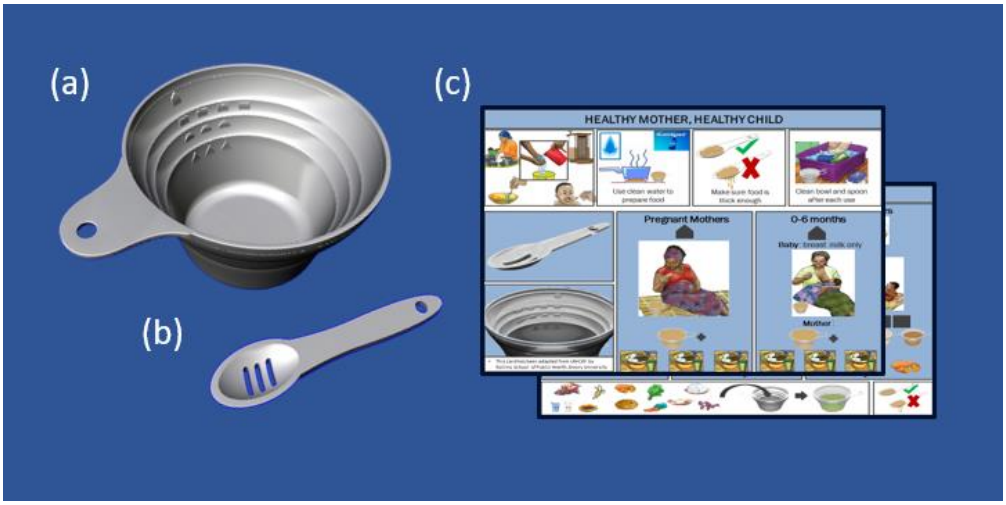


Figure 1. The Healthy Baby Toolkit.

Orange Fleshed Sweetpotatoes.

Despite the clear success of vitamin A supplementation in reducing child mortality, gaps and disparities in supplementation coverage persist. An average orange-fleshed sweetpotato (OFSP) root provides 13.1 milligrams of beta-carotene [18] – or 1100 retinol activity equivalents (RAE). With only lactating women having a Recommended Dietary Allowance (RDA) of more than 1100 RAE per day (Table 1), an average OFSP root would exceed vitamin A needs for everyone else. While some vitamin content may be lost in cooking, OFSP retains, on average, over 90% of their carotenoids after being boiled [19]. Complementary foods made from OFSP are a better source of vitamin A than complementary food made from white fleshed sweet potato or maize-based commercial complementary foods [20]. Notably, vitamin A is a fat-soluble vitamin; therefore, dietary fat is required for the absorption of vitamin A.

Table 1. Recommended Dietary Allowances for vitamin A by age and life stage, in retinol activity equivalents (RAE) [1].

	Male	Female	Pregnancy	Lactation
0-6 months	400	400		
7-12 months	500	500		
1-3 years	300	300		
4-8 years	400	400		
9-13 years	600	600		
14-18 years	900	700	750	1200
19-50 years	900	700	770	1300
51+ years	900	700		

Researchers first demonstrated that OFSP promotion could increase vitamin A intake in young children in Kenya 1999 [21]. In 2005, van Jaarsveld et al demonstrated that giving OFSP to school-aged children in in a controlled setting in South Africa improved their vitamin A status [22]. In subsequent years, coordinated projects in sub-Saharan Africa aimed to increase vitamin A intake of young children through nutrition sensitive agricultural approaches. Such approaches increase OFSP supply by supporting OFSP-producing farmers, while simultaneously increasing OFSP *demand* through nutrition education and value chain development. Evaluation of these programs demonstrate improvements in both vitamin A intake and status of young children [23-27]. Interestingly, causal mediation analyses of programs in Uganda and Mozambique suggest that nutrition knowledge seemed to play only a minor role in the realization of increased vitamin A intake [23].

Orange fleshed sweet potatoes (OFSP), bio-fortified with vitamin A, are a programmatically sustainable, food-based means of combatting VAD in sub-Saharan Africa. Particularly considering the aforementioned gaps in vitamin A supplementation, a food-based strategy for combatting vitamin A deficiency may be an ideal complement.

Health Extension Program in Ethiopia

IN 2003, seeking to improve health outcomes, Ethiopia's Federal Ministry of Health launched the Health Extension Program (HEP) in four large, rural regions; the program subsequently expanded to all rural communities and then to include urban areas in 2006 and 2010, respectively [28]. The HEP includes a series of "packages" – or focus areas – that fall into four programs: hygiene and environmental sanitation, disease prevention and control, family health services, and head education and communication.

The program established at least one health post in each kebele, intended to serve 3,000 to 5,000 people. At health posts, Health Extension Workers (HEW) provide basic support and services, such as immunizations, contraceptives, and screening and referrals as needed [28]. All HEW are females who have completed at least grade 10. They attend a one-year training, and in most cases return to the communities from which they came to serve. Each health post has at least two HEW. Since its inception, several health outcomes have improved nationwide, though it is difficult to attribute such outcomes to the HEP, the program has been well received in communities [29].

Quality Diets for Better Health

Quality Diets for Better Health (QDBH) is a 54-month project that seeks to introduce OFSP as a reliable, bioavailable source of vitamin A and energy into the food supply within project areas, and to improve the quality of diets of young children and their families. The project is led by the International Potato Center (CIP), in partnership with People In Need (PIN) and Emory University; there are additionally multiple local collaborators and stakeholders. Funding for the project is provided by the European Union.

Specific program activities are organized under four, overarching program goals:

Program Goal 1: Establish 53 OFSP vine multiplication sites, which will provide 15,000 local households with inputs and knowledge required for homestead production of OFSP. *(Activities under this goal can be thought of as improving the supply of OFSP in the project areas.)*

Program Goal 2: Educate 15,000 women and 10,000 men on the benefits of OFSPs, recipes for their use, and child nutrition practices. *(Activities under this goal can be thought of as improving the demand of OFSP in the rural project areas.)*

Program Goal 3: Improve supply and demand for OFSP products in urban areas with increased consumption of vitamin A. *(Activities under this goal are focused on urban markets and demand for products in urban areas.)*

Program Goal 4: Project monitoring and evaluation, including recommendations for larger-scale OFSP dissemination in SNNPR.

Direct beneficiaries are households with pregnant women and/or young children who are enrolled in Healthy Living Clubs. A Health Living Club (HLC) is a group of approximately 30 households which will gather approximately monthly for 8 sessions on OFSP agriculture and/or nutrition education. Members of HLCs also receive OFSP vines and technical support in planting, managing and harvesting OFSP. The QDBH project works closely with the government's Agriculture and Health Extension Programmes by building the capacity of local Health Extension Workers and Agriculture Development Agents, who are invited to Training of Trainer (ToT) sessions developed as part of QDBH. These agents receive ongoing support from CIP and PIN to incorporate project activities into their existing work. By working with these

systems, QDBH aims to reach a greater number of households, to build the capacity of government workers, and to demonstrate the sustainability of the project.

Project implementation was originally planned for 41 kebeles (the smallest administrative unit in Ethiopia) in three woredas - the Aleta Chuko woreda in Sidama zone and the Wonago and Dila Zuria woredas in the Gedeo zone. Project activities will be implemented in 13 kebeles in the first year of QDBH, with scale up to 29 and 41 kebeles in year 2 and years 3 and 4, respectively. The intensity of project within kebeles will also increase as the project is scaled up: in year 1, there will be two HLCs per kebele, but this number will increase to 4 or 5 HLCs per kebele in later years, depending on kebele size and demographics. The project aims to reach 15,000 direct beneficiaries.

Southern Nations, Nationalities, and Peoples' Region, Ethiopia

Child Nutrition

In the Southern Nations, Nationalities, and Peoples' Region (SNNPR), Ethiopia, an estimated 38.6% of children under 5 years are stunted [30] and 13.3% suffer from VAD [31]. Though rates of breastfeeding initiation and duration tend to be high in SNNPR, the diets of infants and young children in SNNPR are wanting. In the 2013 Ethiopian National Food Consumption Survey, children aged 6 to 35 months in SNNPR had the lowest overall energy intake, as well as the lowest protein and fat intakes across all regions of the country [32]. Children in this age group in SNNPR had a median daily vitamin A intake of 34 retinol activity equivalents (RAE) [32].

Setting: Sidama and Gedeo Zones

While the QDBH project's main office is in Hawassa, SNNPR, implementation of the project is designed to grow from implementation in 13 kebeles to 41 kebeles located in three woredas in two zones: Aleta

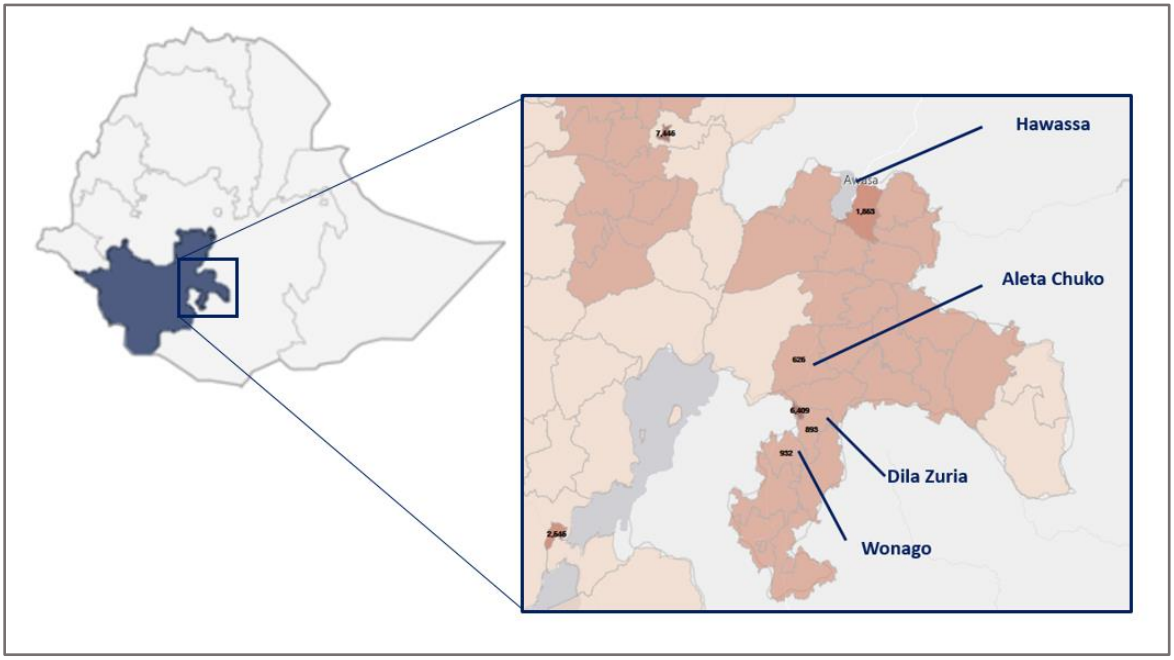


Figure 2. Quality Diets for Better Health project area.

Chuko in the Sidama zone and Dila Zuria and Wonago in the Gedeo zone (Figure 2). Each kebele, woreda and zone have unique characteristics relevant to the QDBH project.

The nation's most densely populated region is SNNPR, with an average of 114 persons per square-kilometer, as of 2015 [33]. However, within the southern region, the project area includes some of the most densely populated woredas. Based on the 2007 census, Aleta Chuko in the Sidama zone has an average population density of 625 persons per square-kilometer, while Dila Zuria and Wonago in the Gedeo zone have population densities of 893 and 932 persons per square-kilometer [34].

Formative Nutrition Work

Prior to implementation of the Healthy Living Clubs, the team from Emory University conducted formative work to identify motivators and facilitators of infant and young child feeding (IYCF) practices, and to assess acceptability of various program components. In the spring of 2017, we reviewed literature relevant to these objectives. In the summer of 2017, we conducted focus group discussions and key informant interviews. Details of this formative work, including methods and findings, can be found elsewhere [35]. We used findings from the formative work to develop problem and solution trees for key IYCF practices, identifying barriers and facilitators of each.

Findings from the formative work were also used to develop and Social Behavior Change Strategy and Healthy Living Club Curriculum [36]. We used the COM-B system, defined and characterized by Michie *et al* [37], which states that factors that influence behavior (B) can be categorized into the following domains: capability (C), opportunity (O), and motivation (M).

Longitudinal Study

Emory University is conducting a one-year cluster-randomized controlled trial to evaluate the effect of the QDBH project on energy and vitamin A intakes of infants and young children in HLCs, including any added benefit of the HBT on these outcomes. The longitudinal study is nested within the larger project. Of the 41 kebeles included in the project, 26 were considered eligible for project activities in year 1 based on their potential for growing OFSP and the absence of other community nutrition projects (aside from the standard Health Extension Program). Of those 26 kebeles, seven were randomly selected for the QDBH project components and to also receive the HBT (referred to as the full intervention); six kebeles were randomly selected to receive the QDBH project components without the HBT (referred to as the partial intervention); and seven were randomly selected to act as control kebeles (Figure 3). The seven control kebeles will be included in the final stage of project scale-up, which will occur after the longitudinal study has ended. The remaining kebeles not selected for participation in the longitudinal study will still receive QDBH project inputs, but without regard to the longitudinal study timeline.

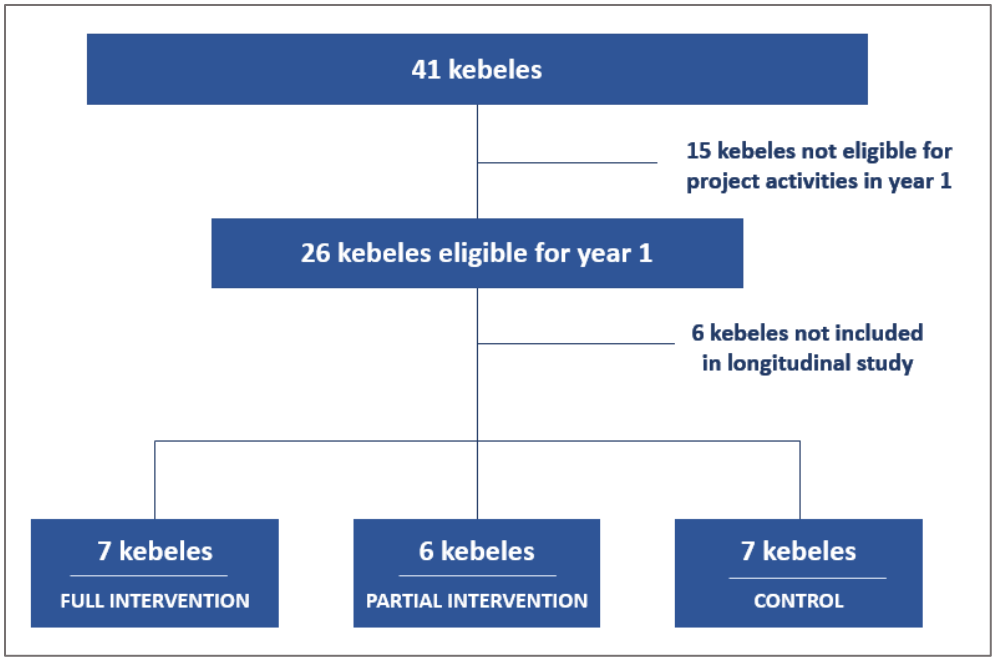


Figure 3. Process of kebele randomization for the longitudinal study.

Timeline

Project activities began in the spring of 2017, with hiring of staff, holding stakeholder meetings, formative work, OFSP vine multiplication, and other activities to build partnerships and around preparing to implement project activities. The International Potato Center began distributing vines in September 2017, at which time households were enrolled in Healthy Living Clubs. Households with women in late pregnancy or with infants less than 3 months were preferentially enrolled, in order to provide enough eligible households for the longitudinal study. The first Healthy Living Club sessions began in November 2017 with an agriculture-focused training.

The longitudinal study was designed to collect data at three time points: a baseline, a midline, and an endline survey. The baseline survey was scheduled for December 2017 – after Healthy Living Clubs had been formed but before any nutrition-focused Healthy Living Clubs had begun. The midline and endline surveys were completed in August 2018 and February 2019, respectively; those reports are forthcoming. The purpose of this report is to describe baseline characteristics of the sample, including any marked differences between woredas and intervention groups.

Methods

Eligibility Criteria

Households were considered eligible for participation in the longitudinal baseline survey if they met the following criteria at the time of the baseline survey:

1. Infant less than 6 months of age in the household
2. Primary caregiver and, if possible, head of household give informed consent

3. Participation in a Healthy Living Club (full and partial intervention kebeles *only*)

Children with serious health problems (such as HIV/AIDS, birth defect) were excluded.

Sample Size Estimation

A target sample size of 600, or 200 per arm, was estimated assuming the following parameters: difference in energy intake of 100-150 kilocalories per day; a 10-15% coefficient of variation; an intra-class correlation coefficient of 0.05; and 30% lost to follow-up.

Sampling Strategy

In the months preceding the baseline survey, PIN compiled lists of the households in each HLC; these lists included the ages of any children in the household who was under 6 months of age, as well as the current gestational age of any pregnant woman in the household. For control kebeles, which do not have HLCs, a complete listing of all households in the kebele, including the same demographic information previously stated, were compiled.

From these listings, 601 households were identified as likely to meet the eligibility criteria. Considering that some percentage of eligible households may refuse to participate, may have moved, may not be found, or may not be enrolled for other reasons, there was concern that fewer than 600 households (the desired sample size) would be enrolled. Therefore, every household meeting the stated inclusion criteria was invited to participate in the baseline survey, regardless of whether or not they were listed in the HLC listings (in intervention kebeles) or the kebele-wide household listings (in control kebeles).

Personnel

Emory University was responsible for planning, training data collectors, managing data collection, managing data entry, data cleaning, and analyses. An Emory PhD student in the Nutrition and Health Sciences Program at Emory University trained enumerators, oversaw data collection and entry, and completed data cleaning and analyses under the guidance of Amy Webb Girard, of the Hubert Department of Global Health at Emory University. The International Potato Center provided logistical support and management of data collectors' payments.

Enumerators were recruited primarily through the Hawassa University School of Nutrition, Food Science and Technology. Requirements for the position of enumerator included: fluency in English, Amharic, and either Sidamigna or Gede'offa; Bachelor's degree in nutrition, public health, nursing, or related field (Master's preferred); preference was given to applicants with experience in data collection or data entry. As part of the QDBH project goal of building the capacity of Hawassa University students, graduate students in the School of Nutrition, Food Science and Technology were given preference.

Due to a scarcity of applicants meeting language requirements, particularly for Gede'offa, additional applications were solicited through community members who had knowledge of requirements and knowledge of communities where local languages were spoken.

In total, 16 enumerators were invited to a 5-day training in Hawassa, which took place from 20 November 2017 to 24 November 2017. The training program is outlined in Box 1. Of those who completed the training, 12 were invited to participate in data collection and accepted; the remaining were either excluded based on performance during the training or availability.

Box 1. Enumerator Training Schedule.

Day 1	Introductions, project overview, research ethics
Day 2	Informed consent, introduction to questionnaire
Day 3	Questionnaire (continued)
Day 4	Questionnaire (continued)
Day 5	Pilot test

Two teams of two anthropometry specialists were hired for all anthropometric measurements. Each team had at least one clinical nurse with extensive experience in anthropometry. Both teams underwent a 1-day training followed by 1-day of anthropometry standardization exercises described elsewhere [38]. The trainers for anthropometry training were Emily Faerber, a registered dietitian and Emory PhD student in supervising the baseline survey, and Dayan Taye, a clinical nurse; both have experience in taking anthropometric measurements and in supervising surveys with anthropometry. Standardization was done in the Gedeo zone, with infants all less than 6 months of age.

Three supervisors with previous data collection/supervision experience with CIP were hired. Their responsibilities were to oversee data collection, facilitate communication with key persons in the kebeles, manage per diem payments for necessary community guides, and check completed questionnaires for errors. Each supervisor had extensive experience with data collection and had worked with CIP on previous projects.

Data Collection Instruments

The questionnaire was translated to Amharic by a former CIP employee who had worked on integrated OFSP and nutrition projects in the past and therefore had technical expertise. The baseline questionnaire consisted of the following 11 sections:

1. Household identification
2. Household roster and eligibility
3. Housing characteristics and ownership of durable assets
4. Sweetpotato farming practices
5. Livestock and other farming practices
6. Household food security
7. Basic food purchasing practices
8. Water, sanitation, and hygiene
9. Household and caregiver dietary diversity
10. Basic child health information
11. Vitamin A and nutrition knowledge assessment

The questionnaire was reviewed in detail during enumerator training, including comparisons between English and Amharic versions. Enumerators were given time to practice administering the questionnaire in their local languages. Where inconsistencies between English and Amharic existed, the inconsistencies were discussed as a group and changed or clarified as appropriate.

Enumerators conducted 1 day of pilot testing in Sidama (excluding anthropometry), and 2 days of pilot testing in Gedeo (1 day excluding anthropometry, 1 day including anthropometry).

Anthropometry equipment procured from outside the country was unavailable due to being held with customs and immigration. Two wooden Schorr boards and one SECA scale were obtained from Hawassa University, and one standing digital scale was borrowed from a health office. However, mid-way through the survey, the health office requested their scale back and another scale had to be procured from a local health post.

Data Collection and Entry

Data collection commenced on 25 December, 2017 and ended on 18 January, 2018. Data were collected Monday through Saturday, with Sundays off or, if necessary, were used to re-train or address problems with completed questionnaires. Christmas in Ethiopia was observed on 7 January 2018. Therefore, data collection was paused from 5 January until 9 January in observance of this national holiday.

Data were entered into a CSPro 7.0 concurrently with data collection, by two enumerators with previous experience with data entry into CSPro. Each questionnaire was entered once. Following data entry, the supervising PhD student or the two enumerators then visually inspected each questionnaire and the entered data to verify data entry and make corrections where needed.

Ethical Approvals

All research and evaluation protocols and data collection tools were reviewed and approved by the Emory University Internal Review Board which oversees research ethics at Emory University.

Data Cleaning

Data were exported from CSPro to SAS 9.4 for cleaning. Frequencies and/or distributions of all variables were assessed for outliers or inconsistencies. For values that were missing, implausible, or those flagged for inconsistencies with other variables or as being unusual, paper copies of the questionnaires were consulted to check for data entry errors. Where no data entry error had occurred, the data were examined in totality (considering responses to other questions as well as distribution of responses of the rest of the sample) on a case-by-case basis, and cleaned as appropriate.

Data Analysis

Continuous variables were assessed for normality by examining histograms and skewness and kurtosis (in most cases, skewness and kurtosis of less than |1.0| was considered compatible with normality). Means and standard deviations (SD) are presented for normally distributed variables, where medians and interquartile range (IQR) are presented for non-normally distributed continuous variables. Count variables (such as the number of food groups consumed) were treated as continuous if their distribution

mirrored normal; otherwise count variables were grouped by meaningful cutoffs and treated as categorical. For categorical variables, crude numbers and percentages are presented.

For continuous, nominal, and ordinal variables, unadjusted linear, logistic, and multinomial regression, respectively, was used to obtain p-values for differences across woredas and intervention group. To obtain p-values for differences across intervention group while controlling for woredas, the same form of regression was used by woredas was added as a covariate. In cases where one or more cell counts was 0, p-value estimates are unreliable and therefore omitted.

Unless otherwise noted, all descriptives and analyses for this report were done in SAS-callable SUDAAN (SAS 9.4, SAS Institute INC, Cary, NC; SAS-callable SUDAAN 11.0.3, RTI International, Research Triangle Park, NC) to account for clustering at the kebeles. Given that all eligible, consenting households were included in the analyses, a finite population correction was applied to estimates of confidence intervals and p-values by specifying a sampling without replacement design.

Variable Specification

Education and Occupation Categories

When completing the household roster, respondents provided the highest level of educational attainment that had been completed at the time of the survey for each household member over 5 years and older, as well as their primary and (if applicable) secondary occupation.

Head of households' and caregivers' highest level of completed education was used to categorize education as follows: less than Cycle 1 completed (Cycle 1 ends at grade 4), Cycle 1 completed, Cycle 2 completed (Cycle 2 ends at grade 8), and secondary school or higher completed.

For occupation categories, head of household and caregiver were considered as having no employment outside the home only if they cited no employment, being a housewife, or being retired as both their primary and secondary forms of occupation. Heads of households' occupations were otherwise classified according to their primary occupation. If a caregiver selected being a housewife as her primary occupation, but selected some other form of employment as her secondary occupation, then that was counted as her employment status for the purpose of this report. For example, if a caregiver responded that her primary occupation was a housewife and her secondary occupation was agriculture, then she was classified as working in agriculture. If a caregiver had both primary and secondary employment outside the home, then her primary employment was used to categorize her status.

Wealth Index.

A wealth index was developed using methods described in detail elsewhere [39-42]. Briefly, indicators were developed based on ownership of durable assets (whether the goods were owned by anyone in the household or not), housing characteristics (floor, roof and wall materials), number of rooms for sleeping per person in the household, cooking fuel and location, source of drinking water, and type of sanitation facility. Categorical indicators were dichotomized into dummy variables while combining similar categories if any one category had less than 6 (1%) responses. Continuous variables were standardized. Indicators with insufficient heterogeneity were not included in the final wealth index – that is if an indicator was so rare that less than 1% or was so ubiquitous that more than 99% had an affirmative response, it was not included in index construction. If any of the aforementioned data were

missing, provided the number of missing was less than 1% of the whole sample, the missing value was replaced with the woreda-specific mean.

Principal component analyses was then used to assign weights to each indicator, resulting in a quantitative score that follows a standard normal distribution. Lower values correspond to less wealth whereas higher values correspond to greater wealth. For the sake of interpretability, the continuous wealth index was categorized by quintile, with the first quintile representing poorer households and the fifth quintile representing the wealthiest.

It should be noted that the indicators used in this wealth index are "more reflective of longer-run household wealth or living standards" [39] rather than short term fluctuations in income, expenditures, or job security.

Water, Sanitation, and Hygiene.

Households' main source of drinking water was classified as improved or unimproved according to WHO and UNICEF guidelines [43]. Improved sources of drinking water include water piping into dwelling, piping into yard/plot, public tap, tubewell or borehole, protected well, protected spring, bottled water, and rainwater. Unimproved sources of drinking water, then, include unprotected spring, unprotected well, cart with small tank, a tanker truck, or surface water.

Additionally, based on WHO and UNICEF updated guidelines as of 2017, main source of drinking water was also classified according to a "ladder" system as safely managed, basic, limited, unimproved, or surface water [44]. According to this system, safely managed sources are improved sources that are on the household premises; basic water sources are improved and require not more than 30 minutes to collect (including wait time and round-trip travel time); limited water sources are improved sources that do require more than 30 minutes to collect; unimproved water sources are unprotected wells or unprotected springs, and surface water sources include rivers, lakes, and so on [44].

Adequate methods of treating drinking water include boiling, adding bleach or chlorine, use of a ceramic, sand, or composite water filter, and solar disinfection. Any other method is considered "inadequate" (though it may be paired with an appropriate method, which would be considered adequate water treatment) [43].

Each households' sanitation facility was classified as improved or unimproved [43]. Improved toilets are those that are flush (including pour flush) that connect to a sewer, septic tank, or pit; a ventilated pit latrine; a pit latrine with a slab; or a composting toilet.

Each household's toilet was also classified according to the updated WHO/UNICEF ladder categorization [44]. Safely managed toilets are improved, are not shared with other households, and "where excreta are safely disposed of in situ or transported and treated offsite" [44]. Basic toilet facilities are improved toilets that are not shared with other households; limited toilet facilities are improved toilets that are shared between two or more households; unimproved toilets include pit latrines without slabs, hanging latrines, or bucket latrines; and open defecation includes open spaces such as fields, forests, bushes, or bodies of water [44]. For the purpose of this report, insufficient data were collected to distinguish safely managed from basic, and therefore safely managed is excluded as an option.

Food Insecurity.

Food insecurity was assessed using three different indicators.

Months of Adequate Household Food Provisioning (MAHFP) [45] has a recall period of one year. Respondents are asked if there were any months in the past year in which they did not have enough food to meet their family's needs. Those with affirmative responses are asked to state in which months they did *not* have sufficient food; this number is then subtracted from 12 months in the year such that higher numbers represent more food secure months. Ethiopia uses a 13-month calendar – with 12 months each consisting of 30 days plus one thirteenth month, *Pagume*, consisting of 7 days. Therefore, the indicator was modified to include the thirteenth month. *Pagume* is sometimes viewed as a holiday and therefore patterns of food access may be quite different.

The Food Insecurity Experience Scale (FIES) is an "experience-based metric of severity of food insecurity that relies on people's direct response to a series of questions regarding their access to adequate food" [46].

Household Hunger Score (HHS) [47] is a rapid, 3 item tool that uses a 4 week recall to assess hunger in the household. The 3 items in the HHS assess moderate-severe states of household food insecurity and do not distinguish mild food insecurity from none. The scale has been cross-contextually validated.

Women's and Household Dietary Diversity.

At the time of the baseline survey, all index children were infants less than 6 months. Therefore, because exclusive breastfeeding is recommended, there is no indicator of dietary diversity of infants at baseline.

Caregivers' dietary diversity was assessed with the Minimum Dietary Diversity for Women (MDD-W) indicator [48]. The indicator is based on women's consumption of foods from 10 food groups in the previous day; the food groups are listed in Table 2. Any foods or beverages consumed by the woman are included, whether they are consumed at home or away from home. The list-based method was used. The indicator dichotomizes respondents as having minimum dietary diversity if they consume at least 5 food groups, and inadequate dietary diversity if less than 5 food groups were consumed.

Household dietary diversity – measured via the Household Dietary Diversity Score (HDDS) – was measured as an indicator of household food access, considered a "proxy measure of the socio-economic level of the household" [49]. The reference period for this recall is the previous day, and unlike indicators of dietary adequacy, only includes foods eaten at or prepared at home. The 12 food groups included in the HDDS are listed in Table 2.

Table 2. Food groups included in the Minimum Dietary Diversity for Women and Household Dietary Diversity Score indicators.

Minimum Dietary Diversity for Women [48]	Household Dietary Diversity Score [49]
1. Grains, white roots and tubers, and plantains 2. Pulses (beans, peas, and lentils) 3. Nuts and seeds 4. Dairy 5. Meat, poultry and fish 6. Eggs 7. Dark green leafy vegetables 8. Other vitamin A-rich fruits and vegetables 9. Other vegetables 10. Other fruits	1. Cereals 2. Roots and tubers 3. Vegetables 4. Fruits 5. Meat, poultry, and offal 6. Eggs 7. Fish and seafood 8. Pulses, legumes, and nuts 9. Milk and milk products 10. Oils and fats 11. Sugar and honey 12. Miscellaneous

Production Diversity.

A production diversity index was created to reflect homestead production of foods falling into different food groups. The food groups used in the production diversity index mirror the food groups used in the Minimum Dietary Diversity for Women (MDD-W) indicator [48] described above.

For each food group, one point was added to the production diversity score if the household produced at least one food belonging to that food group. A household can receive only one point per food group; that is, if a household grew more than one food in any particular food group, they received only one point for that food group. For example, a household producing both tomato and cabbage would receive one point for the "other vegetables" group. However, a household producing tomato and kale would receive two points – one for "other vegetables" and one for "dark green leafy vegetables."

If a household owned livestock and reported the *primary* purpose of that livestock fell into any of the animal source food groups, then one point was given for that food group. For example, a family with a cow for producing milk would receive one point for "dairy." However, if the family reported the primary purpose of owning the cow was to breed and sell, then no point would be given. Thus, the highest possible value for the production diversity score is 10. Coffee, chat, sugar cane, and honey did not count toward any of the food groups in the production diversity score, though several are common in the project area.

Additionally, because OFSP vines had been distributed and planted at the time of the baseline survey, a second index was tabulated which excludes OFSP to allow for testing of a truer baseline production diversity.

Antenatal Care Index

In addition to examining individual antenatal health seeking behaviors, an index was created to summarize antenatal care (ANC). The indicators included and points assigned to each are shown in Table 3; there are 10 points possible.

For households with incomplete data, one ANC index was tabulated in which households missing data on any of the indicators included in the index are excluded, and one ANC index was tabulated where missing values for indicators are replaced with woredas-specific means for that indicator.

Table 3. Scoring of Antenatal Care Index.

Component	Points
Received any antenatal care during pregnancy with index child	+1
Timing of first antenatal visit	
First trimester	+2
Second trimester	+1
Third trimester	+0
Total number of antenatal visits	
4 or more	+2
2 or 3	+1
Received advice on maternal nutrition during pregnancy	+1
Received advice on infant and young child feeding	+1
Location of delivery	
Hospital (private or public) or health center	+2
Health post	+1
Home (own or someone else's) or other	+0
Birth was attended by a skilled professional	+1
Points Possible	10

Nutrition Knowledge Score.

A nutrition knowledge score was developed consisting of the following domains: healthy growth, vitamin A, colostrum, timely initiation of complementary foods, age of introduction of thick consistency, meal frequency, and portion size. Each of the domains was given equal weighting – two points each – with the exceptions of colostrum and vitamin A. Knowledge of colostrum was weighted at one point, because it consists of only one question and because feeding colostrum is not a primary focus of the QDBH project or the HLC curriculum. The vitamin A domain, on the other hand, was weighted slightly higher, at three points. The reason being that vitamin A knowledge is primary focus of the project. Details of the scoring system are shown in Table 4.

Domain specific-scores were tabulated, followed by the complete knowledge score based on each of the domains and their respective weights.

Table 4. Nutrition knowledge scoring system.

Domain	Indicator Questions / Responses	Scoring	Domain Weight
Healthy growth:			2
	What makes a child grow well? (open ended)		
	Mentioned breastfeeding	+1	
	Mentioned giving enough food	+1	
	Mentioned giving a variety of foods	+1	
	Mentioned child not getting sick often	+1	
Vitamin A:			3
	Have you ever heard of vitamin A?		
	Yes	+1	
	No / Don't know	+0	
	Why is vitamin A important (open ended)		
	Prevents disease / diarrhea	+1	
	For healthy eyes and vision	+1	
	Don't know	+0	
	Can you name 3 sources of vitamin A?	+1 per correct response	
Colostrum:			1
	Is it good or bad to give the first milk (colostrum)?		
	Good	+1	
	Bad or Don't know	+0	
Timely introduction of diverse complementary foods:			2
	At what age should a child first be given [list of 12 foods]?[1]		
	6 months	+2	
	7 or 8 months	+1	
	<6 or >8 months	+0	
Timely introduction of thick complementary foods:			2
	At what age should a child be given thick porridge like this [show photograph]		
	6 months	+2	
	7 or 8 months	+1	
	<6 or >8 months	+0	
Meal Frequency:			2
	How many times per day should 6 to 8 months old children be fed?		
	2 or more times	+1	
	Less than 2 or Don't know	+0	

How many times per day should 9 to 11 months old children be fed?		
3 or more times	+1	
Less than 2 or Don't know	+0	
How many times per day should 12 to 23 months old children be fed?		
3 or more times	+1	
Less than 2 or Don't know	+0	
Portion Size:		2
How many buna cups should a 6 to 8 months old child be fed per meal?		
3 or more buna cups	+2	
2 buna cups	+1	
1 buna cup or less	+0	
How many buna cups should a 9 to 11 months old child be fed per meal?		
3 or more buna cups	+2	
2 buna cups	+1	
1 buna cup or less	+0	
How many buna cups should a 12o 23 months old child be fed per meal?		
3 or more buna cups	+2	
2 buna cups	+1	
1 buna cup or less	+0	

[1]Foods listed are: water, porridge/gruel, avocado, haricot beans, sweetpotato, egg, mango, cow's milk, goat meat, kale, chicken, and lentils

As previously discussed, at the time of the baseline survey, HLC formation and OFSP vine distribution had already begun, and therefore it is reasonable to assume that there may be differences in vitamin A knowledge at baseline because of recruitment activities. Therefore, a nutrition knowledge score that *excludes* vitamin A was also tabulated to compare baseline knowledge of nutrition without impact of these recruitment activities.

For both the total nutrition knowledge and nutrition knowledge without vitamin A, three versions of the scores were tabulated. One that did not exclude any household regardless of missing data; rather households with missing data were not given any points for missing values. Additionally, scores where households with missing values were excluded were also tabulated, as were scores where missing values

were imputed with woredas-specific means. The choice of which of these scores to use depends on the analyses conducted, but each have strengths and limitations and potential biases.

Anthropometry.

Duplicate measures whose differences fall within acceptable thresholds – no more than 1.0 centimeters (cm) for length and no more than 0.5 kilograms (kg) for weight – were averaged. Observations where duplicate measures fell outside of this acceptable range were examined on a case-by-case basis; if the third measurement fell within acceptable range of either of the previous two, then those two were averaged. If the third observation was within range of both the first and second measurements, and if all were plausible, then the average of all three was taken. These averages were then converted into z scores using the WHO macro for SAS [50].

Results

Most results tables are shown at the end of this section.

Data were collected from 25 December 2017 until 18 January 2018. Of the 26 kebeles eligible for activities in the first year of QDBH, 7 were randomly allocated to act as control kebeles (to which QDBH will be scaled in the final stage of scale-up), 6 were randomly allocated to partial intervention, and 7 were randomly allocated to full intervention. The randomization assignments by woreda are shown in Table 5. Notably, the control group has more kebeles from Dila Zuria and fewer from Aleta Chuko while the inverse is true for the partial intervention group.

Table 5. Results of randomization of kebeles from each woreda.

Zone	Woreda	Control	Partial Intervention	Full Intervention	Total
Sidama	Aleta Chuko	2	3	3	8
Gedeo	Dila Zuria	4	2	3	9
	Wonago	1	1	1	3
Total		7	6	7	20

A total of 605 eligible households completed the baseline survey, including 269 (44.5%) from control kebeles, 154 (25.5%) from partial intervention kebeles, and 182 (30.1%) from full intervention kebeles (Table 6). Just as the numbers of kebeles assigned to each group from Aleta Chuko and Dila Zuria are somewhat imbalanced, the numbers of households sampled from these woredas are also imbalanced. Of the total sample, approximately equal numbers of eligible households were included from Aleta Chuko in Sidama zone (n = 244, 40.3%) and Dila Zuria in Gedeo zone (n = 245, 40.5%), where 116 households were sampled in Wonago in Gedeo zone (19.2%). However, of households from control kebeles, more than half reside in Dila Zuria and less than one-quarter reside in Aleta Chuko, and of households from partial intervention kebeles, less than one-quarter reside in Dila Zuria and more than 6 in 10 reside in Aleta Chuko.

Table 6. Number of participants within randomized clusters in each woreda and intervention group.

Zone	Woreda	Control n (%)	Partial Intervention n (%)	Full Intervention n (%)	Total n (%)
Sidama	Aleta Chuko	58 (21.6)	96 (62.3)	90 (49.5)	244 (40.3)
Gedeo	Dila Zuria	147 (54.7)	36 (23.4)	62 (34.1)	245 (40.5)
	Wonago	64 (23.8)	22 (14.3)	30 (16.5)	116 (19.2)
Total		269 (44.5)	154 (25.5)	182 (30.1)	605 (100.0)

Because woreda factors – including but not limited to agroecological factors, market access, access to health services, and population density – are likely to influence a number of important variables, we present the baseline characteristics for the full sample, as well as by woreda and by intervention group. P-values are given for differences across woreda groups, for differences across intervention groups, as well as for differences across intervention groups *while controlling for woreda*. Woreda should be included a priori as a covariate in any hypothesis testing.

Households per Kebele

On average, there were 30.3 ± 11.8 households enrolled per kebele. The average numbers sampled from each kebele in Aleta Chuko, Dila Zuria, and Wonago were 30.5 (±5.8), 27.2 (±11.6) and 38.7 (±18.2), respectively.

Control kebeles averaged 38.4 ± 12.7 households per kebele; 6 partial intervention kebeles averaged 25.7 ± 8.2 households per kebele; and full intervention kebeles averaged 26.0 ± 8.6 households per kebele. That more households were enrolled per control kebele than either partial or intervention is likely because control kebeles, being absent HLCs, had less inclusion criteria than intervention kebeles.

Household Composition

Household composition characteristics by woreda and by intervention group are displayed in Table 7 and Table 8, respectively. The average household size was 5.6 ± 2.1 total members, including 1.6 ± 0.6 children under 5 years. Households were smallest in Aleta Chuko (5.2 ± 1.7 total household members, 1.3 ± 0.5 children under 5 years) and largest in Dila Zuria (6.0 ± 2.2 household members, 1.7 ± 0.6 children under 5 years). When adjusting for woredas, household size differed significantly by intervention group.

A vast majority of households (96.5%) report Protestantism as their religion. Other reported religions include Ethiopian Orthodox (1.2%), Catholicism (1.0%), Islam (0.3%), and other (which includes traditional, paganism, and unspecified; 1.0%). Several cell counts for this variable are 0, resulting in unreliable p values; therefore, the p-values included in Table 7 and Table 8 represent religion dichotomized as protestant or other, for which values are similar across all groups.

Just over half (55.5%) of all households had at least one household member with an income-generating occupation *other* than agriculture; the proportion did not differ by woreda (p=0.19) but did differ by intervention after controlling for woreda (p<0.001). In the partial intervention group, 72.1% of

households had some off-farm income compared to 51.7% in the control group and 47.3% in the full intervention.

Head of Household

All but four heads of household were male. The median age of all heads of household was 30.0 (IQR 27.2, 34.9) years, with heads of household being oldest in Aleta Chuko (31.8 [IQR 28.9, 37.5] years) and youngest in Wonago (28.0 [IQR 24.6, 33.5] years; p<0.001). There were no differences in the age of the head of household by intervention group (p=0.96).

Of all heads of household, 18.6% had less than Cycle 1 education (defined as grade 4) completed; 41.2% had completed Cycle 1; 34.4% had completed Cycle 2 (defined as grade 8); and 5.8% had completed secondary school or higher education. Educational attainment was highest in Aleta Chuko and lowest in Wonago (p=0.04), but educational attainment was similar in all intervention groups (p=0.36).

Only 9 (1.5%) heads of household reported no employment. Agriculture was the most common, with 64.7% of all heads of household reporting it as their primary employment. Due to cells having zero observations, a p value for differences by woreda could not be computed, but agriculture was less common in Dila Zuria with only 56.2%, compared to 71.3% in Aleta Chuko and 69.0% in Wonago. Sales, skilled manual, or technical employment was the second most common, at 26.3% of the full sample, followed by unskilled manual labor reported by 7.5% of heads of household. Primary employment did not differ by intervention group (p=0.48).

Caregiver

All 605 of the caregivers in this sample were female. The average age was 26.0 ± 5.2 years. Like the heads of household, caregivers were slightly older in Aleta Chuko (26.6 ± 5.4 years) and younger in Wonago (24.9 ± 5.0 years; p=0.03).

Caregivers in Aleta Chuko had more formal education (p<0.0001); 28.3% of caregivers in Aleta Chuko had not completed Cycle 1 compared to 50.6% and 73.3% in Dila Zuria and Wonago. More caregivers in Aleta Chuko reported being employed in agriculture or any other form of employment (18.9% and 15.6%, respectively) than in Dila Zuria (2.9% and 8.2%, respectively) or Wonago (8.6% and 8.6%, respectively; p=0.0001). Neither caregiver education or occupation differed by intervention group (p=0.87 for education and 0.78 for occupation).

Table 7. Household composition by woreda.

	Total N = 605	Aleta Chuko n = 244	Dila Zuria n = 245	Wonago n = 116	p*
Household Composition					
Individuals per household	5.6 ± 2.1	5.2 ± 1.7	6.0 ± 2.2	5.6 ± 2.2	< 0.001
Children < 5 years per household	1.6 ± 0.6	1.3 ± 0.5	1.7 ± 0.6	1.7 ± 0.6	< 0.0001
Religion					0.51
Protestant (%)	584 (96.5)	233 (95.5)	238 (97.1)	113 (97.4)	
Orthodox (%)	7 (1.2	3 (1.2)	3 (1.2)	1 (0.9)	
Catholic (%)	6 (1.0)	5 (2.1)	1 (0.4)	0	
Muslim (%)	2 (0.3)	1 (0.4)	1 (0.4)	0	
Other (%)	6 (1.0)	2 (0.8)	2 (0.8)	2 (1.7)	
Any off farm income (n, %)	336 (55.5)	144 (59.0)	135 (55.1)	57 (49.1)	0.19
Head of Household					
Male (n, %)	601 (99.3)	241 (98.8)	244 (99.6)	116 (100.0)	n/a
Age, years (median, [IQR])	30.0 (27.2, 34.9)	31.8 (28.9, 37.5)	29.9 (27.1, 34.7)	28.0 (24.6, 33.5)	<0.001
Education (completed)					0.04
Less than cycle 1	112 (18.6)	31 (12.8)	42 (17.3)	39 (33.6)	
Cycle 1	248 (41.2)	128 (52.7)	87 (35.8)	33 (28.5)	
Cycle 2	207 (34.4)	67 (27.6)	100 (41.2)	40 (34.5)	
Secondary or higher	35 (5.8)	17 (7.0)	14 (5.8)	4 (3.5)	
Primary occupation					n/a
No employment	9 (1.5)	0	6 (2.5)	3 (2.6)	
Agriculture	391 (64.7)	174 (71.3)	137 (56.2)	80 (69.0)	
Sales, skilled manual or technical	159 (26.3)	66 (27.1)	69 (28.3)	24 (20.7)	
Unskilled manual	45 (7.5)	4 (1.6)	32 (13.1)	9 (7.8)	
Caregiver					
Female (n, %)	605 (100.0)	244 (100.0)	245 (100.0)	116 (100.0)	n/a
Age, years (median, [IQR])	26.0 ± 5.2	26.6 ± 5.4	26.0 ± 5.1	24.9 ± 5.0	0.03
Education (completed)					<0.0001
Less than cycle 1	277 (45.9)	69 (28.3)	123 (50.6)	85 (73.3)	
Cycle 1	216 (35.8)	122 (50.0)	71 (29.2	23 (19.8)	
Cycle 2 or higher	110 (18.2)	53 (21.7)	49 (20.2)	8 (6.9)	
Occupation					0.0001
No employment	473 (78.3)	160 (65.6)	217 (88.9)	96 (82.8)	
Agriculture	63 (10.4)	46 (18.9)	7 (2.9)	10 (8.6)	
Any other employment	68 (11.3)	38 (15.6)	20 (8.2)	10 (8.6)	

* p value for differences across woredas

[1] p value for protestant versus any other religion

Table 8. Household composition by intervention groups.

	Total N = 605	Control n = 269	Partial Intervention n = 154	Full Intervention n = 182	p**	p***
Household Composition						
Individuals per household	5.6 ± 2.1	5.5 ± 2.1	5.7 ± 2.2	5.6 ± 1.9	0.43	0.02
Children < 5 years per household	1.6 ± 0.6	1.6 ± 0.6	1.5 ± 0.6	1.5 ± 0.6	0.13	0.59
Religion					0.70	0.36
Protestant (%)	584 (96.5)	258 (95.9)	150 (97.4)	176 (96.7)		
Orthodox (%)	7 (1.2	6 (2.2)	0	1 (0.6)		
Catholic (%)	6 (1.0)	1 (0.4)	3 (2.0)	2 (1.1)		
Muslim (%)	2 (0.3)	1 (0.4)	1 (0.7)	0		
Other (%)	6 (1.0)	3 (1.1)	0	3 (1.7)		
Any off farm income (n, %)	336 (55.5)	139 (51.7)	111 (72.1)	86 (47.3)	<0.001	<0.001
Head of Household						
Male (n, %)	601 (99.3)	268 (99.6)	152 (98.7)	181 (99.5)	0.55	0.83
Age, years (median, [IQR])	30.0 (27.2, 34.9)	39.8 (25.2, 34.8)	31.0 (27.2, 35.7)	30.4 (28.0, 34.7)	0.37	0.96
Education (completed)					0.47	0.36
Less than cycle 1	112 (18.6)	63 (23.6)	22 (14.4)	27 (14.8)		
Cycle 1	248 (41.2)	98 (36.7)	70 (45.8)	80 (44.0)		
Cycle 2	207 (34.4)	88 (33.0)	49 (32.0)	70 (38.5)		
Secondary or higher	35 (5.8)	18 (6.7)	12 (7.8)	5 (2.8)		
Primary occupation					0.59	0.48
No employment	9 (1.5)	6 (2.2)	1 (0.7)	2 (1.1)		
Agriculture	391 (64.7)	169 (63.1)	96 (62.3)	126 (69.2)		
Sales, skilled manual, or technical	159 (26.3)	71 (26.5)	45 (29.2)	43 (23.6)		
Unskilled manual	45 (7.5)	22 (8.2)	12 (7.8)	11 (6.0)		
Caregiver						
Female (n, %)	605 (100.0)	269 (100.0)	154 (100.0)	182 (100.0)	n/a	n/a
Age, years (median, [IQR])	26.0 ± 5.2	26.0 ± 5.5	25.9 ± 5.5	26.3 ± 4.6	0.76	0.69
Education (completed)					0.13	0.87
Less than cycle 1	277 (45.9)	141 (52.8)	59 (38.3)	77 (42.3)		
Cycle 1	216 (35.8)	74 (27.7)	72 (46.8)	70 (38.5)		
Cycle 2 or higher	110 (18.2)	52 (19.5)	23 (14.9)	35 (19.2)		
Occupation					0.08	0.78
No employment	473 (78.3)	223 (83.2)	109 (70.8)	141 (77.5)		
Agriculture	63 (10.4)	22 (8.2)	21 (13.6)	20 (11.0)		
Any other employment	68 (11.3)	23 (8.6)	24 (15.6)	21 (11.5)		

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

[1] p value for protestant versus any other religion

Household Wealth and Housing Characteristics

Households' wealth and housing characteristics are summarized in Table 9 and Table 10. Several goods – computer, refrigerator, electric stove, gas cooker, bicycle, motor vehicle, bajaj, sewing machine, water tank, water pump, and drip irrigation – were possessed by fewer than 1% of all households and therefore were not included in principle component analysis and wealth index tabulation. The wealth index, which by design follows a standard normal distribution, was highest in Dila Zuria (0.23 ± 1.0) and lowest in Wonago (-0.48 ± 0.9), but did not differ by intervention group (p=0.52).

Housing characteristics differed across woredas, as shown in Table 9. Briefly, the median number of sleeping rooms per household member was 0.20 (IQR: 0.14, 0.29) and was higher in Aleta Chuko and lower in both Dila Zuria and Wonago (p<0.0001). Over three-quarters of all households had a floor composed of earth, sand, or dung, but this was most common in Wonago (91.4%); flooring made from cement or rock was more common in Aleta Chuko, while palm, bamboo, or wood plank flooring was more common in Dila Zuria than in the other woredas. The most common roof materials were metal or corrugated iron (45.3%), which was most common in Dila Zuria (64.5%), followed by reed, bamboo, or a combination of those (35.3%), which was most common in Aleta Chuko (57.0%). In each woreda, at least 70% of households had exterior walls composed of bamboo or wood with mud. In Aleta Chuko, cane, palm trunks, or bamboo was the next most common wall material at 13.5%; in Dila Zuria and Wonago, re-used wood was the second most common with 15.5% and 25.0% respectively.

In both Aleta Chuko and Wonago, over half of households (64.3% and 73.9%, respectively) reported their cooking location as being in the house. In Dila Zuria, having a separate building for cooking was slightly more common (46.7%) than cooking in the house (44.7%). A vast majority (99.2%) reported using wood as their cooking fuel; only 2 and 3 households reported using charcoal and straw/shrubs/grass, respectively; this indicator had insufficient variability to be included in the wealth index.

Not quite half of all households (46.1%) had electricity, with the lowest proportion having electricity in Aleta Chuko (24.2%) and the highest proportion in Dila Zuria (69.8%). Anecdotally, local partners reported that the proportion having electricity is so high in Dila Zuria because of the population density and the relatively common practice of families making unauthorized connections. Thus, the higher proportion of households with electricity in Dila Zuria and to some extent Wonago may not reflect economic access. Lastly, about one-quarter (26.2%) reported that any household member had a bank account, with this not varying between woredas.

Several of these characteristics had differences that persisted between intervention groups even after controlling for woredas (Table 10). ; however, all (except where otherwise noted) are used to develop the wealth index and would generally not be meaningful covariates to consider on their own for most hypothesis tests.

Table 9. Household wealth and housing characteristics by woreda.

	Total N = 605	Aleta Chuko n = 244	Dila Zuria n = 245	Wonago n = 116	p*
Wealth Index	-0.00 ± 1.00	-0.01 ± 0.98	0.23 ± 1.00	-0.48 ± 0.87	<0.0001
Sleeping rooms per person (median [IQR])	0.20 (0.14, 0.29)	0.23 (0.18, 0.31)	0.18 (0.13, 0.24)	0.19 (0.13, 0.25)	<0.0001
Floor material					<0.0001
Earth, sand or dung	459 (75.9)	186 (76.2)	167 (68.2)	106 (91.4)	
Palm, bamboo, or wood planks	77 (12.7)	1 (0.4)	69 (28.2)	7 (6.0)	
Vinyl or asphalt	19 (3.1)	11 (4.5)	7 (2.9)	1 (0.9)	
Cement or other rock	50 (8.3)	46 (18.9)	2 (0.8)	2 (1.7)	
Roof material					<0.0001
Thatch, mud, sod, cardboard, or none	19 (3.1)	6 (2.5)	8 (3.3)	5 (4.3)	
Rustic mat or plastic sheet	71 (11.7)	4 (1.6)	32 (13.1)	35 (30.2)	
Reed, bamboo, or combination thereof	229 (37.9)	139 (57.0)	47 (19.2)	43 (37.1)	
Metal or corrugated iron	274 (45.3)	86 (35.3)	158 (64.5)	30 (25.9)	
Wood	12 (2.0)	9 (1.9)	0	3 (2.6)	
Exterior wall material					<0.001
Cardboard, uncovered adobe, leaves, or no walls	7 (1.2)	3 (1.2)	3 (1.2)	1 (0.9)	
Cane, palm, trunks, or bamboo	43 (7.1)	33 (13.5)	8 (3.3)	2 (1.7)	
Bamboo or wood with mud	466 (77.0)	190 (77.9)	194 (79.2)	82 (70.7)	
Re-used wood	79 (13.1)	12 (4.9)	38 (15.5)	29 (25.0)	
Stone, cement, or brick	10 (1.7)	6 (2.5)	2 (0.8)	2 (1.7)	
Cooking Location					<0.001
In house	351 (58.2)	157 (64.3)	109 (44.7)	85 (73.9)	
Separate building	212 (35.2)	77 (31.6)	114 (46.7)	21 (18.3)	
Outside	40 (6.6)	10 (4.1)	21 (8.6)	9 (7.8)	
Cooking Fuel					n/a
Wood	600 (99.2)	241 (98.8)	243 (99.2)	116 (100.0)	
Charcoal	2 (0.3)	0	2 (0.8)	0	
Straw, shrubs, or grass	3 (0.5)	3 (1.2)	0	0	
House has electricity, %	279 (46.1)	59 (24.2)	171 (69.8)	49 (42.2)	<0.0001
Any household member has bank account, %	158 (26.2)	60 (24.8)	72 (29.4)	26 (22.4)	0.30

* p value for differences across woredas

Table 10. Household wealth and housing characteristics by intervention group.

	Total N = 605	Control n = 269	Partial Intervention n = 154	Full Intervention n = 182	p**	p***
Wealth Index	-0.00 ± 1.00	-0.01 ± 1.04	0.05 ± 0.93	-0.03 ± 1.07	0.69	0.52
Sleeping rooms per person (median [IQR])	0.20 (0.14, 0.29)	0.19 (0.15, 0.29)	0.20 (0.15, 0.29)	0.19 (0.14, 0.29)	0.59	0.05
Floor material					0.02	0.01
Earth, sand or dung	459 (75.9)	209 (77.7)	123 (79.9)	127 (69.8)		
Palm, bamboo, or wood planks	77 (12.7)	34 (12.6)	9 (5.8)	34 (18.7)		
Vinyl or asphalt	19 (3.1)	7 (2.6)	9 (5.8)	3 (1.7)		
Cement or other rock	50 (8.3)	19 (7.1)	13 (8.4)	18 (9.9)		
Roof material					0.15	0.17
Thatch, mud, sod, cardboard, or none	19 (3.1)	6 (2.2)	3 (2.0)	10 (5.5)		
Rustic mat or plastic sheet	71 (11.7)	34 (12.6)	16 (10.4)	21 (11.5)		
Reed, bamboo, or combination thereof	229 (37.9)	95 (35.3)	66 (42.9)	68 (37.4)		
Metal or corrugated iron	274 (45.3)	133 (49.4)	64 (41.6)	77 (42.3)		
Wood	12 (2.0)	1 (0.4)	5 (3.3)	6 (3.3)		
Exterior wall material					0.02	0.001
Cardboard, uncovered adobe, leaves, or no walls	7 (1.2)	5 (1.9)	1 (0.7)	1 (0.6)		
Cane, palm, trunks, or bamboo	43 (7.1)	10 (3.7)	10 (6.5)	23 (12.6)		
Bamboo or wood with mud	466 (77.0)	207 (77.0)	131 (85.1)	128 (70.3)		
Re-used wood	79 (13.1)	42 (15.6)	10 (6.5)	27 (14.8)		
Stone, cement, or brick	10 (1.7)	5 (1.9)	2 (1.3)	3 (1.7)		
Cooking Location					0.08	0.04
In house	351 (58.2)	152 (56.5)	91 (59.1)	108 (60.0)		
Separate building	212 (35.2)	107 (39.8)	49 (31.8)	56 (31.1)		
Outside	40 (6.6)	10 (3.7)	14 (9.1)	16 (8.9)		
Cooking Fuel					n/a	n/a
Wood	600 (99.2)	267 (99.3)	153 (99.4)	180 (98.9)		
Charcoal	2 (0.3)	2 (0.7)	0	0		
Straw, shrubs, or grass	3 (0.5)	0	1 (0.7)	2 (1.1)		
House has electricity, %	279 (46.1)	136 (50.6)	71 (46.1)	72 (39.6)	0.03	0.02
Any household member has bank account, %	158 (26.2)	68 (25.3)	44 (29.0)	46 (25.3)	0.66	0.51

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Water and Sanitation

Key indicators of water and sanitation are shown in Table 11 and Table 12. The most common sources of drinking water were public tap (55.3%), which was highest in Aleta Chuko (69.5%) and lowest in Wonago (44.0%). The next most common sources were protected spring, which was lowest in Aleta Chuko (6.3%) and higher in Dila Zuria (24.9%) and Wonago (31.9%), and unprotected spring, also lowest in Aleta Chuko (7.1%), and higher in Dila Zuria (22.5%) and somewhat in Wonago (8.6%).

Of the entire sample, 80.5% had an improved source of drinking water. An improved source of drinking water was 86.9% in Aleta Chuko, 74.3% in Dila Zuria, and 80.2% in Wonago the difference was significant between woredas ($p<0.01$). Very few households were classified as having "safely managed," so safely managed and basic drinking water categorizations were combined, for a total prevalence of 47.6%, which was lowest in Aleta Chuko (32.0%) and highest in Dila Zuria (59.6%). Conversely, 54.9% of households in Aleta Chuko had limited water access, while only 14.7% of households in Dila Zuria did; the differences between woreda were significant ($p<0.0001$). These findings suggest that improved water sources were relatively common, but households in Aleta Chuko had further distances to travel to reach them than in other woredas. Additionally, households in Aleta Chuko were more likely to report not having water available at their source sometime within the previous 2 weeks (23.1% in Aleta Chuko compared to 6.6% in Dila Zura and 7.8% in Wonago, $p<0.0001$). Most households (82.5%) did not treat their water. Only 14.4% of households used what is considered an adequate water treatment method, with the highest proportion in Wonago (25.9%) and the lowest in Aleta Chuko (9.1%; $p<0.01$).

Pit latrines were the most common type of toilet facility, with 62.6% reporting a pit latrine without a slab and 25.6% reporting the improved version of a pit latrine with a slab. Pit latrines without a slab were more common in Aleta Chuko (72.5%) and least common in Wonago (53.5%). In terms of a dichotomized improved or unimproved toilet facility, just over one-quarter of all households had an improved toilet facility with no significant differences between woreda ($p=0.28$). However, there were significant differences in toilet facility according to the WHO/UNICEF ladder categorization. Most notably, only 2.5% of households in Aleta Chuko practiced open defecation, but this was reported among 11.9% of households in Dila Zuria and 19.1% of households in Wonago ($p<0.01$).

Of the water, sanitation and hygiene indicators, only the unavailability of water within the last 2 weeks was significantly different across intervention groups after controlling for woreda. Only 3.4% of households in the control group reported not having water available at their source recently, while 29.0% and 15.6% of households in the partial and full intervention group reported this was so ($p<0.0001$).

Table 11. Water, sanitation, and hygiene indicators by woreda.

	Total	Aleta Chuko	Dila Zuria	Wonago	p*
	N = 605	n = 244	n = 245	n = 116	
Primary source of drinking water					n/a
Piped water to home	1 (0.2)	1 (0.4)	0	0	
Piped water to yard	2 (0.3)	0	1 (0.4)	1 (0.9)	
Piped water to neighbor	10 (1.7)	2 (0.8)	5 (2.0)	3 (2.6)	
Public tap	332 (55.3)	166 (69.5)	115 (46.9)	51 (44.0)	
Tube well or borehole	5 (0.8)	4 (4.7)	0	1 (0.9)	
Protected well	19 (3.2)	19 (8.0)	0	0	
Unprotected well	7 (1.2)	1 (0.4)	6 (2.5)	0	
Protected spring	113 (18.8)	15 (6.3)	61 (24.9)	37 (31.9)	
Unprotected spring	82 (13.7)	17 (7.1)	55 (22.5)	10 (8.6)	
Cart with small tank	7 (1.2)	7 (2.9)	0	0	
Surface water (river, lake, pond, etc)	22 (3.7)	7 (2.9)	2 (0.8)	13 (11.2)	
Improved water source	487 (80.5)	212 (86.9)	182 (74.3)	93 (80.2)	<0.01
Drinking water access					<0.0001
Safely managed and basic	288 (47.6)	78 (32.0)	146 (59.6)	64 (55.2)	
Limited water	199 (32.9)	134 (54.9)	36 (14.7)	29 (25.0)	
Unimproved	96 (15.9	25 (10.3)	61 (24.9)	10 (8.6)	
Surface water	22 (3.6)	7 (2.9)	2 (0.8)	13 (11.2)	
Water source was unavailable in last 2 weeks	81 (13.5)	56 (23.1)	16 (6.6)	9 (7.8)	<0.0001
Primary person responsible for fetching water					<0.0001
Respondent caregiver	237 (39.5)	129 (53.3)	64 (26.3)	44 (38.3)	
Other adult woman	69 (11.5)	14 (5.8)	39 (16.1)	16 (13.9)	
Adult man	105 (17.5)	20 (8.3)	52 (21.4)	33 (28.7)	
Female under 15 years	118 (19.7)	46 (19.0)	57 (23.5)	15 (13.0)	
Male under 15 years	43 (7.2)	13 (5.4)	27 (11.1)	3 (2.6)	
Other (ex: donkey, laborer, etc)	28 (4.7)	20 (8.3)	4 (1.7)	4 (3.5)	
Water treatment					n/a
No treatment	498 (82.5)	211 (86.8)	203 (82.9)	84 (72.4)	
Boil	1 (0.2)	0	1 (0.4)	0	
Bleach or chlorine	66 (10.9)	11 (4.5)	25 (10.2)	30 (25.9)	
Strain through cloth	11 (1.8)	5 (2.1)	4 (1.6)	2 (1.7)	
Water filter	20 (3.3)	11 (4.5)	9 (3.7)	0	
Stand and settle	4 (0.7)	1 (0.4)	3 (1.2)	0	
Other	4 (0.7)	4 (1.7)	0	0	
Adequate water treatment method	87 (14.4)	22 (9.1)	35 (14.3)	30 (25.9)	<0.01
Toilet					n/a
Flush toilet connected to piped sewer	8 (1.3)	2 (0.8)	4 (1.6)	2 (1.7)	
Flush toilet connected to septic system	2 (0.3)	0	1 (0.4)	1 (0.9)	
Pit latrine with slab	155 (25.6)	57 (23.4)	70 (28.6)	28 (24.1)	

Pit latrine without slab	379	(62.6)	177	(72.5)	140	(57.1)	62	(53.5)	
Hanging latrine	1	(0.2)	1	(0.4)	0		0		
Hole	38	(6.3)	3	(1.2)	23	(9.4)	12	(10.3)	
No facility/bush/field	19	(3.1)	3	(1.2)	6	(2.5)	10	(8.6)	
Other	3	(0.5)	1	(0.4)	1	(0.4)	1	(0.9)	
Improved toilet	165	(27.4)	59	(24.3)	75	(30.7)	31	(27.0)	0.28
Toilet facility									<0.01
Basic	144	(23.9)	55	(22.6)	63	(25.8)	26	(22.6)	
Limited	21	(3.5)	4	(1.7)	12	(4.9)	5	(4.4)	
Unimproved	380	(63.1)	178	(73.3)	140	(57.4)	62	(53.9)	
Open defecation	57	(9.5)	6	(2.5)	29	(11.9)	22	(19.1)	

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Table 12. Water, sanitation, and hygiene indicators by intervention group.

	Total N = 605	Control n = 269	Partial Intervention n = 154	Full Intervention n = 182	p**	p***
Primary source of drinking water					n/a	n/a
Piped water to home	1 (0.2)	0	1 (0.7)	0		
Piped water to yard	2 (0.3)	0	0	2 (1.1)		
Piped water to neighbor	10 (1.7)	4 (1.5)	5 (3.3)	1 (0.6)		
Public tap	332 (55.3)	115 (42.9)	98 (64.1)	119 (66.5)		
Tube well or borehole	5 (0.8)	5 (0.8)	2 (2.0)	3 0.0		
Protected well	19 (3.2)	6 (2.2)	10 (6.5)	3 (1.7)		
Unprotected well	7 (1.2)	5 (1.9)	1 (0.7)	1 (0.6)		
Protected spring	113 (18.8)	78 (29.1)	14 (9.2)	21 (11.7)		
Unprotected spring	82 (13.7)	46 (17.2)	14 (9.2)	22 (12.3)		
Cart with small tank	7 (1.2)	1 (0.4)	3 (2.0)	3 (1.7)		
Surface water (river, lake, pond, etc)	22 (3.7)	11 (4.1)	4 (2.6)	7 (3.9)		
Improved water source	487 (80.5)	206 (76.6)	132 (85.7)	149 (81.9)	0.06	0.42
Drinking water access					<0.01	0.51
Safely managed and basic	288 (47.6)	(51.7)	(38.3)	(49.5)		
Limited water	199 (32.9)	(24.9)	(47.4)	(32.4)		
Unimproved	96 (15.9	(19.3)	(11.7)	(14.3)		
Surface water	22 (3.6)	(4.1)	(2.6)	(3.9)		
Water source was unavailable in last 2 weeks	81 (13.5)	9 (3.4)	44 (29.0)	28 (15.6)	<0.0001	<0.0001
Primary person responsible for fetching water					0.20	0.95
Respondent caregiver	237 (39.5)	92 (34.2)	73 (48.0)	72 (40.2)		

Other adult woman	69 (11.5)	33 (12.3)	15 (9.9)	21 (11.7)		
Adult man	105 (17.5)	58 (21.6)	19 (12.5)	28 (15.6)		
Female under 15 years	118 (19.7)	54 (20.1)	25 (16.5)	39 (21.8)		
Male under 15 years	43 (7.2)	22 (8.2)	11 (7.2)	10 (5.6)		
Other (ex: donkey, laborer, etc)	28 (4.7)	10 (3.7)	9 (5.9)	9 (5.0)		
Water treatment					n/a	n/a
No treatment	498 (82.5)	225 (84.0)	127 (82.5)	146 (80.2)		
Boil	1 (0.2)	1 (0.4)	0	0		
Bleach or chlorine	66 (10.9)	29 (9.7)	15 (34.0)	22 (12.1)		
Strain through cloth	11 (1.8)	1 (0.4)	4 (2.6)	6 (3.3)		
Water filter	20 (3.3)	9 (3.4)	5 (3.3)	6 (3.3)		
Stand and settle	4 (0.7)	2 (0.8)	1 (0.7)	1 (0.6)		
Other	4 (0.7)	1 (0.4)	2 (1.3)	1 (0.6)		
Adequate water treatment method	87 (14.4)	39 (14.6)	20 (13.0)	28 (15.4)	0.81	0.59
Toilet					n/a	n/a
Flush toilet connected to piped sewer	8 (1.3)	4 (1.5)	3 (2.0)	1 (0.6)		
Flush toilet connected to septic system	2 (0.3)	0	1 (0.7)	1 (0.6)		
Pit latrine with slab	155 (25.6)	76 (28.3)	34 (22.1)	45 (34.7)		
Pit latrine without slab	379 (62.6)	160 (57.5)	101 (65.6)	118 (64.8)		
Hanging latrine	1 (0.2)	0	1 (0.7)	0		
Hole	38 (6.3)	18 (6.7)	9 (5.8)	11 (6.0)		
No facility/bush/field	19 (3.1)	10 (3.7)	3 (2.0)	6 (3.3)		
Other	3 (0.5)	1 (0.4)	2 (1.3)	0		
Improved toilet	165 (27.4)	80 (29.9)	38 (25.0)	47 (25.8)	0.47	0.76
Toilet facility					0.66	0.84
Basic	144 (23.9)	69 (25.8)	32 (21.1)	43 (23.6)		
Limited	21 (3.5)	11 (4.1)	6 (4.0)	4 (2.2)		
Unimproved	380 (63.1)	160 (59.7)	102 (67.1)	118 (64.8)		
Open defecation	57 (9.5)	28 (10.5)	12 (7.9)	17 (9.3)		

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Agriculture and Livestock

Almost all households (96.9%) own land. The proportion owning land is considerably higher in Aleta Chuko (99.6%) and lower in Wonago (93.1%). The median area of land cultivated in the current season was 0.25 hectares (0.23, 0.49), also higher in Aleta Chuko (0.47 hectares [0.24, 0.75) and lower in the Gedeo woredas (Dila Zuria = 0.24 hectares [0.20, 0.48]; Wonago = 0.23 [0.13, 0.40]).

With 93.1% of the total sample producing coffee, it was the most commonly grown crop. Unlike most other crops, the proportion of households growing coffee was similar in all woredas. Khat was also very common in Sidama only (84.4%), and very uncommon in Dila Zuria (3.3%) and Wonago (0.9%). Both coffee and khat, where produced, are primary sold rather than being kept at home.

Other common crops include enset (91.9%), banana (63.9%), kale (58.0%), maize (55.6%), and avocado (52.8%) were all produced by more than half of all households surveyed. And with the exception of avocado – which was most common in Dila Zuria – each of these crops was most common in Aleta Chuko.

Aside from coffee and chat, pineapple and sugar cane were the only other crops where a majority of the respondents who produced the food reported selling at least half, and these foods were produced by only 13.4% and 24.3% of households surveyed, respectively.

Figure 5**Error! Reference source not found.**, Panels A through G, show the most common crops and the percentage of households who produce the crops, and the approximate proportion that is sold.

Of the full sample, 64.0% reported owning any livestock, chickens, or beehives, but this was more common in Aleta Chuko (80.3%) compared to Dila Zuria (51.0%) and Wonago (56.9%; p<0.0001). The most common animals owned were female cows and chickens, which were primarily for the purpose of milk and eggs, respectively. Figure 6 shows the ownership and primary use for the various animals; ownership of donkeys and horses is not shown in Figure 6, but was relatively rare (20 households in Aleta Chuko, 7 households in Dila Zuria, and no households in Wonago). In each case, the horses and donkeys primary use was for labor. There were no differences between intervention group in ownership of livestock, chickens, or beehives (p=0.32).

Production Diversity

The average production diversity was 4.0 ± 1.8 food groups. As expected based on previously reported differences in characteristics by woreda, production diversity was highest in Aleta Chuko (5.3 ± 1.4) and lowest in Dila Zuria (3.1 ± 1.5) and Wonago (3.2 ± 1.6; p<0.0001). When OFSP was excluded, each of the means dropped slightly but similarly in each woredas such that the difference between woredas persisted. Production diversity was lowest in the control group (3.3 ± 1.6) and higher in the partial (4.7 ± 1.7) and full intervention (4.5 ± 1.8, p=0.001 after controlling for woreda. When OFSP is excluded from production diversity, the difference between intervention groups persisted, but was less stark (3.3 ± 1.6 in the control group and 4.4 ± 1.7 and 4.2 ± 1.9 in the partial and full intervention groups, respectively, p=0.03 after controlling for woreda).

As shown in Table 13 and depicted graphically in Figure 4, production of several food groups was higher in Aleta Chuko than the other woredas. This is true namely for pulses, dairy, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, and other fruits. After controlling for woreda, there were few differences in food group production by intervention group; however, differences did

persist for dark green leafy vegetables (p=0.03) and other vegetables (p=0.05), both of which were lowest in the control group. There also persisted a difference in the production of other vitamin A-rich fruits and vegetables when OFSP was included, which is to be expected given OFSP vines had been distributed just prior to the baseline survey. There was no difference in production of other vitamin A-rich fruits and vegetables when OFSP was excluded (=0.15).

Table 13. Agricultural production of households by woreda.

	Total N = 605	Aleta Chuko n = 244	Dila Zuria n = 245	Wonago n = 116	p*
Own land, %	586 (96.9)	243 (99.6)	235 (95.9)	108 (93.1)	0.04
Area of land cultivated in current season	0.25 (0.23, 0.49)	0.47 (0.24, 0.75)	0.24 (0.20, 0.48)	0.23 (0.13, 0.40)	0.0001
Own livestock, %	387 (64.0)	196 (80.3)	125 (51.0)	66 (56.9)	<0.0001
Food group production					
Grains, white roots and tubers	579 (95.9)	244 (100.0)	227 (93.0)	108 (93.1)	0.99
Pulses	293 (48.5)	183 (75.0)	67 (27.5)	43 (37.1)	<0.0001
Dairy	158 (26.2)	141 (57.8)	10 (4.1)	7 (6.0)	<0.0001
Meat, poultry, and fish	29 (4.8)	11 (4.5)	9 (3.7)	9 (7.8)	0.25
Eggs	222 (36.8)	140 (57.4)	56 (23.0)	26 (22.4)	<0.0001
Dark green leafy vegetables	350 (58.0)	201 (82.4)	97 (39.8)	52 (44.8)	<0.0001
Other vitamin A-rich fruits and vegetables	311 (51.5)	153 (62.7)	105 (43.0)	53 (45.7)	<0.001
Other vitamin A-rich fruits and vegetables (excluding OFSP)	208 (34.4)	107 (43.9)	76 (31.2)	25 (21.6)	<0.001
Other vegetables	28 (4.6)	16 (6.6)	10 (4.1)	2 (1.7)	0.15
Other fruits	450 (74.5)	209 (85.7)	173 (70.9)	68 (58.6)	<0.001
Production Diversity	4.0 ± 1.8	5.3 ± 1.4	3.1 ± 1.5	3.2 ± 1.6	<0.0001
Production Diversity without OFSP	3.8 ± 1.8	5.1 ± 1.4	3.0 ± 1.5	2.9 ± 1.6	<0.0001

Note: no foods from the nuts and seeds food group were reported produced in the sample

* p value for differences across woredas

Table 14. Agricultural production by intervention group.

	Total N = 605	Control n = 269	Partial Intervention n = 154	Full Intervention n = 182	p**	p***
Own land, %	586 (96.9)	260 (96.7)	148 (96.1)	178 (97.8)	0.64	0.29
Area of land cultivated in current season	0.25 (0.23, 0.49)	0.24 (0.23, 0.48)	0.42 (0.21, 0.57)	0.40 (0.22, 0.50)	0.15	0.98
Own livestock, %	387 (64.0)	150 (64.0)	110 (55.8)	127 (69.8)	<0.01	0.32
Food group production						
Grains, white roots and tubers	579 (95.9)	255 (95.2)	148 (96.1)	176 (96.7)	0.69	0.54
Pulses	293 (48.5)	106 (39.6)	94 (61.0)	93 (51.1)	<0.001	0.69
Dairy	158 (26.2)	38 (14.2)	58 (37.7)	62 (34.1)	<0.0001	0.30
Meat, poultry, and fish	29 (4.8)	14 (5.2)	7 (4.6)	8 (4.4)	0.91	0.91
Eggs	222 (36.8)	70 (26.1)	74 (48.1)	78 (42.9)	<0.001	0.11
Dark green leafy vegetables	350 (58.0)	121 (45.2)	104 (67.5)	125 (68.7)	<0.0001	0.03
Other vitamin A-rich fruits and vegetables	311 (51.5)	76 (28.4)	106 (68.8)	129 (70.9)	<0.0001	<0.0001
Other vitamin A-rich fruits and vegetables (excluding OFSP)	208 (34.4)	75 (28.0)	64 (41.6)	69 (37.9)	0.01	0.15
Other vegetables	28 (4.6)	5 (1.9)	8 (5.2)	15 (8.2)	0.02	0.05
Other fruits	450 (74.5)	186 (69.4)	127 (82.5)	137 (75.3)	0.02	0.32
Production Diversity	4.0 ± 1.8	3.3 ± 1.6	4.7 ± 1.7	4.5 ± 1.8	<0.0001	0.001
Production Diversity without OFSP	3.8 ± 1.8	3.3 ± 1.6	4.4 ± 1.7	4.2 ± 1.9	<0.0001	0.03

Note: no foods from the nuts and seeds food group were reported produced in the sample

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

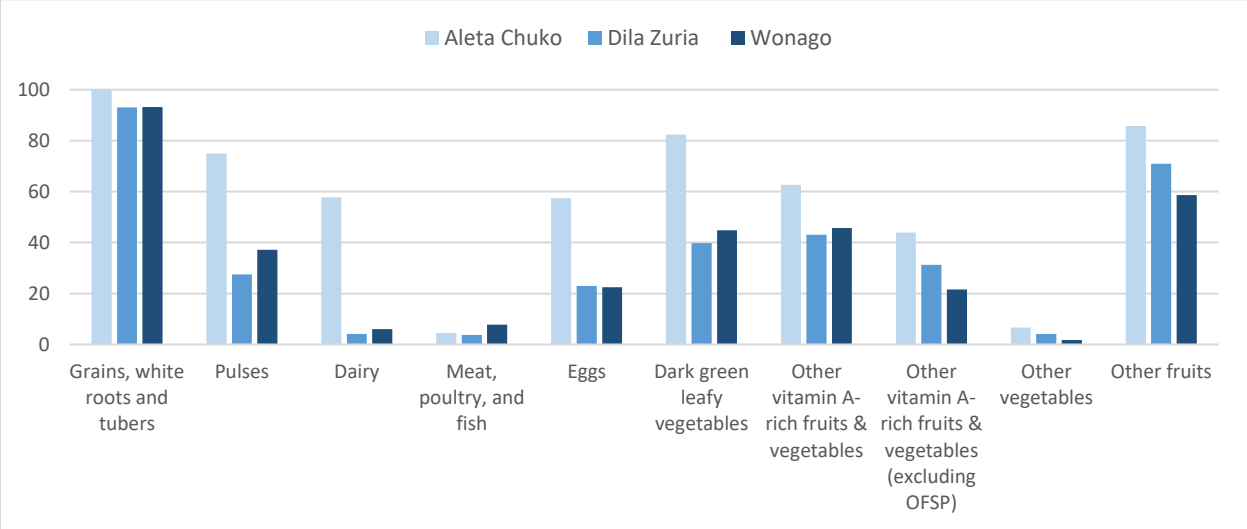
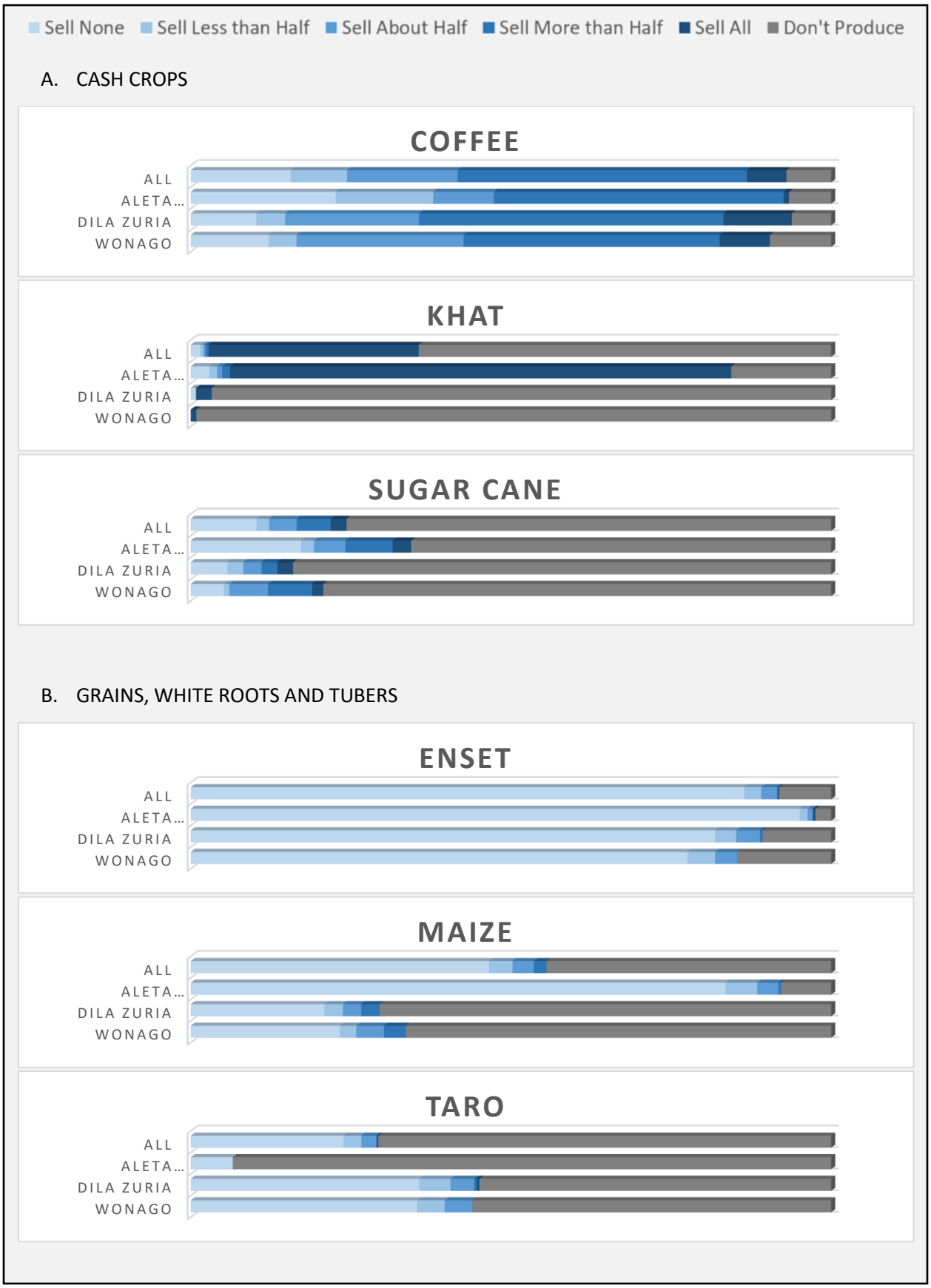
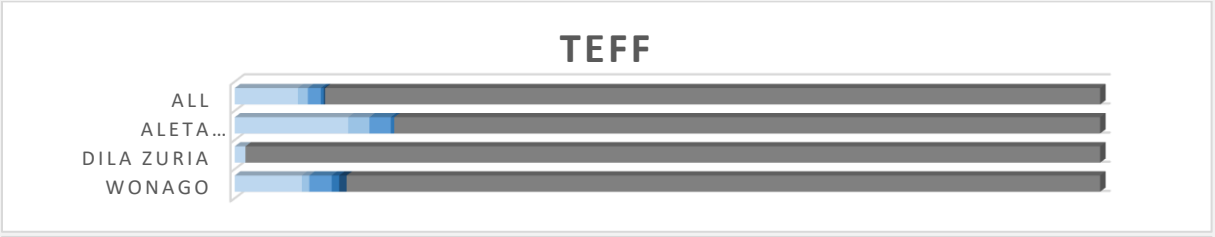
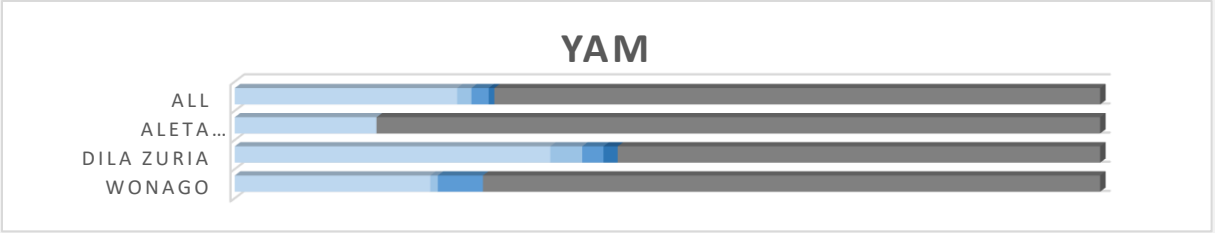
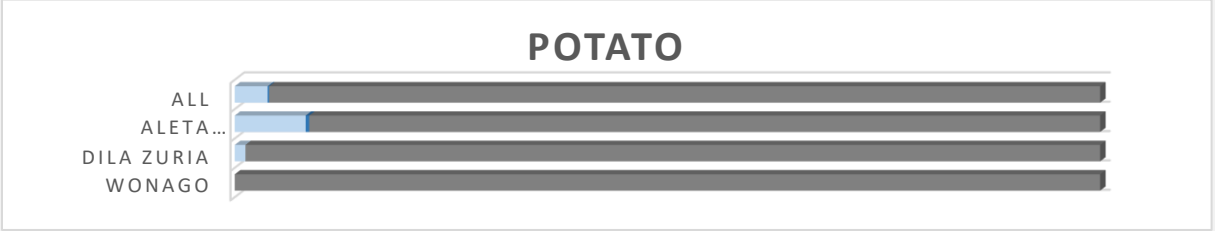


Figure 4. Food group production of households by woreda.

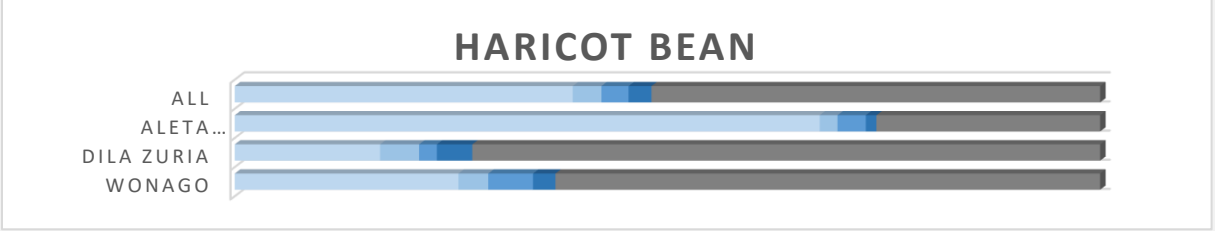

Sell None
Sell Less than Half
Sell About Half
Sell More than Half
Sell All
Don't Produce
A. CASH CROPS
COFFEE
ALL
ALETA...
DILA ZURIA
WONAGO
KHAT
ALL
ALETA...
DILA ZURIA
WONAGO
SUGAR CANE
ALL
ALETA...
DILA ZURIA
WONAGO
B. GRAINS, WHITE ROOTS AND TUBERS
ENSET
ALL
ALETA...
DILA ZURIA
WONAGO
MAIZE
ALL
ALETA...
DILA ZURIA
WONAGO
TARO
ALL
ALETA...
DILA ZURIA
WONAGO

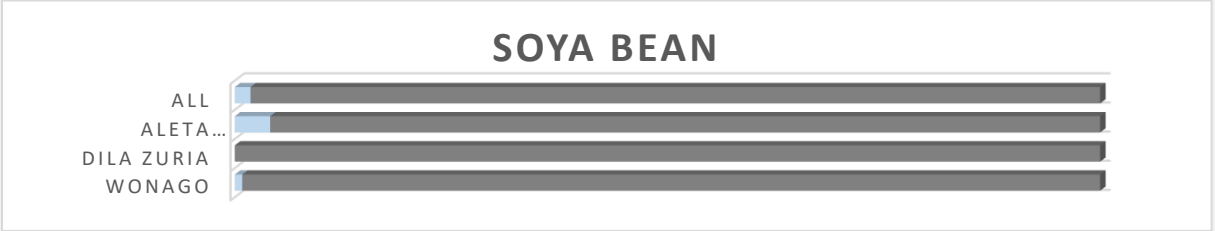




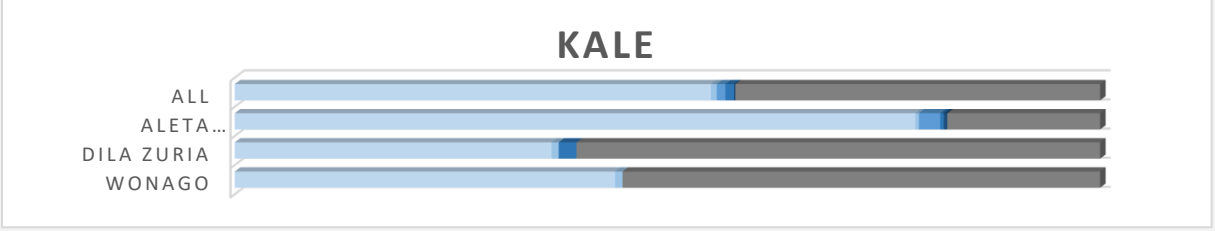


C. PULSES

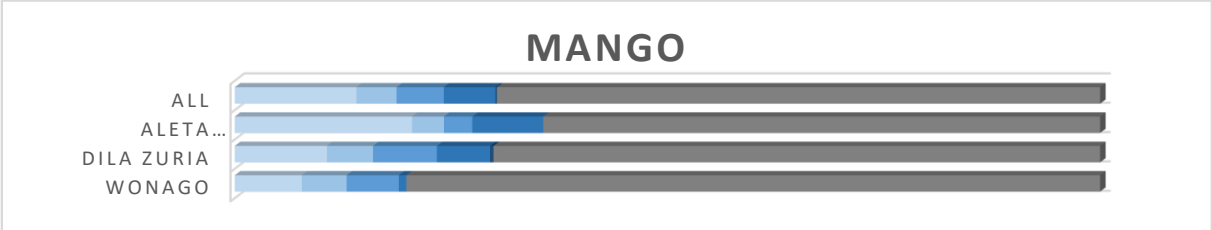


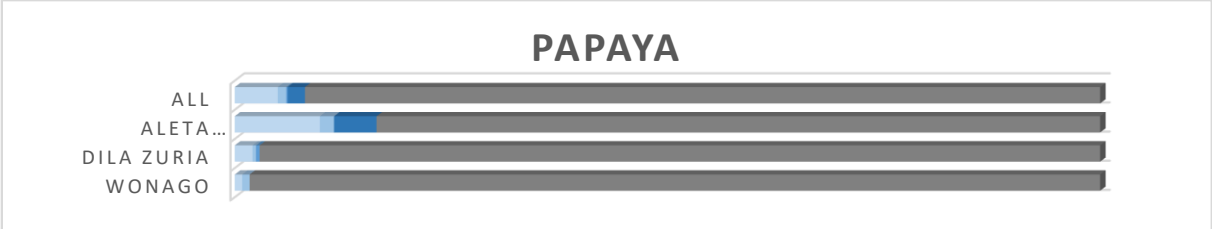


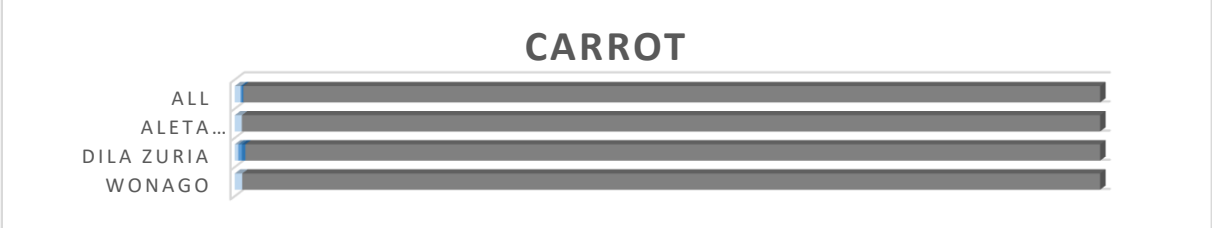
D. DARK GREEN LEAFY VEGETABLES



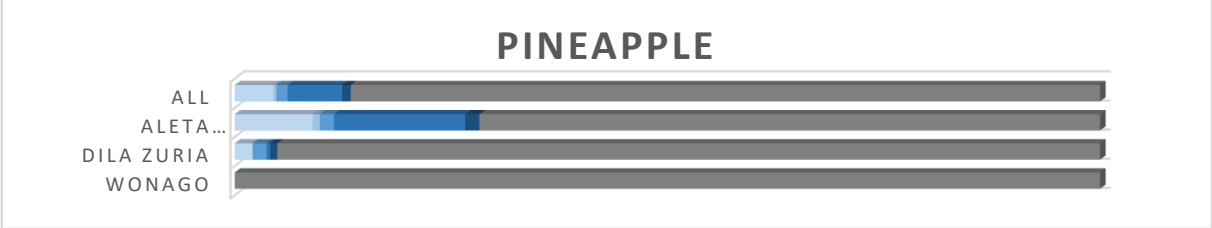
E. OTHER VITAMIN A-RICH FRUITS AND VEGETABLES

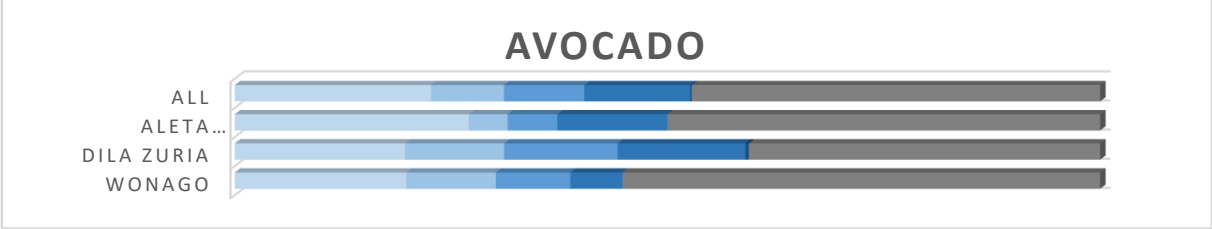


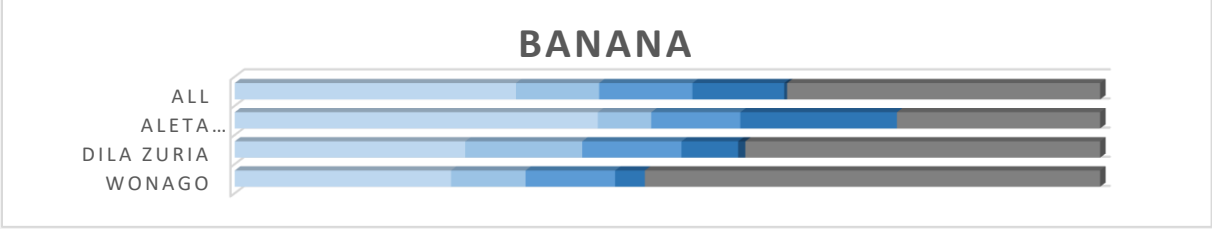




F. OTHER FRUITS







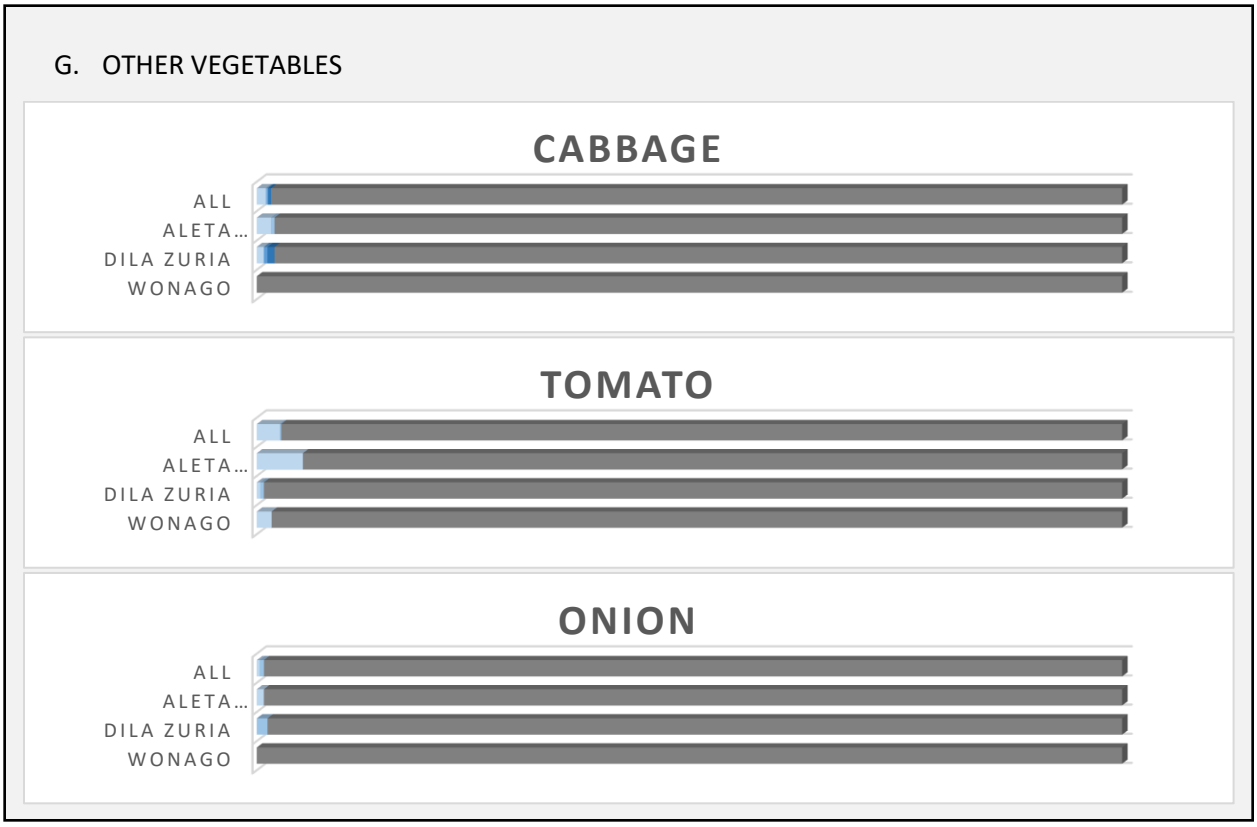


Figure 5. Production of crops for household consumption and for selling by woreda.

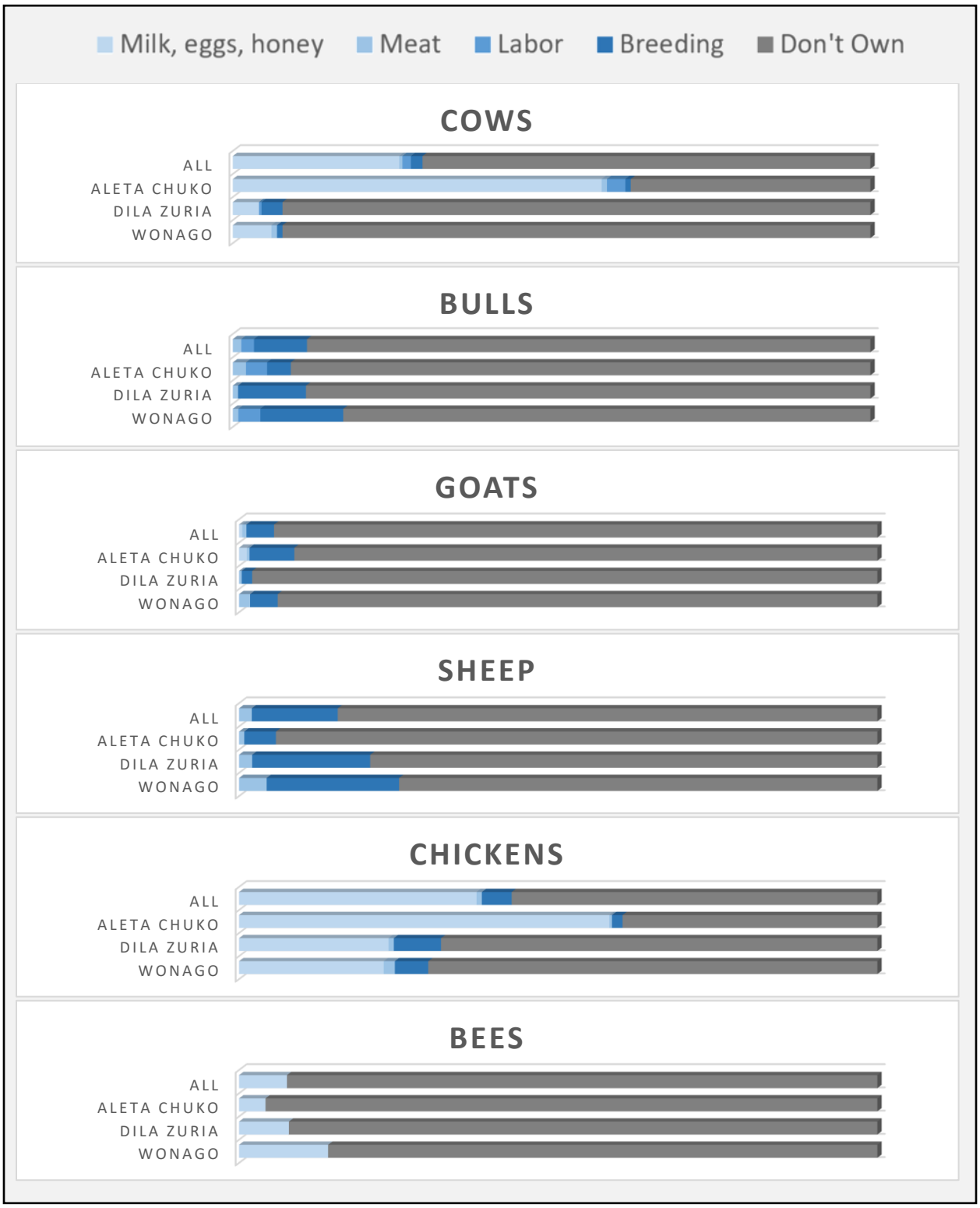


Figure 6. Ownership and primary use of livestock by woreda.

Sweetpotato Farming

Sweetpotato farming practices are described by woreda in …

Just under half of all households surveyed reported growing any type of sweetpotato, with the proportion being highest in Aleta Chuko (72.5%) and lowest in Dila Zuria (26.9%). White-fleshed varieties were most common at 40.2% overall, also most common in Aleta Chuko (63.1%) and least in Dila Zuria (17.6%).

Just over one-quarter (28.6) of all households reported producing orange-fleshed sweetpotato and almost 10% reported growing yellow-fleshed. Formative research suggests that yellow-fleshed varieties were not common, and thus it is likely that households mistook lighter pigmented orange-fleshed varieties as being yellow-fleshed. As expected, only 1.1% and 1.5% of control households reported growing orange- and yellow-fleshed sweetpotatoes, respectively.

Of partial intervention households, 47.1% and 17.0% reported orange- and yellow-fleshed sweetpotatoes. And of full intervention households, 53.9% and 16.5% reported growing orange- and yellow-fleshed sweetpotatoes, respectively. Just under half (47.1%) of all partial intervention households reported growing either orange- or yellow-fleshed sweetpotatoes; the proportion in full intervention was slightly higher at 56.0%. Just under half (47.1%) of all partial intervention households reported growing either orange- or yellow-fleshed sweetpotatoes; the proportion in full intervention was slightly higher at 56.0%. Of households in partial and full intervention, 76.1% and 81.6% reported receiving vines from CIP or PIN, respectively.

The median land area dedicated to growing sweetpotatoes was 573 square meters (m^2; IQR 117, 1164). Despite overall land area cultivated being highest in Aleta Chuko, the area of land for growing sweetpotatoes of any color-flesh is lowest in Aleta Chuko (392 m^2 [89, 733]) and highest in Dila Zuria (1080 m^2 [450, 2068]). Similarly, the proportion of all land cultivated in the last year that was used for sweetpotatoes was lowest in Aleta Chuko (0.08 [0.03, 0.16), and higher in Dila Zuria (0.22 [0.11, 0.48]) and Wonago (0.31 [0.07, 0.45]). Though no data were collected in this survey on intercropping, other assessments as part of QDBH suggest intercropping is more common in Gedeo than Sidama. Thus, Gedeo farmers may have more land that *includes* sweetpotatoes, though it may not be exclusively for sweetpotatoes. It should also be noted that 46 observations are missing data on this variable because their estimate of land area cultivated by sweetpotatoes was larger than the land area they reported cultivating and were thus unreliable; so the indicator may be subject to considerable measurement error.

Of households who grow any sweetpotatoes, a majority (71.0%) do not sell any of their sweetpotatoes, but more sweetpotato-growing households in Dila Zuria and Wonago sell sweetpotatoes than sweetpotato-growing households in Aleta Chuko. Most households reported that the head of household either decides alone (46.2%) or with the caregiver (32.3%) how much of the sweetpotato harvest to sell.

In all woredas, December and January were reported as the most common months for sweetpotato harvest; November was also common in Aleta Chuko and February somewhat common in Dila Zuria (Figure 7).

Table 15. Sweetpotato farming practices by woreda.

	Total	Aleta Chuko	Dila Zuria	Wonago	p*
	N = 605	n = 244	n = 245	n = 116	
Grow any color sweetpotato, %	298 (49.3)	177 (72.5)	66 (26.9)	55 (47.4)	<0.0001
Grow OFSP, %	173 (28.6)	92 (37.9)	44 (18.0)	37 (31.9)	<0.0001
Grow YFSP, %	60 (9.9)	1 (1.0)	28 (11.4)	31 (26.7)	<0.0001
Grow WFSP, %	243 (40.2)	154 (63.1)	43 (17.6)	46 (39.7)	<0.0001
Grow OFSP and/or YFSP	178 (29.5)	92 (37.9)	47 (19.2)	39 (33.6)	0.0001
Received vines from CIP/PIN	188 (64.2)	106 (59.9)	42 (67.7)	40 (74.1)	
NOTE: The rest of the table includes only those who grow any sweetpotato					
Square meters dedicated to sweetpotatoes	573 (117, 1164)	392 (89, 733)	1080 (450, 2068)	875 (125, 1350)	0.001
Percentage cultivated land used for sweetpotato farming	0.12 (0.04, 0.25)	0.08 (0.03, 0.16)	0.22 (0.11, 0.48)	0.31 (0.07, 0.45)	<0.0001
How much of your sweetpotato roots do you sell?					
None	206 (71.0)	146 (82.5)	34 (56.7)	26 (49.1)	<0.0001
Less than half	25 (8.6)	13 (7.3)	5 (8.3)	7 (13.2)	
About half	30 (10.3)	9 (5.1)	12 (20.0)	9 (17.0)	
More than half	24 (8.3)	9 (5.1)	7 (11.7)	8 (15.1)	
All	5 (1.7)	0	2 (3.3)	3 (5.7)	
Who decides how much sweet potato to sell?					
Head of household only	146 (46.2)	100 (56.5)	28 (43.1)	18 (32.7)	<0.0001
Respondent/caregiver only	7 (2.4)	5 (2.8)	2 (3.1)	0	
Both head of household and caregiver	96 (32.3)	39 (22.0)	26 (40.0)	31 (56.4)	
Other / Don't know	48 (16.2)	33 (18.6)	9 (13.9)	6 (10.9)	

* p value for differences across woredas

Table 16. Sweetpotato farming practices by intervention group

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Grow any color sweetpotato, %	298 (49.3)	55 (20.5)	114 (74.0)	129 (70.9)	<0.0001	<0.0001
Grow OFSP, %	173 (28.6)	3 (1.1)	72 (47.1)	98 (53.9)	<0.0001	<0.0001
Grow YFSP, %	60 (9.9)	4 (1.5)	26 (17.0)	30 (16.5)	<0.001	<0.0001
Grow WFSP, %	243 (40.2)	52 (19.3)	97 (63.0)	94 (51.7)	<0.0001	<0.0001
Grow OFSP and/or YFSP	178 (29.5)	4 (1.5)	72 (47.1)	102 (56.0)	<0.0001	<0.0001
Received vines from CIP/PIN	188 (64.2)	0	86 (76.1)	102 (81.6)		
NOTE: The rest of the table includes only those who grow any sweetpotato						
Square meters dedicated to sweetpotatoes	573 (117, 1164)	860 (413, 1475)	550 (97, 1131)	522 (84, 967)	0.25	0.49
Percentage cultivated land used for sweetpotato farming	0.12 (0.04, 0.25)	0.20 (0.07, 0.33)	0.11 (0.04, 0.24)	0.12 (0.02, 0.22)	0.05	0.22
How much of your sweetpotato roots do you sell?						
None	206 (71.0)	34 (61.8)	79 (71.2)	93 (75.0)	0.33	0.34
Less than half	25 (8.6)	6 (10.9)	6 (5.4)	13 (10.5)		
About half	30 (10.3)	9 (16.4)	14 (12.6)	7 (5.7)		
More than half	24 (8.3)	5 (9.1)	11 (9.9)	8 (6.5)		
All	5 (1.7)	1 (1.8)	1 (0.9)	3 (2.4)		
Who decides how much sweet potato to sell?						
Head of household only	146 (46.2)	32 (58.2)	55 (48.3)	59 (46.1)	<0.0001	<0.0001
Respondent/caregiver only	7 (2.4)	0	4 (3.5)	3 (2.3)		
Both head of household and caregiver	96 (32.3)	14 (25.5)	39 (34.2)	43 (33.6)		
Other / Don't know	48 (16.2)	9 (16.4)	16 (14.0)	23 (18.0)		

** p value for differences across intervention groups
*** p value for differences across intervention groups while controlling for woreda

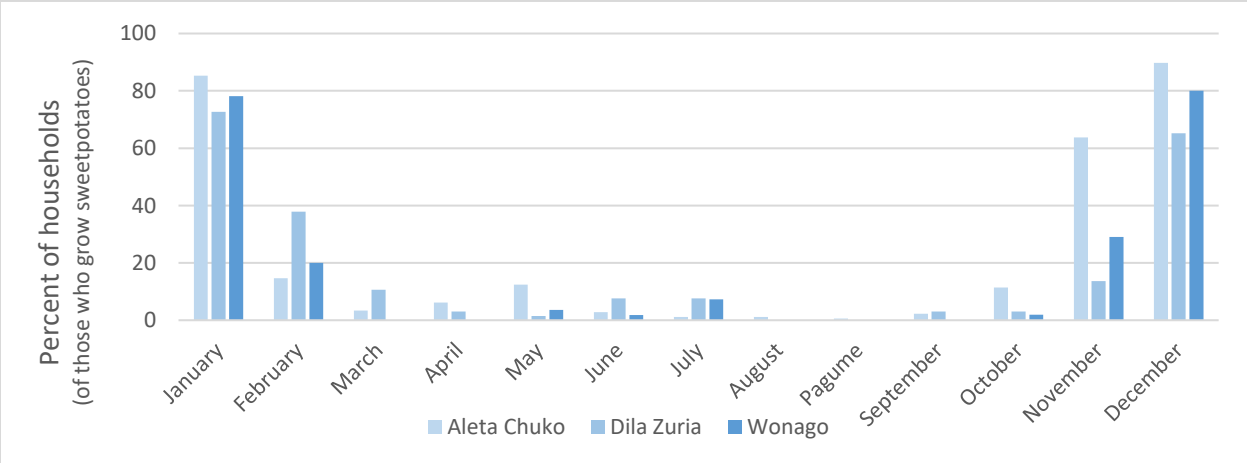


Figure 7. Months in which sweetpotatoes were harvested, by woreda.

Household Fasting Practices

Just under one in three of all households report that they practice fasting at any time, but this practice varies by woredas with nearly half of all households in Wonago, but less than one-quarter in Aleta Chuko, fasting at any time Table 17. However, only 8.3% of the sample reported that any member of their household fasted in the previous day, and this did not vary by woreda (p=0.27). Of respondents who said that her household ever fasts, the median age at which a child typically begins to fast was 14.3 (IQR 9.8, 14.9) years. However, this response ranged from 7 to 25 years, with many caregivers saying they did not know or that it is left to the child to decide when to participate in the practice.

Though the practice of ever fasting was slightly less common in control kebeles (29.4%) and more common in the full intervention (35.2%, p=0.04), there was no difference between intervention group in the proportion who reported fasting in the previous day (p=0.58, Table 18).

Table 17. Fasting by woreda.

	Total	Aleta Chuko	Dila Zuria	Wonago	p*
	N = 605	n = 244	n = 245	n = 116	
Practices fasting at any time, %	195 (32.2)	59 (24.2)	79 (32.2)	57 (49.1)	<0.001
Fasted in the previous day, %	50 (8.3)	18 (7.5)	18 (7.4)	14 (12.1)	0.27
Age at which children begin fasting (of respondents who report fasting)	14.3 (9.8, 14.9)	11.2 (8.9, 14.1)	13.9 (11.3, 15.2)	14.5 (14.0, 14.9)	0.08

* p value for differences across woredas

Table 18. Fasting by intervention group.

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Practices fasting at any time, %	195 (32.2)	79 (29.4)	52 (33.8)	64 (35.2)	0.36	0.04
Fasted in the previous day, %	50 (8.3)	25 (9.4)	13 (8.5)	12 (6.6)	0.54	0.58
Age at which children begin fasting (of respondents who report fasting)	14.3 (9.8, 14.9)	14.2 (9.6, 14.8)	12.4 (9.4, 14.3)	13.9 (11.3, 15.9)	0.08	0.02

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Friday and Wednesdays are the most common day of the week for fasting, with 27.8% and 24.0%, respectively, of all households having at least one member who fasts (Table 19). Fasting on these days was most common in Wonago (38.8% on Wednesdays and 42.2% on Fridays) than in Dila Zuria (23.3% on Wednesdays and 29.0% on Fridays) or Aleta Chuko (17.6% on Wednesdays and 19.8% on Fridays). Regardless of the day of fasting, almost all households report that their fasting means abstaining from all food and water, but only a minority say that fasting lasts the full day (10.3% and 8.3% on Wednesdays and Fridays, respectively). In general, most caregivers report that the fast, but very few say that the child fasts (only 1 and 3 children on Wednesday and Fridays, respectively).

Table 19. Detailed fasting practices.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Holiday
At least one member of household fasts (%)								
Total	0	3 (0.5)	145 (24.0)	5 (0.8)	168 (27.8)	6 (1.0)	4 (0.7)	31 (5.2)
Aleta Chuko	0	1 (0.4)	43 (17.6)	2 (0.8)	48 (19.8)	1 (0.4)	1 (0.4)	16 (6.6)
Dila Zura	0	1 (0.4)	57 (23.3)	1 (0.4)	71 (29.0)	3 (1.2)	2 (0.8)	11 (4.5)
Wonago	0	1 (0.9)	45 (38.8)	2 (1.7)	49 (42.2)	2 (1.7)	1 (0.9)	4 (3.5)
Of households who fast on this day:								
Abstain from all food *and* water (%)	n/a	3 (100.0)	141 (97.2)	5 (100.0)	165 (98.8)	5 (100.0)	4 (100.0)	30 (96.8)
Fasts lasts a full day (%)	n/a	1 (33.3)	15 (10.3)	1 (20.0)	14 (8.3)	1 (16.7)	2 (50.0)	14 (46.7)
Caregiver fasts (%)	n/a	1 (33.3)	117 (80.7)	4 (80.0)	134 (79.8)	5 (83.3)	2 (50.0)	30 (96.8)
Child fasts (%)	n/a	0	1 (0.7)	0	3 (1.8)	0	0	0

Food Security

Household food security indicators are displayed by woreda in Table 20 and by intervention group in Table 21.

Months Adequate Household Food Provisioning

Several respondents were missing data on having adequate food in *Pagume*, which is the seven-day, thirteenth month of the Ethiopian calendar. The month is sometimes treated as celebratory. Because of the missingness, MAHFP is presented both with and without *Pagume* (Table 20, Table 21). The median number months of adequate household food provision was 10 (8, 12) months, excluding Pagume. Most estimates were increase by one with Pagume was included, indicating most respondents who provided a response for the month of Pagume recalled being food secure in this short month. The indicator did not differ with respect to intervention group (p=0.99 and 0.94).

The MAHFP was somewhat higher – reflecting adequate food for more of the year – in Dila Zuria. The proportions of households with *inadequate* household food is shown below in Figure 8, total and woredas specific. April through September are the most food insecure months. Food insecurity peaks in Aleta Chuko earlier in the calendar year – reaching nearly two-thirds in the month of May – but in Dila Zuria and Wonago peaks in July and August, according to respondent recall of the previous year.

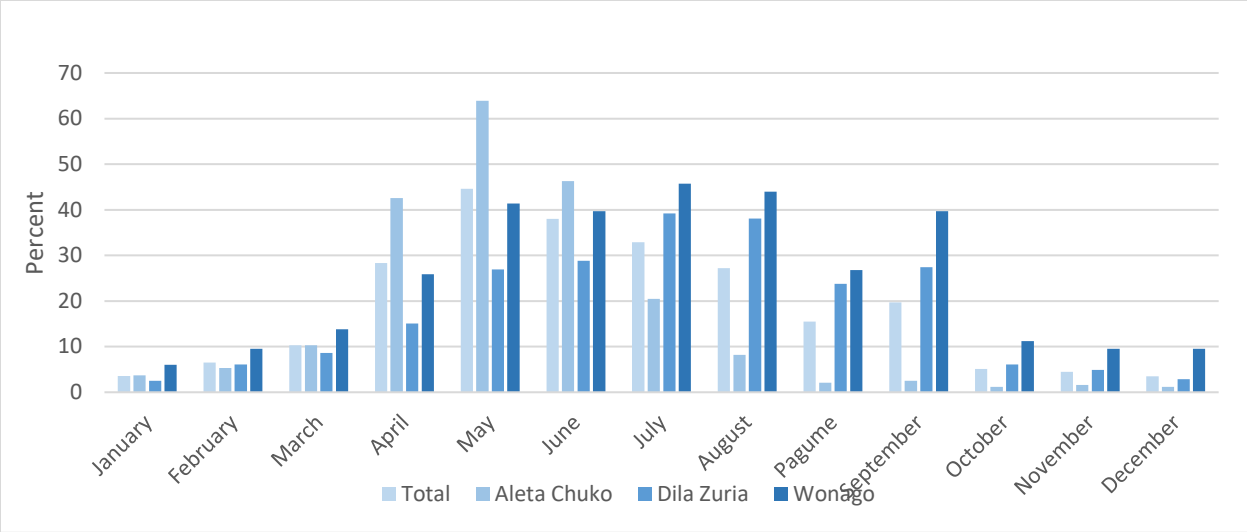


Figure 8. Months of Inadequate Household Food Provisions by woreda.

Household Hunger Score

According to the Household Hunger Score (HHS), 90.4% of the sample had little to no hunger, 7.6% experienced moderate hunger, and 2.0% experienced severe hunger in the previous year. These proportions did not differ by woreda (p=0.34), but did differ slightly by intervention group with those in the control group having a higher proportion with little to no hunger (94.8%) than those in the partial (85.6%) and full intervention (87.9%, p=0.02).

Food Insecurity Experience Scale

The median FIES was 3 (IQR 1,7), but was significantly higher in Wonago (median 5 [IQR 2, 8], p<0.01). There was no difference in FIES by intervention group (p=0.84).

Table 20. Household food security indicators by woreda.

	Total	Aleta Chuko	Dila Zuria	Wonago	p*
	N = 605	n = 244	n = 245	n = 116	
Months Adequate Household Food Provisioning (excludes Pagume)	10 (8, 12)	10 (9, 12)	12 (8, 12)	10 (7, 12)	0.02
Months Adequate Household Food Provisioning (includes Pagume)	11 (9, 13)	11 (10, 13)	13 (9, 13)	11 (8, 13)	0.02
Household Hunger Score					
Little to no hunger, %	545 (90.4)	222 (91.7)	223 (91.0)	100 (86.2)	0.34
Moderate hunger, %	46 (7.6)	14 (5.8)	19 (7.8)	13 (11.2)	
Severe hunger, %	12 (2.0)	6 (2.5)	3 (1.2)	3 (2.6)	
Food Insecurity Experience Scale	3 (1, 7)	3 (1, 6)	3 (0, 7)	5 (2, 8)	<0.01

* p value for differences across woredas

Table 21. Household food security indicators by intervention group.

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Months Adequate Household Food Provisioning (excludes Pagume)	10 (8, 12)	10 (8, 12)	10 (9, 12)	10 (9, 12)	0.90	0.99
Months Adequate Household Food Provisioning (includes Pagume)	11 (9, 13)	11 (9, 13)	11 (10, 13)	11 (10, 13)	0.67	0.94
Household Hunger Score						
Little to no hunger, %	545 (90.4)	255 (94.8)	131 (85.6)	159 (87.9)	0.03	0.02
Moderate hunger, %	46 (7.6)	9 (3.4)	18 (11.8)	19 (10.5)		
Severe hunger, %	12 (2.0)	5 (1.9)	4 (2.6)	3 (1.7)		
Food Insecurity Experience Scale	3 (1, 7)	3 (2, 7)	3 (2, 7)	4 (1, 7)	0.90	0.84

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Household and Women's Dietary Diversity

Dietary diversity scores for women and household, as well as food group specific frequencies, are shown in Table 22 and Table 23.

Household Dietary Diversity Score (HDDS) ranged from 0 to 11, and averaged 5.6 ± 1.7. The score was highest in Aleta Chuko (6.0 ± 1.7) and lowest in Wonago (5.0 ± 1.6; p<0.0001). The most commonly consumed food groups at the household level was "miscellaneous," with 95.4% consuming something from this category, which includes coffee and tea. Other common food groups include roots and tubers (92.2%), vegetables (84.0%), cereals (76.7%), and oils and fats (80.7%).

The median number of food groups consumed by caregivers in the MDD-W indicator was 2.4 (IQR 1.6, 3.5), which was also higher in Aleta Chuko (2.8 [IQR 1.8, 4.0]) and lower in Wonago (2.0 [IQR 1.4, 2.9], p=0.0001). Overall, 16.0% of women met the minimum dietary diversity recommendation of five food groups, also, as expected, higher in Aleta Chuko (25.4%) and lower in Wonago and Dila Zuria (both 9.5%, p<0.001). With the MDD-W food group definitions, grains, white roots, and tubers were the most commonly consumed food group (98.8%), followed by dark green leafy vegetables (68.5%).

In general, cereals, eggs, pulses, dairy, and fruits and vegetables – with the exception of dark green leafy vegetables – were more common in Aleta Chuko. On the other hand, meats, roots and tubers, and dark green leafy vegetables were more commonly consumed in the Gedeo woredas than in Aleta Chuko.

Cereal consumption (according to the HDDS food group definition) was significantly different between intervention groups (Table 23), with it being more common in the partial intervention (85.7%) and less common in the control group (74.7%) and full intervention (72.0%, p=0.01). However, neither HDDS or MDD-W differed by intervention group after controlling for woreda (p=0.83 and 0.07, respectively).

Table 22. Household and Women's Dietary Diversity by woreda.

	Total N = 605	Aleta Chuko n = 244	Dila Zuria n = 245	Wonago n = 116	p*
Household Dietary Diversity Score	5.6 ± 1.7	6.0 ± 1.7	5.5 ± 1.6	5.0 ± 1.6	<0.0001
Cereals	464 (76.7)	232 (95.1)	159 (64.9)	73 (62.9)	<0.0001
Roots and tubers	558 (92.2)	207 (84.8)	240 (98.0)	111 (95.7)	<0.001
Vegetables	508 (84.0)	177 (72.5)	226 (92.2)	105 (90.5)	<0.0001
Fruits	140 (23.1)	69 (28.3)	49 (20.0)	22 (19.0)	0.06
Meat, poultry, and offal	166 (27.4)	43 (17.6)	81 (33.1)	42 (36.2)	<0.001
Eggs	31 (5.1)	23 (9.4)	6 (2.5)	2 (1.7)	<0.01
Fish and seafood	12 (2.0)	8 (3.3)	2 (0.8)	2 (1.7)	0.20
Pulses, legumes, nuts	241 (39.8)	132 (54.1)	86 (35.1)	23 (19.8)	<0.0001
Milk and milk products	129 (21.3)	115 (47.1)	12 (4.9)	2 (1.7)	<0.0001
Oil and fats	488 (80.7)	204 (83.6)	201 (82.0)	83 (71.6)	0.03
Sugar and honey	70 (11.6)	17 (7.0)	44 (18.0)	9 (7.8)	<0.01
Miscellaneous	577 (95.4)	240 (98.4)	231 (94.3)	106 (91.4)	0.03
Women's Dietary Diversity Score	2.4 (1.6, 3.5)	2.8 (1.8, 4.0)	2.3 (1.5, 3.2)	2.0 (1.4, 2.9)	0.0001
Minimum Dietary Diversity (≥5 food groups)	96 (16.0)	62 (25.4)	23 (9.5)	11 (9.5)	<0.001
Grains, white roots, and tubers	594 (98.8)	244 (100.0)	238 (98.8)	112 (96.6)	0.21
Pulses	233 (38.8)	130 (53.5)	82 (34.0)	21 (18.1)	<0.0001
Nuts and seeds	5 (0.8)	5 (2.1)	0	0	n/a
Dairy	125 (20.8)	110 (45.1)	13 (5.4)	2 (1.7)	<0.0001
Meat, poultry, and fish	174 (29.0)	46 (18.9)	84 (34.9)	44 (37.9)	<0.001
Eggs	33 (5.5)	23 (9.4)	7 (2.9)	3 (2.6)	0.01
Dark green leafy vegetables	411 (68.5)	103 (42.2)	213 (88.8)	95 (81.9)	<0.0001
Other vitamin A-rich fruits and vegetables	45 (7.5)	38 (15.6)	2 (0.8)	5 (4.3)	<0.001
Other vegetables	135 (22.5)	102 (41.8)	20 (8.3)	13 (11.2)	<0.0001
Other fruits	141 (23.5)	67 (27.5)	51 (21.2)	23 (19.8)	0.16

* p value for differences across woredas

Table 23. Household and Women's Dietary Diversity by intervention group.

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Household Dietary Diversity Score	5.6 ± 1.7	5.5 ± 1.5	5.7 ± 1.7	5.6 ± 1.9	0.45	0.83
Cereals, %	464 (76.7)	201 (74.7)	132 (85.7)	131 (72.0)	<0.01	0.01
Roots and tubers, %	558 (92.2)	254 (94.4)	136 (88.3)	168 (92.3)	0.09	0.73
Vegetables, %	508 (84.0)	243 (90.3)	122 (79.2)	143 (78.6)	<0.01	0.16
Fruits, %	140 (23.1)	50 (18.6)	40 (26.0)	50 (27.5)	0.07	0.20
Meat, poultry, and offal, %	166 (27.4)	80 (29.7)	34 (22.1)	52 (28.6)	0.21	0.56
Eggs, %	31 (5.1)	7 2.6)	9 (5.8)	15 (8.2)	0.05	0.20
Fish and seafood, %	12 (2.0)	3 (1.1)	4 (2.6)	5 (2.8)	0.41	0.68
Pulses, legumes, nuts, %	241 (39.8)	96 (35.7)	69 (44.8)	76 (41.8)	0.14	0.99
Milk and milk products, %	129 (21.3)	33 (12.3)	46 (29.9)	50 (27.5)	0.0001	0.59
Oil and fats, %	488 (80.7)	219 (81.4)	124 (80.5)	145 (79.7)	0.89	0.68
Sugar and honey, %	70 (11.6)	33 (12.3)	17 (11.0)	20 (11.0)	0.88	0.74
Miscellaneous, %	577 (95.4)	263 (97.8)	146 (94.8)	168 (92.3)	0.05	0.01
Women's Dietary Diversity Score	2.4 (1.6, 3.5)	2.3 (1.5, 3.3)	2.6 (1.7, 3.7)	2.6 (1.6, 3.8)	<0.01	0.19
Minimum Dietary Diversity (≥5 food groups), %	96 (16.0)	27 (10.1)	29 (19.0)	40 (22.2)	<0.01	0.07
Grains, white roots, and tubers, %	594 (98.8)	265 (98.9)	153 (100.0)	176 (97.8)	0.47	0.06
Pulses, %	233 (38.8)	93 (34.8)	64 (41.8)	76 (42.2)	0.18	0.76
Nuts and seeds, %	5 (0.8)	0	3 (2.0)	2 (1.1)	0.60	0.74
Dairy, %	125 (20.8)	34 (12.7)	39 (25.5)	52 (28.9)	<0.001	0.15
Meat, poultry, and fish, %	174 (29.0)	87 (32.5)	33 (21.6)	54 (30.0)	0.06	0.38
Eggs, %	33 (5.5)	8 (3.0)	8 (5.2)	17 (9.4)	0.03	0.09
Dark green leafy vegetables, %	411 (68.5)	208 (77.6)	89 (58.2)	114 (63.7)	<0.001	0.94
Other vitamin A-rich fruits and vegetables, %	45 (7.5)	7 (2.6)	18 (11.8)	20 (11.1)	<0.01	0.13
Other vegetables, %	135 (22.5)	36 (13.4)	54 (35.3)	45 (25.0)	0.0001	0.12
Other fruits, %	141 (23.5)	50 (18.7)	39 (25.5)	52 (28.9)	0.04	0.10

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Antenatal Care

About one-quarter (24.6%) of all index children were reported as the respondent's first live birth, with the average number of reported live births being 3.4 ± 2.3 (Table 24). Respondents in Aleta Chuko reported fewer live births (2.8 ± 1.7), while women in Dila Zuria reported more (3.9 ± 2.5, p<0.0001).

Overall, 85.6% of women received prenatal care, but prenatal care was more common in Aleta Chuko (93.0%) and least common in Wonago (71.6%, p<0.001). Of women who received prenatal care, the mean estimated gestation at which women had their first prenatal visit was 4.8 ± 1.2, and women reported on average 2.9 ± 1.6 total visits during pregnancy. Both metrics were most favorable in Aleta Chuko, and least favorable in Wonago.

Over half (56.5%) of all respondents said they received advice on maternal nutrition in pregnancy from a health care professional, but less than half (46.6%) of all respondents received prenatal advice on infant feeding. Differences between woredas were small and not significant.

Table 24. Antenatal care utilization during most recent pregnancy by woreda.

	Total N = 605	Aleta Chuko n = 244	Dila Zuria n = 245	Wonago n = 116	p*
Number of live births	3.4 ± 2.3	2.8 ± 1.7	3.9 ± 2.5	3.7 ± 2.5	<0.0001
Reference child is first birth	149 (24.6)	67 (27.5)	53 (21.6)	29 (25.0)	0.32
Received prenatal care	518 (85.6)	227 (93.0)	208 (84.9)	83 (71.6)	<0.001
Months gestation at first antenatal care visit	4.8 ± 1.2	4.5 ± 1.2	4.9 ± 1.7	5.1 ± 1.6	<0.01
Total Number of antenatal care visits	2.9 ± 1.6	3.1 ± 1.3	2.9 ± 1.6	2.4 ± 1.8	<0.01
Had 4 or more antenatal care visits	236 (39.1)	100 (41.0)	93 (38.1)	43 (37.1)	0.71
Received advice on nutrition in pregnancy from Health Care Provider	342 (56.5)	145 (59.4)	136 (55.5)	61 (52.6)	0.42
Received advice on IYCF	281 (46.6)	112 (45.9)	118 (48.2)	51 (44.7)	0.79
Location of birth					
Health post	270 (44.7)	93 (38.1)	141 (57.8)	36 (31.0)	<0.0001
Health center or hospital	86 (14.2)	71 (29.1)	11 (4.5)	4 (3.5)	
Home or other	248 (41.1)	80 (32.8)	92 (37.7)	76 (65.5)	
Skilled attendant present at birth	365 (60.5)	171 (70.1)	154 (63.4)	40 (34.5)	<0.0001
Antenatal Care Score	5.4 ± 2.6	6.0 ± 2.3	5.3 ± 2.5	4.2 ± 2.7	<0.0001
Antenatal Care Category					
Low	192 (31.7)	56 (23.0)	77 (31.4)	59 (50.9)	<0.001
Medium	284 (46.9)	117 (48.0)	125 (51.0)	42 36.2)	
High	129 (21.3)	71 (29.1)	43 (17.6)	15 (12.9)	
Antenatal Care Score (excluding any missing)	5.4 ± 2.6	6.0 ± 2.3	5.3 ± 2.5	4.2 ± 2.7	<0.0001
Antenatal Care Score with imputed values	5.4 ± 2.6	6.0 ± 2.3	5.3 ± 2.5	4.2 ± 2.7	<0.0001

* p value for differences across woredas

Of the infant feeding advice women reported receiving during pregnancy (Figure 9), exclusive breastfeeding for 6 months was the most common, followed by not giving pre-lacteals and extra meals for breastfeeding moms. Early initiation of breastfeeding and skin-to-skin contact were least commonly reported.

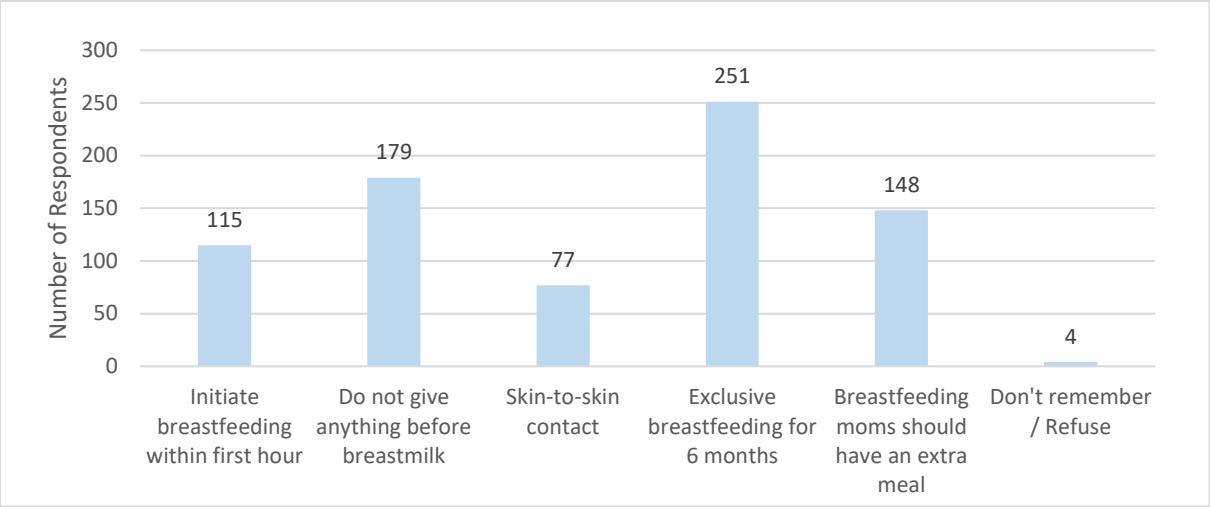


Figure 9. Infant feeding advice received during antenatal care visits

More than four in ten respondents (41.1%) gave birth at her home or at someone else's home. The remaining women either birthed at a health post in the kebele (44.7%), or at a health center or hospital (14.2%). Notably, however, 64.9% of respondents in Wonago gave birth at home, compared to 31.1% and 37.5% in Aleta Chuko and Dila Zuria, respectively ($p<0.0001$). And while 60.5% of the entire sample had a skilled attendant – which includes doctors, nurses, midwives, government health officers, or government HEW – at the birth, the proportion was considerably lower in Wonago (34.5%) compared with Aleta Chuko (70.1%) or Dila Zuria (63.4%, $p<0.0001$).

Overall, the average ANC score was 5.4 ± 2.6, but significant differences across woredas are apparent with Aleta Chuko having the highest average (6.0 ± 2.3) and Wonago having the lowest (4.2 ± 2.7, $p<0.001$).

Notably, the ANC score also differed by intervention group (Table 25), even after adjusting for woreda, with a lower score in the control group (4.9 ± 2.3) compared to the partial (5.7 ± 2.6) and full intervention groups (5.8 ± 2.3, $p=0.02$). Of the individual components, there were significant differences in having received advice on nutrition in pregnancy, having received advice on IYCF, birth location, and having a skilled birth attendant at delivery.

Antenatal care or the summary score may be a relevant covariate to include in hypothesis testing where knowledge, feeding practices, or child health are outcomes of interest.

Table 25. Antenatal care utilization during most recent pregnancy by intervention group.

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Number of live births	3.4 ± 2.3	3.4 ± 2.3	3.3 ± 2.2	3.5 ± 2.2	0.62	0.10
Reference child is first birth	149 (24.6)	77 (28.6)	39 (25.3)	33 (18.1)	0.05	0.02
Received prenatal care	518 (85.6)	225 (83.6)	133 (86.4)	160 (87.9)	0.40	0.70
Months gestation at first antenatal care visit	4.8 ± 1.2	4.9 ± 1.6	4.6 ± 1.3	4.7 ± 1.4	0.22	0.74
Total Number of antenatal care visits	2.9 ± 1.6	2.7 ± 1.6	3.0 ± 1.6	3.0 ± 1.6	0.07	0.27
Had 4 or more antenatal care visits	236 (39.1)	97 (36.2)	69 (44.8)	70 (38.5)	0.22	0.29
Received advice on nutrition in pregnancy from Health Care Provider	342 (56.5)	133 (49.4)	92 (57.9)	117 (64.3)	0.01	0.02
Received advice on IYCF	281 (46.6)	110 (40.9)	73 (47.4)	98 (54.4)	0.03	0.02
Location of birth						
Health post	270 (44.7)	103 (38.4)	74 (48.1)	93 (51.1)	<0.01	<0.01
Health center or hospital	86 (14.2)	29 (10.8)	26 (16.9)	31 (17.0)		
Home or other	248 (41.1)	136 (50.8)	54 (35.1)	58 (31.9)		
Skilled attendant present at birth	365 (60.5)	134 (50.2)	103 (66.9)	128 (70.3)	<0.001	<0.01
Antenatal Care Score	5.4 ± 2.6	4.9 ± 2.6	5.7 ± 2.6	5.8 ± 2.3	<0.001	0.02
Antenatal Care Category						
Low	192 (31.7)	107 (39.8)	40 (26.0)	45 (24.7)	<0.01	0.07
Medium	284 (46.9)	120 (44.6)	72 (46.8)	92 (50.6)		
High	129 (21.3)	42 (15.6)	42 (27.3)	45 (24.7)		
Antenatal Care Score - excluding any missing	5.4 ± 2.6	4.9 ± 2.6	5.7 ± 2.6	5.8 ± 2.3	<0.001	0.01
Antenatal Care Score with imputed values	5.4 ± 2.6	4.9 ± 2.6	5.7 ± 2.6	5.8 ± 2.3	<0.001	0.02

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Maternal Nutrition Knowledge

Maternal nutrition knowledge outcomes are shown in Table 26 and Table 27.

The vitamin A knowledge domain score, which ranged from 0 to 5 points, was considerably higher in Aleta Chuko (1.1 ± 1.0) than in Dila Zuria (0.5 ± 0.9) or Wonago (0.5 ± 0.9, p<0.001), and was also higher in partial (0.9 ± 1.0) and full intervention (0.9 ± 1.0) households than in control (0.5 ± 0.9, p=0.03). Recall that OFSP vine distribution and HLC formation had already taken place at the time of the baseline survey, and therefore it is plausible that awareness of OFSP as a source of vitamin A could account for baseline differences in vitamin A knowledge. Furthermore, the intervention kebeles are more concentrated in Aleta Chuko, possibly also accounting for differences across woredas.

Domains where respondents scored fairly well include the healthy growth domain ("what makes a child grow well"), knowledge of colostrum, meal frequency recommendations, and timely introduction of

thick complementary foods. Scores on knowledge of age appropriate portions sizes were quite low. Timely introduction of diverse foods was mediocre.

The overall knowledge score *with* vitamin A included was similar across woredas and across intervention groups. However, the score was also assessed with the vitamin A domain excluded – to assess differences in nutrition knowledge prior to any effect that OFSP distribution may have had on vitamin A awareness. When vitamin A was excluded from the nutrition knowledge score, scores were higher in Dila Zuria (7.6 ± 1.4) and Wonago (7.6 ± 1.4) compared to Aleta Chuko (6.9 ± 1.5). However, knowledge scores did not differ across intervention groups after controlling for woreda.

Table 26. Caregiver nutrition knowledge by woreda.

	Total N = 605	Aleta Chuko n = 244	Dila Zuria n = 245	Wonago n = 116	p*
Healthy Growth (range 0-4)	1.9 ± 1.1	1.7 ± 0.9	2.0 ± 1.2	2.0 ± 1.2	<0.01
Vitamin A (range 0-5)	0.7 ± 1.0	1.1 ± 1.0	0.5 ± 0.9	0.5 ± 0.9	<0.0001
Colostrum (range 0-1)	0.9 ± 0.3	0.9 ± 0.3	0.9 ± 0.3	1.0 ± 0.2	<0.01
Timely Introduction of Diverse Complementary Foods (range 0-24)	18.3 ± 6.0	15.7 ± 6.6	20.0 ± 4.9	20.4 ± 4.7	<0.0001
Timely Introduction of Thick Complementary Foods (range 0-2)	1.4 ± 0.8	1.4 ± 0.8	1.5 ± 0.8	1.6 ± 0.7	0.03
Meal Frequency (range 0-3)	2.8 ± 1.6	2.8 ± 0.5	2.8 ± 0.5	2.7 ± 0.7	0.06
Portion Size (range 0-6)	1.9 ± 1.4	2.0 ± 1.3	1.9 ± 1.5	1.8 ± 1.4	0.54
Composite Knowledge Score					
Knowledge Score without vitamin A	7.3 ± 1.5	6.9 ± 1.5	7.6 ± 1.4	7.6 ± 1.4	0.0001
Knowledge Score w/o Vitamin A (missing values excluded)	7.4 ± 1.5	6.9 ± 1.5	7.7 ± 1.3	7.6 ± 1.4	<0.0001
Knowledge Score w/o Vitamin A (missing values imputed)	7.4 ± 1.5	6.9 ± 1.5	7.7 ± 1.3	7.6 ± 1.4	<0.0001
Total Score	8.0 ± 1.8	8.0 ± 1.8	8.0 ± 1.8	8.1 ± 1.7	0.82
Total Knowledge Score (missing values excluded)	8.1 ± 1.8	8.0 ± 1.8	8.1 ± 1.8	8.1 ± 1.7	0.70
Total Knowledge Score (missing values imputed)	8.1 ± 1.7	8.1 ± 1.8	8.1 ± 1.7	8.1 ± 1.7	0.70

* p value for differences across woredas

Table 27. Caregiver nutrition knowledge by intervention group.

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Healthy Growth (range 0-4)	1.9 ± 1.1	1.9 ± 1.2	1.9 ± 1.0	1.9 ± 1.0	0.96	0.58
Vitamin A (range 0-5)	0.7 ± 1.0	0.5 ± 0.9	0.9 ± 1.0	0.9 ± 1.0	0.0001	0.03
Colostrum (range 0-1)	0.9 ± 0.3	0.9 ± 0.2	0.9 ± 0.3	0.9 ± 0.3	0.10	0.36
Timely Introduction of Diverse Complementary Foods (range 0-24)	18.3 ± 6.0	19.2 ± 5.6	17.8 ± 6.2	17.5 ± 6.3	<0.01	0.36
Timely Introduction of Thick Complementary Foods (range 0-2)	1.4 ± 0.8	1.5 ± 0.7	1.4 ± 0.8	1.4 ± 0.8	0.05	0.15
Meal Frequency (range 0-3)	2.8 ± 1.6	2.8 ± 0.5	2.7 ± 0.6	2.8 ± 0.5	0.21	0.13
Portion Size (range 0-6)	1.9 ± 1.4	1.9 ± 1.5	2.0 ± 1.4	2.0 ± 1.3	0.57	0.75
Composite Knowledge Score						
Knowledge Score without vitamin A	7.3 ± 1.5	7.5 ± 1.3	7.2 ± 1.6	7.2 ± 1.6	0.02	0.36
Knowledge Score w/o Vitamin A (missing values excluded)	7.4 ± 1.5	7.6 ± 1.3	7.2 ± 1.6	7.2 ± 1.6	0.01	0.37
Knowledge Score w/o Vitamin A (missing values imputed)	7.4 ± 1.5	7.6 ± 1.2	7.2 ± 1.6	7.2 ± 1.6	<0.01	0.31
Total Score	8.0 ± 1.8	8.0 ± 1.5	8.1 ± 1.9	8.0 ± 2.0	0.85	0.78
Total Knowledge Score (missing values excluded)	8.1 ± 1.8	8.1 ± 1.5	8.1 ± 1.9	8.1 ± 2.0	0.95	0.84
Total Knowledge Score (missing values imputed)	8.1 ± 1.7	8.1 ± 1.5	8.1 ± 1.9	8.0 ± 2.0	0.91	0.78

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Infant Feeding

Infant feeding practices assessed at baseline are shown in Table 28 and Table 30.

All infants enrolled had been breastfed at some point, and 99.7% were breastfed in the day before the survey. Additionally, 95.0% of respondents said they had initiated breastfeeding within the first hour of life. Delayed initiation of breastfeeding was more common in Aleta Chuko, where 8.2% and 2.1% reported initiating after the first hour but still within the first day, or after the first day of life, respectively. A small minority (2.2%) of infants had received any pre-lacteal. Somewhat contradicting the delayed breastfeeding initiation in Aleta Chuko, pre-lacteals were least common in Aleta Chuko (0.4%) and most common in Wonago (6.9%). Of the 13 respondents who reported giving a pre-lacteal, 12 of them were water and one was a traditional tea.

A similarly small proportion (2.3%) had ever been fed with a bottle. Nearly 6% of infants had received medication or vitamins in the previous day, which was more common in Aleta Chuko (p<0.01), and 1.0% had taken oral rehydration salts in the previous day.

Over one in five (22.5%) had received any non-breastmilk food or liquid in the previous 7 days or in the previous day (21.3%). Non-exclusive breastfeeding was more in Aleta Chuko (41.0% and 39.8% in the previous 7 days and previous 24 hours, respectively) and less common in Dila Zurai (9.4% and 8.2%) and Wonago (11.2% and 10.3%), with a p<0.0001 for non-exclusive breastfeeding in both the previous 7 days and 24 hours.

Table 28. Infant feeding practices by woreda.

	Total N = 605	Aleta Chuko n = 244	Dila Zuria n = 245	Wonago n = 116	p*
Child was ever breastfed	605 (100.0)				
Child was breastfed yesterday	602 (99.7)	243 (100.0)	244 (99.6)	115 (99.1)	n/a
How long after birth was breastfeeding initiated					
Within 1 hour	572 (95.0)	218 (89.7)	241 (99.2)	113 (97.4)	<0.0001
Between 1-24 hours	24 (4.0)	20 (8.2)	2 (0.8)	2 (1.7)	
24 hours or longer	6 (1.0)	5 (2.1)	0	1 (0.9)	
Child received pre-lacteals	13 (2.2)	1 (0.4)	4 (1.6)	8 (6.9)	0.01
Child has ever been fed with a bottle	14 (2.3)	10 (4.1)	3 (1.2)	1 (0.9)	0.10
Any medicines or vitamins in previous day	35 (5.8)	24 (9.8)	6 (2.5)	5 (4.3)	<0.01
Oral rehydration salts in previous day	6 (1.0)	2 (0.7)	3 (2.0)	1 (0.6)	0.49
Child had any non-breastmilk food or liquid in any of the last 7 days	136 (22.5)	100 (41.0)	23 (9.4)	13 (11.2)	<0.0001
Had any non-breastmilk food or liquid	129 (21.3)	97 (39.8)	20 (8.2)	12 (10.3)	<0.0001

* p value for differences across woredas

The percentages of infants who received non-breastmilk beverages or foods in the previous 7 days or in the previous day are shown in Table 29. Water was the most common non-breastmilk liquid given, and was more common in Aleta Chuko. Hamesa (a traditional tea) was also somewhat common, but only in Aleta Chuko. Because the baseline survey occurred prior to the index child's sixth month information on complementary feeding practices was not collected.

There were no significant differences in infant feeding practices by intervention group (Table 30).

Table 29. Percentage of infants who consumed non-breastmilk foods and liquids.

	In last 7 days				In previous day			
	Total	Aleta Chuko	Dila Zuria	Wonago	Total	Aleta Chuko	Dila Zuria	Wonago
Water	15.4	24.2	8.6	11.2	14.1	22.5	7.4	10.3
Formula	1.7	3.7	0.4	0	1	2.1	0.4	0
Milk	2.5	5.3	0.8	0	2.3	5.3	0.4	0
Juice or juice drinks	1.2	2.9	0	0	0.8	2.1	0	0
Thin porridge	2.8	6.2	0.8	0	2.2	4.9	0.4	0
Hamesa	7.9	19.3	0.4	0	7.9	19.3	0.4	0
Traditional medicines	0.5	1.2	0	0	0.5	1.2	0	0
Coffee	0.2	0	0.4	0	0.2	0	0.4	0
Tea	0.7	0.8	0.8	0	0.7	0.8	0.8	0
Gripe Water	0.2	0.4	0	0	0.2	0.4	0	0
Thick porridge	0.4	0.4	0.4	0	0.4	0.5	0.4	0

Table 30. Infants feeding practices by intervention group.

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Child was ever breastfed	605 (100.0)					
Child was breastfed yesterday	602 (99.7)	267 (99.6)	154 (100.0)	181 (99.5)	n/a	n/a
How long after birth was breastfeeding initiated						
Within 1 hour	572 (95.0)	261 (97.8)	146 (94.8)	165 (91.2)	0.07	0.26
Between 1-24 hours	24 (4.0)	4 (1.5)	6 (3.9)	14 (7.7)		
24 hours or longer	6 (1.0)	2 (0.8)	2 (1.3)	2 (1.1)		
Child received pre-lacteals	13 (2.2)	8 (3.0)	4 (2.6)	1 (0.6)	0.28	0.30
Child has ever been fed with a bottle	14 (2.3)	3 (1.1)	5 (3.3)	6 (3.3)	0.26	0.60
Any medicines or vitamins in previous day	35 (5.8)	9 (3.4)	18 (11.7)	8 (4.4)	<0.01	0.06
Oral rehydration salts in previous day	6 (1.0)	3 (1.2)	1 (0.4)	2 (1.7)	0.41	0.46
Child had any non-breastmilk food or liquid in any of the last 7 days	136 (22.5)	47 (17.5)	45 (29.2)	44 (24.2)	0.02	0.85
Had any non-breastmilk food or liquid	129 (21.3)	42 (15.6)	44 (28.6)	43 (23.6)	<0.01	0.98

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Infant Health and Nutritional Status

Nearly one in four respondents (24.3%) reported that their infant had experienced some form of illness in the previous two weeks. The proportion was higher in Aleta Chuko (33.2%) and lower in Dila Zuria (16.3, p<0.01). The most common illness reported was respiratory (14.4%), diarrhea (11.9%) and fever (11.7%). A very small minority of infants had been hospitalized or had measles (1.2% and 1.3%, respectively) at any point in their life.

The average length-for-age z score (LAZ) was -0.43 ± 1.46 and 13.0% of all infants surveyed were stunted; this is comparable but slightly more favorable than the 16.2% of infants under 6 months nationwide who were stunted in the 2016 DHS [30]. Infants were least stunted in Aleta Chuko (average LAZ 0.19 ± 1.24, 3.7% stunted) and most stunted in Wonago (average LAZ -0.94 ± 1.60, 24.4% stunted, p<0.0001 for LAZ and p=0.0001 for percentage of infants stunted). Only 1 infant in Aleta Chuko (0.4%) was severely stunted, but 7.0% and 8.7% of infants and Dila Zuria and Wonago, respectively, were severely stunted (p=0.02).

The average weight-for-age z score (WAZ) was -0.17 ± 1.43 and 10.1% of the infants were underweight. Again, these metrics are similar to the 2016 DHS, which found that 12.3% of infants under 6 months were underweight. And similar to stunting, underweight was least prevalent in Aleta Chuko (average WAZ 0.22 ± 1.13, 2.5% underweight) and most prevalent in Wonago (average WAZ -0.53 ± 1.78, 18.7% underweight, p<0.0001 and p<0.001). Again, only 1 child in Aleta Chuko (0.4%) was severely underweight, but 4.3% and 11.2% in Dila Zuria and Wonago were severely underweight (p<0.01).

The average weight-for-length z score (WLZ) was 0.24 ± 1.76 and 9.7% of infants surveyed were wasted. The national rate of wasting in the 2016 DHS was 15.4%. The rate of wasting was also lowest in Aleta Chuko (3.3%) and highest in Dila Zuria (14.0%) and Wonago (15.1%, p<0.01). Again, severe wasting was least common in Aleta Chuko (0.8%) and more common in Dila Zuria (7.4%) and Wonago (8.5%, p=0.01).

By intervention, there were no differences in reported child illness in the previous 2 weeks, or in lifetime hospitalization or measles (Table 32). However, there were significant differences in LAZ. Infants in the control group had a lower LAZ (-0.85 ± 1.51) and higher in both the partial (-0.13 ± 1.51) and full intervention groups (-0.08 ± 1.29, p<0.01). Infants in the control group also had a higher WFL (0.52 ± 2.02) than infants in the partial (0.12 ± 1.48) and full intervention groups (-0.07 ± 1.52, p<0.01). The higher WFL in the control group could be due to the shorter length of infants in this group and should not be interpreted as being a “better” nutritional status.

It should be noted that the standard deviations for LAZ, WAZ, and WLZ were 1.46, 1.43, and 1.76, respectively. Furthermore, 5 LAZ scores, 21 WAZ scores, and 27 WLZ scores were omitted for implausibility. Thus, quality of anthropometric data is a concern.

Table 31. Infant health and anthropometry by woreda.

	Total	Aleta Chuko	Dila Zuria	Wonago	p*
	N = 605	n = 244	n = 245	n = 116	
Child illness in the past 2 weeks					
Any illness	147 (24.3)	81 (33.2)	40 (16.3)	26 (22.4)	<0.01
Diarrhea	72 (11.9)	39 (16.0)	20 (8.2)	13 (11.2)	0.04
Vomiting	41 (6.8)	25 (10.3)	10 (4.1)	6 (5.2)	0.04
Fever	71 (11.7)	43 (17.6)	18 (7.4)	10 (8.6)	<0.01
Respiratory Illness	87 (14.4)	49 (14.4)	23 (9.4)	15 (12.9)	0.01
Hospitalization	7 (1.2)	1 (0.4)	3 (1.2)	3 (2.6)	0.26
Measles	8 (1.3)	0	4 (1.6)	4 (3.5)	0.33
Anthropometry					
Edema, %	3 (0.5)	1 (0.4)	0	2 (1.8)	n/a
Length-for-age z score	-0.43 ± 1.46	0.19 ± 1.24	-0.83 ± 1.35	-0.94 ± 1.60	<0.0001
Stunted, %	78 (13.0)	9 (3.7)	41 (16.9)	28 (24.4)	0.0001
Severely Stunted, %	28 (4.7)	1 (0.4)	17 (7.0)	10 (8.7)	0.02
Weight-for-age z score	-0.17 ± 1.43	0.22 ± 1.13	-0.40 ± 1.45	-0.53 ± 1.78	<0.0001
Underweight, %	59 (10.1)	6 (2.5)	33 (14.2)	20 (18.7)	<0.001
Severely Underweight, %	23 (3.9)	1 (0.4)	10 (4.3)	12 (11.2)	<0.01
Weight-for-length z score	0.24 ± 1.76	0.19 ± 1.32	0.31 ± 1.93	0.19 ± 2.21	0.72
Wasted, %	56 (9.7)	8 (3.3)	32 (14.0)	16 (15.1)	<0.01
Severely Wasted, %	28 (4.8)	2 (0.8)	17 (7.4)	9 (8.5)	0.01

* p value for differences across woredas

Table 32. Child health and anthropometry by intervention group.

	Total	Control	Partial Intervention	Full Intervention	p**	p***
	N = 605	n = 269	n = 154	n = 182		
Child illness in the past 2 weeks						
Any illness	147 (24.3)	61 (22.7)	39 (25.3)	47 (25.8)	0.68	0.65
Diarrhea	72 (11.9)	29 (10.8)	19 (12.3)	24 (13.2)	0.71	0.87
Vomiting	41 (6.8)	21 (7.8)	7 (4.6)	13 (7.1)	0.43	0.09
Fever	71 (11.7)	26 (9.7)	21 (13.6)	24 (13.2)	0.36	0.96
Respiratory Illness	87 (14.4)	38 (14.1)	23 (14.9)	26 (14.3)	0.97	0.55
Hospitalization	7 (1.2)	2 (0.7)	2 (1.3)	3 (1.7)	0.67	0.42
Measles	8 (1.3)	4 (1.5)	2 (1.3)	2 (1.1)	0.94	0.82
Anthropometry						
Edema, %	3 (0.5)	2 (0.8)	1 (0.7)	0	n/a	n/a
Length-for-age z score	-0.43 ± 1.46	-0.85 ± 1.51	-0.13 ± 1.51	-0.08 ± 1.29	<0.0001	<0.01
Stunted, %	78 (13.0)	49 (18.5)	16 (10.5)	13 (7.1)	<0.01	0.09
Severely Stunted, %	28 (4.7)	19 (7.2)	6 (3.9)	3 (1.7)	0.05	0.19
Weight-for-age z score	-0.17 ± 1.43	-0.26 ± 1.58	-0.05 ± 1.35	-0.13 ± 1.25	0.30	0.90
Underweight, %	59 (10.1)	36 (14.2)	13 (8.7)	10 (5.5)	0.02	0.13
Severely Underweight, %	23 (3.9)	14 (5.5)	3 (2.0)	6 (3.3)	0.20	0.80
Weight-for-length z score	0.24 ± 1.76	0.52 ± 2.02	0.12 ± 1.48	-0.07 ± 1.52	<0.01	<0.01
Wasted, %	56 (9.7)	29 (11.7)	10 (6.8)	17 (9.3)	0.27	0.95
Severely Wasted, %	28 (4.8)	18 (7.3)	3 (2.0)	7 (3.9)	0.07	0.47

** p value for differences across intervention groups

*** p value for differences across intervention groups while controlling for woreda

Summary

To summarize, 605 households with infants under 6 months were enrolled and completed the baseline survey. Approximately 40% of the households come from 8 kebeles in Aleta Chuko, while another approximately 40% come from 9 kebeles in Dila Zuria, and the remaining approximately 20% come from 3 kebeles in Wonago. Overall, 44.5% of households are in control kebeles, 25.5% are in partial intervention kebeles, and 30.1% are in full intervention kebeles.

Almost all (99.3%) households had male heads of household, and all caregivers were women. Heads of household had higher levels of education, with 40.2% having completed Cycle 2 (grade 8), whereas only 18.2% of caregivers achieved this benchmark. A majority of heads of household worked in agriculture, while nearly three in four women had no employment outside the home. Over half of all households had some non-agriculture source of income from someone in the household. Less than half of the households had a safely managed or basic drinking water source, and only 27.4% had access to an improved toilet.

Almost all of the households surveyed (96.9%) owned land, and cultivated a median 0.25 (IQR 0.23, 0.49) hectares of land in the current season. Households produced an average of 4.0 ± 1.8 food groups (3.8 ± 1.8 prior to introduction of OFSP), with the most common food groups produced being grains, white roots, and tubers (95.9%), non-vitamin A-rich fruits (74.5%), dark green leafy vegetables (58.0%), and other vitamin A-rich fruits and vegetables (51.5%). Cash crops and to a lesser extent sugar cane and pineapple are often sold for income, while other foods are primarily for household consumption.

Less than half of all households reported growing any color sweetpotato. Sweetpotato farming was most common in Aleta Chuko, were 72.5% of households farm sweetpotato, than in Wonago (47.4%) and Dila Zuria (26.9%). Only 47.1% and 56.0% of households in the partial and full intervention reported producing orange- or yellow-fleshed sweetpotato. However, 76.1% and 81.6% reported that they received vines. Therefore, self-reported growing of sweetpotato may be unreliable, and could be due to the fact that sweetpotato had not yet been harvested at the time of the baseline survey. Of those who did report growing sweetpotato in the previous year, they reported harvesting of sweetpotato usually happens in December and January, and to a lesser extent in November and February.

Households tend to be more food secure from October to March, noting that the baseline survey took place during this food secure season. Households experience food shortages from April to September. While the average HDDS is 5.6 ± 1.7, only 16.0% of women are meeting MDD-W, and both indicators suggest that dietary diversity is lower in Dila Zuria and in Wonago than in Aleta Chuko.

Women in Aleta Chuko also had greater utilization of antenatal care, and had fewer live births. However, their summary nutrition knowledge scores were lower than women in Dila Zuria and Wonago. Breastfeeding was nearly ubiquitous, though 22.5% of infants were not exclusively breastfed in the previous 7 days. The sample experienced similar rates of stunting, underweight, and wasting as national averages for infants under 6 months, though the rate of undernutrition is still high.

A general trend to emerge is that, with the exception of nutrition knowledge, households and individuals in Aleta Chuko tend to have a more favorable baseline status than their counterparts in Dila Zuria and Wonago. Aleta Chuko is less densely populate. Based on observations by the study team, many kebeles in Dila Zuria are slightly more urban, or are at least nearer to an urban center than

households in Aleta Chuko. Caregivers in Dila Zuria and Wonago may be nearer to their health posts, and may be more likely to receive counseling in the postnatal period, which could account for the higher nutrition knowledge scores. However, indicators of socioeconomic status suggest that households in Aleta Chuko are less impoverished. Households in Aleta Chuko have better dietary diversity and nutritional status.

Implications of Baseline Findings

There are several important findings from this baseline data that should be considered moving forward with the longitudinal study and analysis. Most notably, the intervention groups are different at baseline. Many of these differences are seemingly due to the differences in woreda, and woreda should be included as a covariate in any hypothesis testing. However, other key differences exist between intervention groups even after controlling for woreda. These include having off-farm income, production diversity (even excluding OFSP from the production diversity index), utilization of antenatal care, and child nutritional status. In each of these examples, households in the control group are at a disadvantage at baseline. Thus, these indicators should be assessed as potential confounders in any statistical analyses to follow, but nevertheless, baseline differences in these indicators could make some results difficult to interpret.

Limitations

There are a number of limitations of the data collected in this baseline survey. While the target sample size of 600 households was reached, the proportion of households from control, partial, and full intervention kebeles was imbalanced. This could impact statistical power.

Secondly, despite oversight and training of the data collection team, some missing data is evidence. We have attempted to minimize bias and retain sample size by imputing data where missing for indices that are particularly impact, such as for nutrition knowledge scores, the antenatal care score, and the wealth index.

Recruitment of subjects, and in particular the difference in recruitment between control and intervention groups, could introduce bias as well. Households in the intervention kebeles were recruited with the help of PIN community facilitators and other kebele leaders, and households had to have been in a HLC at the time of the baseline survey to be eligible. However, because there were no HLC in control kebeles, this was not an inclusion criteria, and households were recruited with the help of HEW and other kebele leaders. Thus, any characteristic that might have impacted the recruitment of households into HLC could introduce bias in the study. In particular, households had to agree to clear some land for planting OFSP to be included in the HLC. It is possible that only wealthier households would have land available for OFSP. On the other hand, households who agreed to be in the HLC could be those that are nearer to the farmer training sites or health posts, other factors that could impact their baseline status. We attempted to minimize this potential for bias by using PIN's household listings to identify eligible households in each kebele, nevertheless, it will be important to be thoughtful when analyzing the data to come from this study.

References

1. National Institutes of Health Office of Dietary Supplements. *Vitamin A: Fact Sheet for Health Professionals*. 2016 31 August, 2016 [cited 2017 5 September]; Available from: https://ods.od.nih.gov/factsheets/VitaminA-HealthProfessional/.
2. Black, R.E., et al., *Maternal and child undernutrition and overweight in low-income and middle-income countries.* Lancet, 2013. **382**(9890): p. 427-51.
3. G. B. D. Risk Factors Collaborators, *Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015.* Lancet, 2016. **388**(10053): p. 1659-1724.
4. W. H. O. Multicentre Growth Reference Study Group, *WHO Child Growth Standards based on length/height, weight and age.* Acta Paediatr Suppl, 2006. **450**: p. 76-85.
5. Frongillo, E.A., Jr., *Symposium: Causes and Etiology of Stunting. Introduction.* J Nutr, 1999. **129**(2S Suppl): p. 529S-530S.
6. Victora, C.G., et al., *Worldwide timing of growth faltering: revisiting implications for interventions.* Pediatrics, 2010. **125**(3): p. e473-80.
7. Stewart, C.P., et al., *Contextualising complementary feeding in a broader framework for stunting prevention.* Matern Child Nutr, 2013. **9 Suppl 2**: p. 27-45.
8. Ahmed, T., M. Hossain, and K.I. Sanin, *Global burden of maternal and child undernutrition and micronutrient deficiencies.* Ann Nutr Metab, 2012. **61 Suppl 1**: p. 8-17.
9. WHO, *Global prevalence of vitamin A deficiency in populations at risk 1995-2005. WHO Global Database on Vitamin A Deficiency*. 2009: Geneva, World Health Organization.
10. Imdad, A., et al., *Vitamin A supplementation for preventing morbidity and mortality in children from 6 months to 5 years of age.* Cochrane Database Syst Rev, 2010(12): p. CD008524.
11. Imdad, A., et al., *Vitamin A supplementation for preventing morbidity and mortality in children from six months to five years of age.* Cochrane Database Syst Rev, 2017. **3**: p. CD008524.
12. WHO., *Guideline: Vitamin A supplementation in infants and children 6-59 months of age.* 2011, Geneva, World Health Organization.
13. Bhutta, Z.A., et al., *Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost?* Lancet, 2013. **382**(9890): p. 452-477.
14. Collison, D.K., et al., *Acceptability and utility of an innovative feeding toolkit to improve maternal and child dietary practices in Bihar, India.* Food Nutr Bull, 2015. **36**(1): p. 24-32.
15. Kedera, E., et al., *Acceptability and feasibility of a child-feeding toolkit in Malawi.* Field Exchange, 2016(52): p. 24.
16. Kram, N., et al., *The acceptability of dietary tools to improve maternal and child nutrition in Western Kenya.* Public Health Nutr, 2016. **19**(10): p. 1823-33.
17. Faerber, E.C., et al., *Evaluation of an Innovative Toolkit to Improve Complementary Feeding and Child Growth in Rural Malawi*, in *Experimental Biology / American Society for Nutrition*. 2017: Chicago, Illinois.
18. International Potato Center. *Sweetpotato Nutrition*. 2017 [cited 2017 8 November]; Available from: https://cipotato.org/crops/sweetpotato/nutrition/.
19. Islam, S.N., et al., *Carotenoids and beta-carotene in orange fleshed sweet potato: A possible solution to vitamin A deficiency.* Food Chem, 2016. **199**: p. 628-31.
20. Amagloh, F.K. and J. Coad, *Orange-fleshed sweet potato-based infant food is a better source of dietary vitamin A than a maize-legume blend as complementary food.* Food Nutr Bull, 2014. **35**(1): p. 51-9.

21. Hageniman, V., et al., *The Effects of Women Farmers' Adoption of Orange-Fleshed Sweet Potatoes: Raising Vitamin A Intake in Kenya*. 1999, International Center for Research on Women.
22. van Jaarsveld, P.J., et al., *Beta-carotene-rich orange-fleshed sweet potato improves the vitamin A status of primary school children assessed with the modified-relative-dose-response test.* Am J Clin Nutr, 2005. **81**(5): p. 1080-7.
23. de Brauw, A., et al., *Biofortification, Crop Adoption, and Health Information: Impact Pathways in Mozambique and Uganda*. 2015: HarvestPlus.
24. Hotz, C., et al., *Introduction of beta-carotene-rich orange sweet potato in rural Uganda resulted in increased vitamin A intakes among children and women and improved vitamin A status among children.* J Nutr, 2012. **142**(10): p. 1871-80.
25. Girard, A.W., et al., *Promotion of Orange-Fleshed Sweet Potato Increased Vitamin A Intakes and Reduced the Odds of Low Retinol-Binding Protein among Postpartum Kenyan Women.* J Nutr, 2017. **147**(5): p. 955-963.
26. Low, J.W., et al., *A food-based approach introducing orange-fleshed sweet potatoes increased vitamin A intake and serum retinol concentrations in young children in rural Mozambique.* J Nutr, 2007. **137**(5): p. 1320-7.
27. Jenkins, M., C. Byker Shanks, and B. Houghtaling, *Orange-Fleshed Sweet Potato: Successes and Remaining Challenges of the Introduction of a Nutritionally Superior Staple Crop in Mozambique.* Food Nutr Bull, 2015. **36**(3): p. 327-53.
28. Wang, H., et al., *Ethiopia health extension program : an institutionalized community approach for universal health coverage*. 2016, Washington, DC: World Bank Group. xvi, 100 pages.
29. Workie, N.W. and G.N. Ramana, *The Health Extension Program in Ethiopia*, in *Universal Health Coverage (UNICO) Studies Series 10*. 2013, The World Bank: Washington DC.
30. Central Statistical Agency (CSA) [Ethiopia] and ICF, *Ethiopia Demographic and Health Survey 2016*. 2016: Addis Abba, Ethiopia and Rockville, Maryland, USA: CSA and ICF.
31. Ethiopian Public Health Institute, *Ethiopian National Micronutrient Survey Report*. 2016.
32. Institute, E.P.H., *Ethiopian National Food Consumption Survey*. 2013, Ethiopian Public Health Institute, Addis Ababa, Ethiopia: www.ephi.gov.et.
33. FAO., *AQUASTAT Country Profile –Ethiopia*. 2016, Food and Agriculture Organization of the United Nations (FAO). Rome, Italy.
34. Esri. *ArcGIS*. [cited 2019 31 May]; Available from: http://www.arcgis.com/home/webmap/viewer.html?webmap=de8f5c12764b47cdbc6333aa93d79ad1.
35. Faerber, E., E. Waugh, and A. Webb Girard, *Quality Diets for Better Health Formative Nutrition Report: Assessment of Infant and Young Child Feeding in Southern Nations, Nationalities, and Peoples' Region, Ethiopia*. 2019, Emory University: https://www.sweetpotatoknowledge.org/files/quality-diets-for-better-health-formative-nutrition-report/.
36. Waugh, E., E. Faerber, and A.W. Girard, *Quality Diets for Better Health: Healthy Living Clubs Curriculum*. 2019.
37. Michie, S., M.M. van Stralen, and R. West, *The behaviour change wheel: a new method for characterising and designing behaviour change interventions.* Implement Sci, 2011. **6**: p. 42.
38. Cogill, B., *Anthropometric Indicators Measurement Guide*, in *Indicator Guides*. 2001, Food and Nutrition Technical Assistance: Academy for Educational Development, Washington DC.
39. Vyas, S. and L. Kumaranayake, *Constructing socio-economic status indices: how to use principal components analysis.* Health Policy Plan, 2006. **21**(6): p. 459-68.
40. Cordova, A., *Methodological Note: Measuring Relative Wealth using Household Asset Indicators*, in *Insights*. 2008, Latin American Public Opinion Project. p. 1-9.

41. Rutstein, S.O., K. Johnson, and ORC Macro. MEASURE/DHS+ (Programme). *The DHS wealth index*. DHS comparative reports. 2004, Calverton, Md.: ORC Macro, MEASURE DHS+. ix, 71 p.
42. Filmer, D. and L.H. Pritchett, *Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India.* Demography, 2001. **38**(1): p. 115-32.
43. World Health Organization and UNICEF, *Core questions on drinking-water and sanitation for household surveys*. 2006: Geneva, Switzerland.
44. World Health Organization and the United Nations Children's Fund (UNICEF), *Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines.* 2017: Geneva.
45. Bilinsky, P. and A. Swindale, *Months of Adequate Household Food Provisioning (MAHFP) for Measurement of Household Food Access: Indicator guide (v.4).* 2010, FHI 360/FANTA: Washington, D.C.
46. Ballard, T.J., A.W. Kepple, and C. Cafiera, *The food insecurity experience scale: developing a global standard for monitoring hunger worldwide.* 2013, FAO: Rome.
47. Ballard, T., et al., *Household Hunger Scale: Indicator Definition and Measurement Guide*. 2011, Food and Nutrition Technical Assistance II Project, FHI 360: Washington, DC.
48. FAO and FHI 360, *Minimum Dietary Diversity for Women: A guide for Measurement*. 2016, FAO: Rome.
49. Swindale, A. and P. Bilinsky, *Household Dietary Diversity Score (HHDS) for Measurement of Household Food Access: Indicatore Guide (v.2)*. 2006, FHI 360/FANTA: Washington, D.C.
50. World Health Organization. *WHO Anthro (version 3.2.2, January 2011) and macros*. 2011; Available from: https://www.who.int/childgrowth/software/en/.