

TIGRAY REGION OF ETHIOPIA

Consumption, production, market access and affordability of nutritious foods



Acknowledgements

We are grateful to the Central Statistical Agency for providing access to datasets used in the analysis. We thank Kebede Tafesse, Victor Pinga, Dr. Girma Abebe and Regional NSA Advisors, namely Dires Beza, Haimanot Woldemariam, Habtu Assefa, Muluken Tamene, Alemayehu Lebeta, and Muhyadin Mohammed as well as the colleagues at the Food and Nutrition Coordination Office at the Ministry of Agriculture for useful comments on the earlier versions of this document.

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Alive & Thrive is funded by the Bill & Melinda Gates Foundation and the governments of Canada and Ireland. The initiative is managed by FHI 360. The Alive & Thrive initiative, managed by FHI 360, is currently funded by the Bill & Melinda Gates Foundation, Irish Aid, the Tanoto Foundation, and UNICEF.

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Suggested Citation

Hirvonen K, and Wolle A. Consumption, production, market access and affordability of nutritious foods in the Tigray Region of Ethiopia. Addis Ababa, Ethiopia: Alive & Thrive and International Food Policy Research Institute, 2019.



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Table of contents

| | |
|--|----|
| 1. Introduction..... | 3 |
| 2. Description of the data sources used in this report | 5 |
| 2.1. Demographic and Health Survey (DHS) data | 5 |
| 2.2. PSNP and FtF evaluation surveys | 5 |
| 2.3. CSA agricultural sample survey data | 7 |
| 2.4. CSA retail price survey data..... | 8 |
| 3. Consumption of nutritious foods | 8 |
| 3.1. Child diets..... | 8 |
| 3.2. Women's diets..... | 13 |
| 4. Food production from a nutrition perspective | 17 |
| 5. Market availability of nutritious foods | 19 |
| 6. Affordability of nutritious foods..... | 24 |
| 7. Conclusions..... | 28 |
| 7.1. Legumes and nuts | 29 |
| 7.2. Dairy products | 29 |
| 7.3. Flesh foods..... | 29 |
| 7.4. Eggs | 29 |
| 7.5. Vitamin A-rich fruits and vegetables..... | 30 |
| 7.6. Other fruits and vegetables | 30 |
| 7.7. Orthodox fasting..... | 30 |
| 7.8. Limitations..... | 31 |
| References..... | 32 |
| Appendix A: Initiation of complementary feeding in PSNP areas of Tigray..... | 36 |
| Appendix B: Recalculating affordability considering the second cheapest food items in fruit and vegetable categories | 38 |

1. Introduction

Poor dietary quality is a significant risk factor for stunting and micronutrient deficiencies among young children and globally one of the leading causes of premature death and disease (Arimond & Ruel, 2004; Forouzanfar et al., 2015).

Dietary quality is typically proxied by diversity of the consumed diet. Foods with similar nutritional qualities are first grouped together and dietary diversity is measured by the number of different food groups consumed in a certain time interval. For example, the World Health Organization recommends that children 6-23 months consume from at least four food groups (out of seven) every day. Based on this metric, Ethiopian children in this age range consume one of the least diversified diets in sub-Saharan Africa (Hirvonen, 2016) with only 14 percent meeting the WHO recommendation (CSA & ICF, 2016). Recent analysis of the timing of growth faltering of young children suggests that poor complementary feeding practices, including poor dietary quality, is an important risk factor for stunting in Ethiopia (Hirvonen, Headey, Golan, & Hoddinott, 2019). The available evidence suggests that diets are monotonous also at the household level. For example, in 2011, the average Ethiopian household consumed only 42 kg of fruits and vegetables in a year per adult equivalent (Hassen Worku, Dereje, Minten, & Hirvonen, 2017) – far below the World Health Organization’s recommendation of 146 kg per year (Hall, Moore, Harper, & Lynch, 2009).

Such monotonous diets are likely to increase the risk of various chronic diseases. For example, a recent global study indicated elevated mortality as well as major cardiovascular disease risk when energy intake from carbohydrates exceed 60 percent (Dehghan et al., 2017). This is particularly worrying for Ethiopia as recent estimates by the Ethiopian Public Health Institute suggest that 60-80 percent of the energy intake of children and adults comes from carbohydrates (Misganaw et al., 2017). Meanwhile cardiovascular diseases are among the top causes of premature mortality in the country (Misganaw et al., 2017). Another indication of limited dietary quality is that micronutrient deficiencies in Ethiopia are widespread. Nearly 60 percent of young children are anemic (CSA & ICF, 2016) and more than one-third suffer from Vitamin A deficiency (Demissie, Ali, Mekonen, Haider, & Umata, 2010). Recent research from Ethiopia further highlights the importance of fruit and vegetable consumption among pregnant and lactating women. Data from health centers in rural Oromia, Zerfu, Pinto, and Baye (2018) find

that pregnant women who consumed fruits and dark green leafy vegetables more frequently were less likely to experience adverse pregnancy outcomes. Moreover, analyzing samples of breastmilk from mothers in rural Amhara, Abebe, Haki, Schweigert, Henkel, and Baye (2018) find very low concentrations of Vitamin A in milk.

These issues are well-acknowledged by the government of Ethiopia. The national nutrition programme sets out ambitious plans to increase the year-around availability, access, and consumption of nutritious foods (GFDRE, 2016a). Through its 'Seqota Declaration of 2015,' Ethiopia further announced its ambitious goal of ending child malnutrition by 2030 (GFDRE, 2016b). These nutrition strategies are endorsed by several ministries highlighting that the emerging consensus that combating under-nutrition and poor diets requires multi-sectoral efforts (Menon & Frongillo, 2018).

At the core of these efforts is the urgent need to transform food systems in Ethiopia to support healthier diets (Gebru et al., 2018). The concept of food system captures the *food environment* (affordability and accessibility), *consumer preferences*, and the *food supply system* that is formed of production, storage, transportation, processing, and marketing (Scott, 2017). It is now well acknowledged that the dietary choices of individuals are determined by the surrounding food system.

Against this backdrop, in this report, we aim to gain a better understanding of the food sub system¹ in the Tigray region of Ethiopia by analyzing the affordability, accessibility, and consumption of nutritious foods.² The region hosts more than 5 million people out of which most reside in rural areas and rely on agricultural production as their main livelihood (CSA, 2018a). About 39 percent of the children under 5 in Tigray are chronically under-nourished (or stunted) (Hirvonen et al., 2019) while 34 percent of the women 15-49 years of age are underweight (CSA & ICF, 2016).³ Moreover, according to the Ethiopian Public Health Institute (EPHI), 11 percent of children 6-59 months are Vitamin A deficient (EPHI, 2016).

¹ We call this a *sub* system analysis because due to data limitations, we do not assess consumer preferences and we also are forced to overlook (due to data limitations) important parts of the food supply system: storage, transportation, processing, marketing as well as inter-regional and international trade.

² Similar analysis was carried out for six regions in total: Afar, Amhara, Oromia, Somali, SNNP, and Tigray.

³ About 6 percent of the women in this age group in Tigray are over-weight or obese.

This report is structured as follows. In the subsequent section we describe the data used in this report. In section 3, we assess the consumption of nutritious foods among vulnerable groups: young children and mothers. In section 4, we assess the production of nutritious foods in the region. In section 5, we study the availability of nutritious foods in rural markets. In section 6, we assess the affordability of nutritious foods in the region. Section 7 concludes and summarizes the findings.

2. Description of the data sources used in this report

All the analyses in this report are based on secondary data collected by the Central Statistical Agency (CSA) of Ethiopia or the International Food Policy Research Institute (IFPRI). This section describes these data sources.

2.1. Demographic and Health Survey (DHS) data

We use the 2016 Demographic and Health Survey (DHS) data for Ethiopia to analyze child diets. This survey is nationally as well as regionally representative and was implemented by the CSA with technical assistance from the ICF. The interviews took place between January 18, 2016, and June 27, 2016. A total of 16,650 households were interviewed in all regions of Ethiopia, and 1,734 households in Tigray. Apart from rich information on various health outcomes and socio-economic characteristics, the DHS collects information about complementary feeding practices of young children.

2.2. PSNP and FtF evaluation surveys

We use the Productive Safety Net Program (PSNP) and Feed the Future (FtF) evaluation data sets to assess diets of adult women (mothers) as well as market availability of nutritious foods.

In 2016, the International Food Policy Research Institute was tasked by the Bill and Melinda Gates Foundation to evaluate the impact of the nutrition-sensitive components of the PSNP. To this end, we fielded a baseline survey in PSNP localities in Amhara, Oromia, SNNP, and Tigray. This baseline survey was administered in two parts. The first baseline survey took place in March 2017. In this round, 2,635 households with a child less than 2 years of age were interviewed. Out of these, 660 households were from Tigray. Roughly half of the sampled households benefitted from the PSNP and the other half identified themselves as poor but did not benefit from the program. The second baseline survey took place roughly six months later in August 2017. In this round, the survey teams visited the same households that were interviewed

in the March round. A total of 2,569 households were interviewed, indicating a dropout (attrition) rate of 3 percent. The first endline survey took place in March 2019. Again more than 2,500 households were interviewed in the same localities.

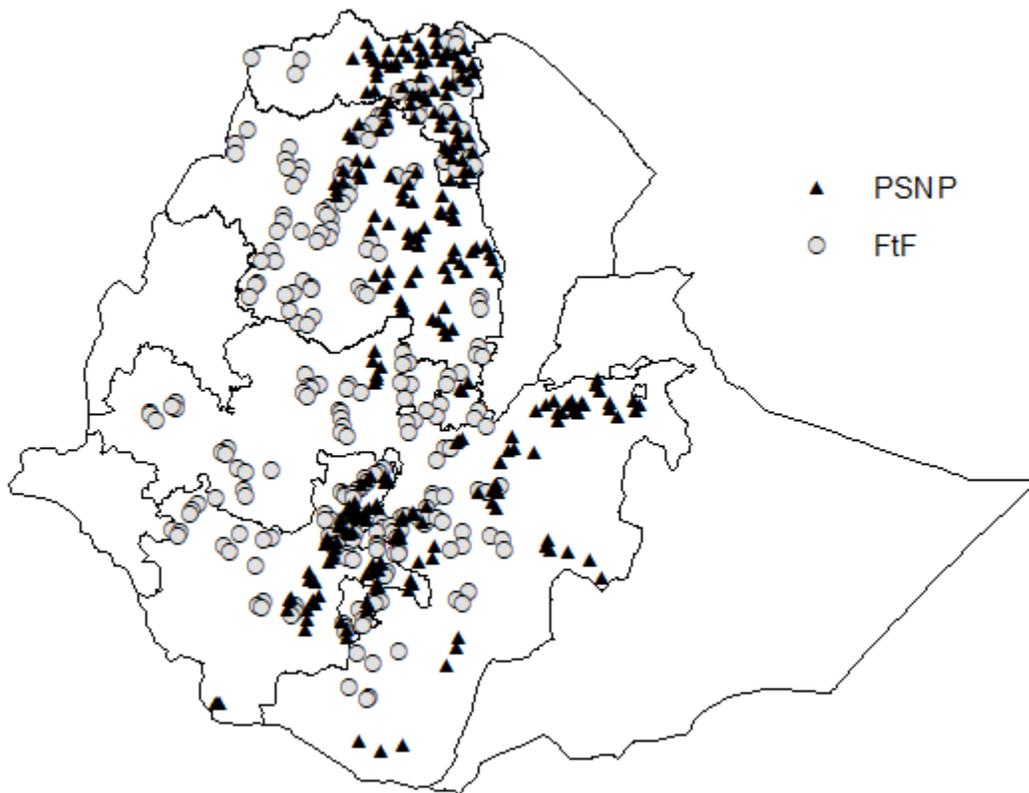
In this report, we use the August 2017 round to assess women's dietary diversity in PSNP localities. To assess market availability of nutritious foods, we use the March 2019 survey round. The reason for using this round is that we improved the market questionnaire by including more food items, especially with respect to animal-sourced foods.

These PSNP surveys are geographically widespread having been administered in 264 kebeles in 88 woredas in the four regions (66 kebeles and 22 woredas from Tigray). Despite this, the survey focused on localities in which the PSNP is operational and therefore these data sets are not representative of the country, nor any of the four regions.

In our attempt to address this limitation about representativeness, we append the analysis with the FtF survey that was based on similar survey instruments as the BMGF-PSNP survey. The FtF survey data were collected between September and October 2018 in Amhara, Oromia, SNNP, and Tigray regions. These data sets were collected to obtain post-intervention (endline) information in localities that received investments aimed at improving agricultural production and nutrition under the Feed the Future (FtF) program funded by the United States Agency for International Development (USAID). The sample is large – 3,890 households – and widely distributed, the survey having been implemented in 151 kebeles in 51 woredas. In Tigray, 386 households from 24 kebeles in eight woredas were interviewed. As with the BMGF-PSNP survey, it is important to note that while these data are representative of the zone of influence within which the FtF program operates, they are not nationally or regionally representative.

Figure 2.1 shows the geographical overlap of the two surveys in the highlands.

Figure 2.1: Geographical coverage of the FtF and PSNP surveys in the highlands



Source: own calculation from the PSNP and FtF surveys

2.3. CSA agricultural sample survey data

Building on Baye, Hirvonen, Dereje, and Remans (2019), we use the CSA's Agricultural Sample Survey reports to estimate the annual agricultural production in the country. To do so we rely on CSA's annual flagship reports:

1) *Report on Area and Production of Major Crops, private peasant holdings*

This report provides the total annual crop output in 10 out of the 11 administrative regions of the country. Only the production in the capital, Addis Ababa, is not reported. The crop output for *meher* (long rainy season and the main cropping season for most part of the country) and *belg* (short rainy season) are reported separately.

2) *Report on Livestock and Livestock Characteristics, private peasant holdings*

This report provides the annual estimates of the livestock population and livestock production. The sample sizes are large – typically containing more than 40,000 rural households. These reports are based on nationally and regionally representative data collected by the CSA each year.

We digitalized these reports. For crop output, we aggregated the total annual production for each crop in each region during *meher* and *belg* seasons as well as the total crop output produced by the commercial sub-sector. For livestock products, we took the total annual milk (cow and camel), eggs, and honey produced. The CSA reports give the number of different livestock types slaughtered. These numbers were converted to kilograms of beef, sheep, goat, camel, and poultry meat using conversion factors to account for edible portions only (FAO, 1972).

The annual crop and livestock production was then converted into energy (kilocalories) using the Ethiopian food composition tables (EPHI, undated). We also used FAO reject estimates which correspond to weight estimations of edible portions of foods produced to calculate energy and nutrients supplied. The total energy was then divided by the total population for that specific year based on estimates by the CSA (2013). The energy and nutrients produced were expressed on a per day basis by dividing by 365 to enable comparison with daily requirements.

2.4. CSA retail price survey data

For the affordability analysis, we use monthly retail price data collected by the CSA. The original purpose of these data sets is to calculate the official consumer price index (CPI) in the country. These price data are collected from about 110 markets in all regions of Ethiopia with the number of markets approximately proportional to the region's size in terms of population. The CSA enumerators visit these markets every month and collect price data for more than 400 food and non-food items. For each item, the enumerators target three price quotations from different traders. For more information about this survey, see Headey, Nisrane, Worku, Dereje, and Taffesse (2012) and Bachewe, Hirvonen, Minten, and Yimer (2017).

3. Consumption of nutritious foods

3.1. Child diets

Child diets are described using the World Health Organization recommended infant and young child feeding (IYCF) indicators, which are widely accepted and used to capture optimal feeding practices in populations (WHO, 2010). Here we focus on indicators related to adequate

consumption of high quality complementary foods that are dense in key micro and macronutrients. We assess this using the protocols recommended by the World Health Organization (WHO, 2008). The DHS-2016 survey asked mothers a series of yes/no questions about foods consumed in the past 24 hours by children 6-23 months. These responses were grouped into the following categories:

1. Grains, roots, and tubers (e.g., barley, enset, maize, teff, and wheat);
2. Legumes and nuts (e.g. chickpea, beans, groundnut);
3. Dairy products (milk, yogurt, cheese);
4. Flesh foods (meat, poultry, and fish products);
5. Eggs;
6. Vitamin A-rich fruits and vegetables (e.g. mango, pumpkin, carrots);
7. Other fruits and vegetables (e.g. onions, tomatoes, bananas).

This yields a count ranging in value from zero to seven. WHO (2008) recommends that children in this age range consume daily at least from four food groups out of the above seven food groups. This number was selected to maximize the likelihood that in addition to the staple food (grain, root, tuber), the child consumed animal source foods as well as fruits and vegetables in the previous day (WHO, 2008).

This relatively simple indicator is highly correlated with more detailed measures of food intake (Ruel, 2003) as well as with children's micronutrient intakes⁴. Moreover, several studies show strong correlations with this dietary diversity score and longer term measures of children's nutritional status (e.g. child stunting prevalence) in a number of countries including Bangladesh, Ethiopia, India, and Zambia (Jones et al., 2014).

In Tigray, the average 6-23 month old child consumes from 1.8 food groups and consequently, only 12.9 percent of the children meet the criteria for minimum dietary diversity (at least four food groups in the last 24 hours). Children's diets are more diverse in urban areas: 10.5 percent

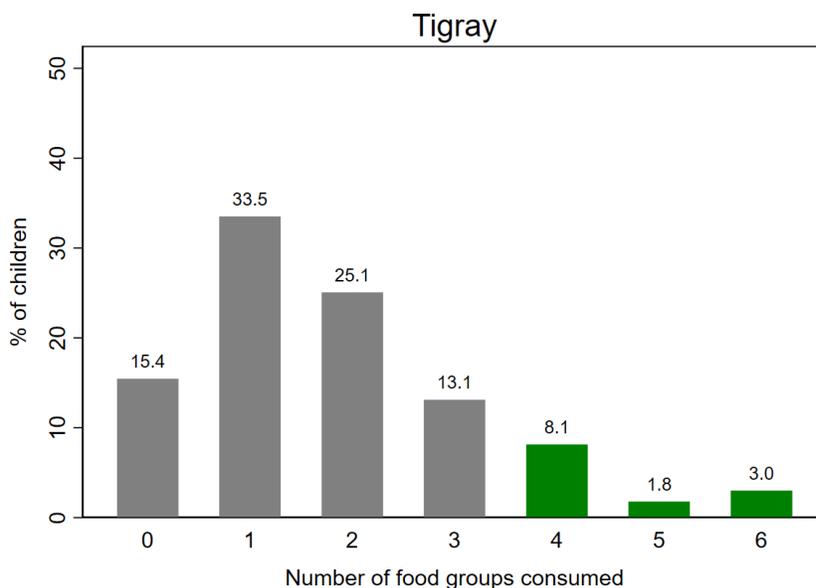
⁴ See Moursi et al. (2008); Daniels, Adair, Popkin, and Truong (2009), Kennedy, Pedro, Seghieri, Nantel, and Brouwer (2007) and Steyn, Nel, Nantel, Kennedy, and Labadarios (2006).

of the rural children and 22.3 percent of the urban children in Tigray met the minimum dietary diversity.

Figure 3.1 shows the full distribution of children's dietary diversity in the region. We can use this graph to understand how far the children are from meeting the recommended dietary diversity. The bars falling short from the recommended four food groups are marked with gray color. Starting from the bottom part of the distribution, 15 percent of the children did not consume from any food group in the previous 24 hours. As this is a relatively high percentage, we highlight two things. First, the BMGF-PSNP survey conducted in the PSNP woredas shows similar percentages in this regard; in March-2017 and August-2017, about 15 percent of the children in Tigray of the same age range (6-23) did not consume from any of the seven food groups in the past 24 hours. Second, the same survey indicates widespread misperceptions about the correct timing when children should be transitioned from exclusive breastfeeding to complementary foods. Appendix A provides more details on this.

Meanwhile, one-third of the children (33.5%) consumed only from one food group. For these children, the dietary diversity would have to increase by three food groups in order to meet the minimum recommended dietary diversity. About 25 percent were two food groups shy from meeting the recommendation while 13 percent of the children were missing just one food group. The remaining 13 percent of the children consumed from four or more food groups. Figure 3.1.

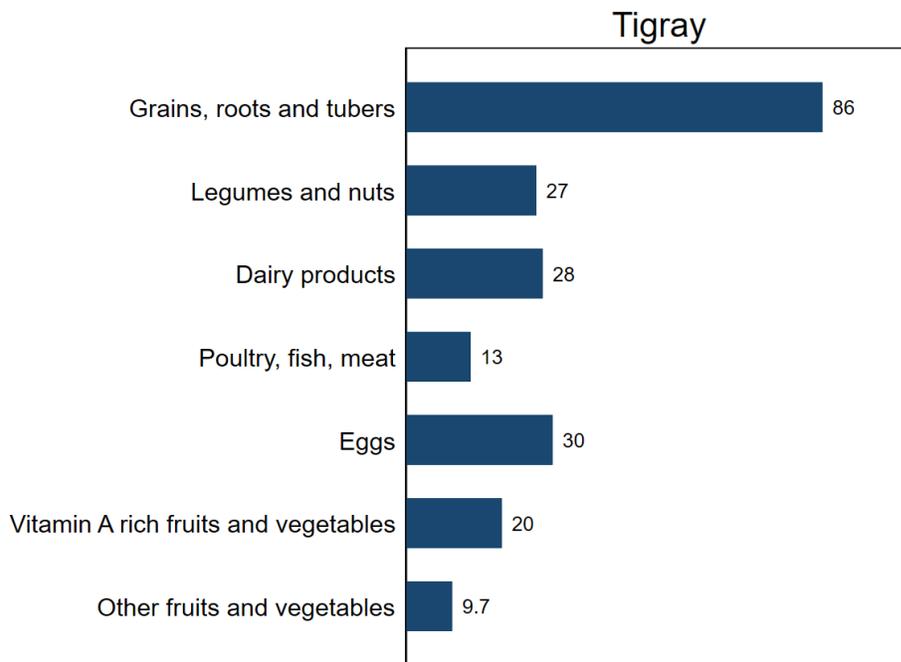
Distribution of children's dietary diversity score, Tigray region



Source: own calculation from DHS-2016.

Next, we exclude those children that did not consume any solid or semi-solid foods in the last 24 hours and assess the diet content. Figure 3.2 shows the percent of children consuming from the seven food groups. As expected, food consumption is concentrated on staple crops (grains, roots, or tubers) while 27 percent of the children consumed legumes or nuts. About 30 percent of the children consumed eggs, 28 percent dairy products and 13 flesh foods (poultry, fish, red meat). Vitamin A-rich fruits and vegetables were consumed by 20 percent of the children, while 10 percent consumed other types of fruits and vegetables that are not rich in Vitamin A.

Figure 3.2. Percent of children consuming from different food groups, Tigray region

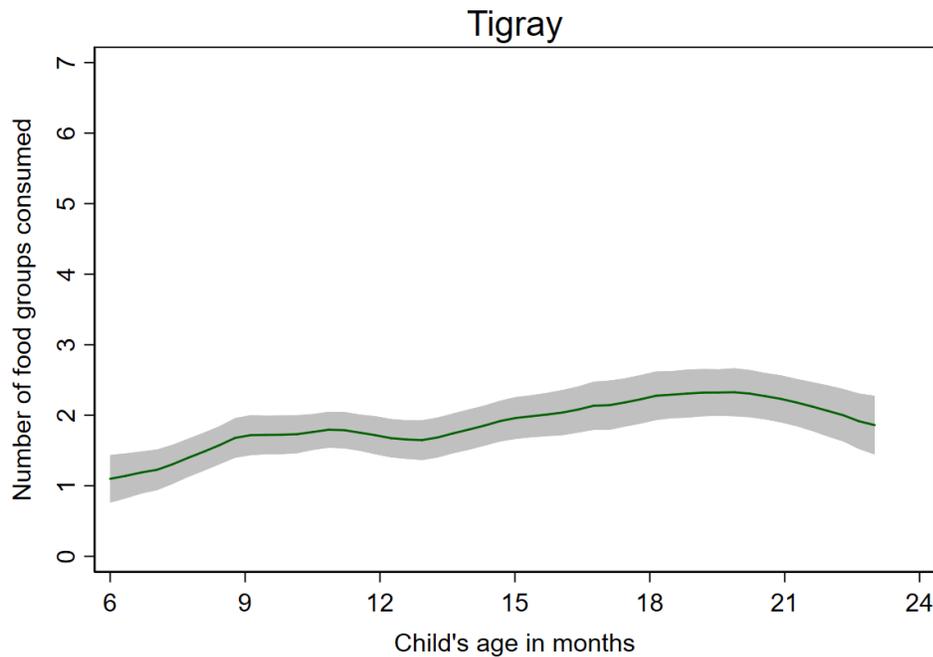


Source: own calculation from DHS-2016. Note: sample restricted to children who did consume foods in the last 24 hours.

We wondered how dietary diversity changes as children age. To assess this, we regressed dietary diversity score (number of food groups consumed by the child) on a child's age using local polynomial regression approach. Figure 3.3 shows how dietary diversity increases as children age. This could be due to the fact that the introduction of complementary foods is delayed (see above). Alternatively, caregivers do not give certain food types (e.g. fruits, vegetables, or animal-source foods) to very young children due to misperceptions that children cannot digest these (for evidence on this across Ethiopia, see Alive & Thrive, 2010; Hadley, Lindstrom,

Belachew, & Tessema, 2008; USAID, 2011). Still, despite the increasing trend, the dietary diversity remains extremely low even for the older children; the average child in the 18-23 month age range consumes from two food groups. We also see that the 21-23-month-old children consume a slightly less diverse diet than 18-20-month-old children.

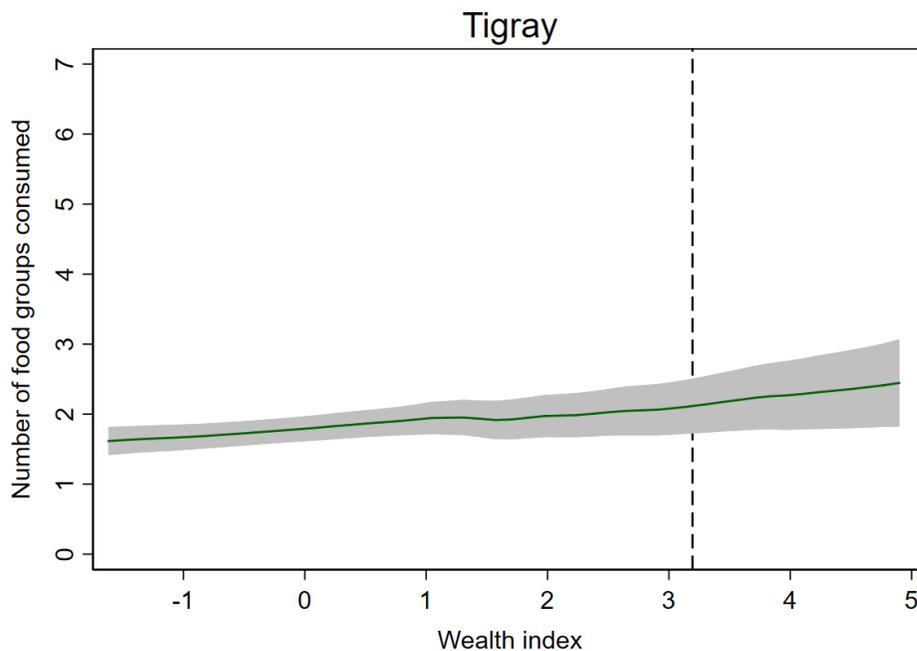
Figure 3.3. Relationship between child dietary diversity and child's age, Tigray region



Note: Local polynomial regression. Shaded areas represent 95% confidence intervals.
Source: own calculation from DHS-2016.

There is an emerging consensus among researchers and practitioners that income growth alone will not address poor dietary quality (Ruel, Alderman, Maternal, & Group, 2013). To illustrate this, we regressed child dietary diversity on an aggregated wealth measure based on household's ownership of different durable assets. Figure 3.4 shows how children originating from wealthier households do consume a more diverse diet but even in the richest households, the average child consumes only from two food groups.

Figure 3.4. Relationship between child dietary diversity and household wealth, Tigray region



Note: Local polynomial regression. Shaded areas represent 95% confidence intervals. The vertical dashed line represents 90th percentile of the wealth index distribution; 90 % of the (child) sample are located on the left side of this line.

Source: own calculation from DHS-2016.

3.2. Women's diets

We assessed maternal diets using FAO and FHI 360 (2016) guidelines that group women's food consumption into 10 food groups:

1. All starchy staple foods;
2. Beans and peas;
3. Nuts and seeds;
4. Dairy;
5. Flesh foods;
6. Eggs;
7. Vitamin A-rich dark green leafy vegetables;
8. Other vitamin A-rich vegetables and fruits;
9. Other vegetables;

10. Other fruits.

This yields a dietary diversity score ranging from 0 to 10. Minimum Dietary Diversity (MDD-W) is met if the mother consumed from five or more food groups during the 24-hour window.

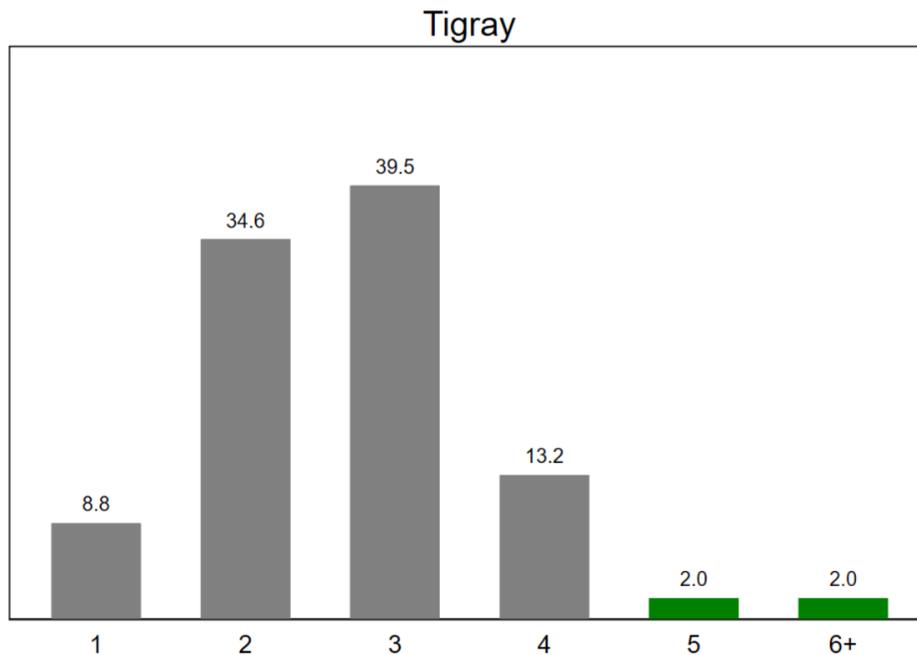
The average mother in the BMGF-PSNP sample consumed from 2.6 food group (out of 10).

Figure 3.5 shows the full distribution of mothers' dietary diversity score in PSNP woredas in August 2017. As before, the bars falling short from five food groups are marked with gray color.

Only 4 percent of the mothers met the minimum dietary diversity of five food groups.

Meanwhile, 9 percent of the mothers consumed only from one food group. These women would have to increase their dietary diversity by four food groups in order to meet the minimum recommended dietary diversity. About 35 percent of the women were three food groups shy from meeting the recommendation, while 40 percent needed two food groups to meet (MDD-W) dietary diversity. About 13 percent of the women were missing just one food group.

Figure 3.5. Distribution of mothers' dietary diversity score, PSNP areas

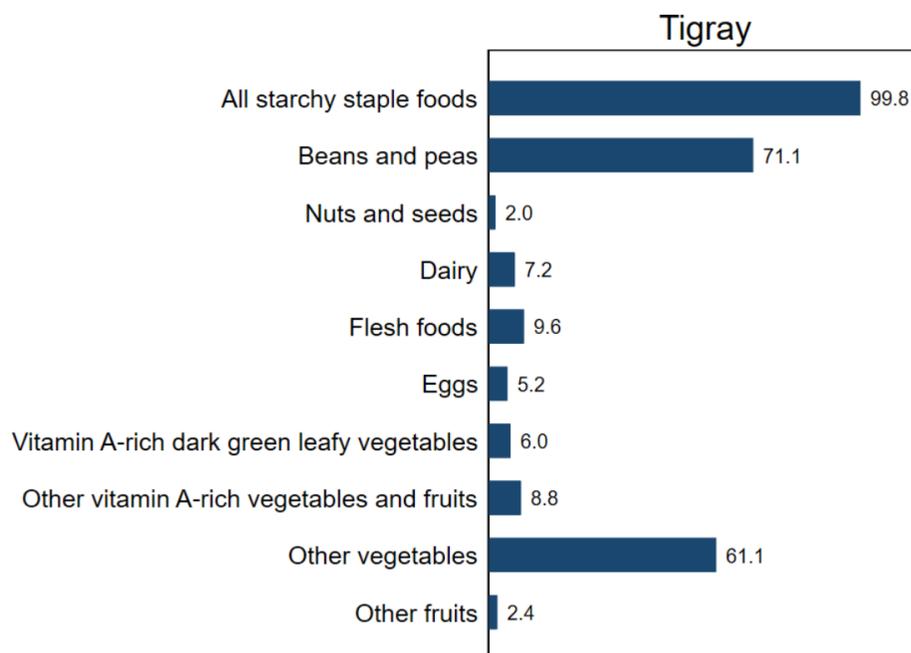


Source: own calculation from PSNP-2017.

Figure 3.6 shows the percent of mothers consuming from the 10 food groups. As with children, food consumption is highly concentrated on staple crops (grains, roots, or tubers), beans and

peas, and vegetables that are not rich in Vitamin A. The consumption of other food groups is rare. From animal-sourced foods, 7 percent consumed dairy, 10 percent meat products, and only 5 percent eggs. Only 6 percent of the women consumed Vitamin A-rich dark green leafy vegetables and 9 percent other Vitamin A-rich fruits and vegetables. Less than 3 percent consumed other fruits.

Figure 3.6. Percent of mothers consuming from different food groups, PSNP areas



Source: own calculation from PSNP-2017.

The FtF data collected in July 2018 confirm these findings. The data do not allow us to construct the same 10-food group indicator.⁵ Instead, we used an earlier women's dietary diversity score indicator developed by FAO (2012). This indicator is based on the following nine food groups:

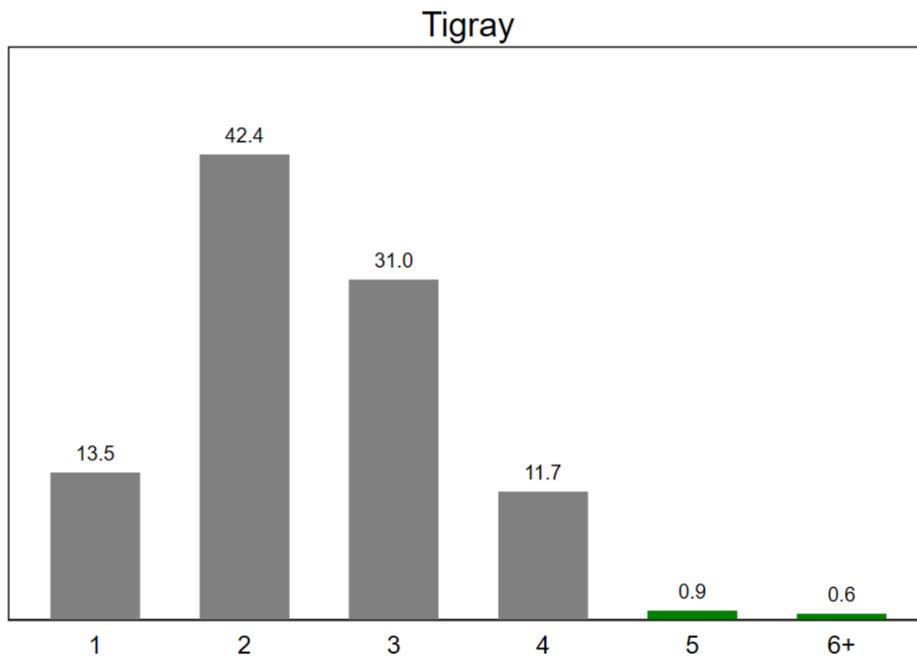
1. Grains, roots, and tubers;
2. Legumes and nuts;
3. Dairy products (milk, yogurt, cheese);
4. Organ meat;

⁵ This is because the questionnaire did not separate nuts and seeds from legumes.

5. Eggs;
6. Flesh foods and other misc. small animal protein;
7. Vitamin A dark green leafy vegetables;
8. Other Vitamin A-rich vegetables and fruits;
9. Other fruits and vegetables.

In this sample, the average prime-age woman (15-49 years of age) consumed from 2.4 food groups (out of nine). Figure 3.7 shows the full distribution of mothers' dietary diversity score in the FtF woredas in July 2018. About 13.5 percent of the women consumed only from one food group and 42 percent consumed from two food groups. About 31 percent of the women consumed from three food groups and 12 percent from four food groups. Very few women (1.5 percent) consumed from more than four food groups. Limited knowledge of the health consequences of dietary quality combined with low incomes and poor affordability of nutritious foods may explain why only few women met the recommended dietary diversity.

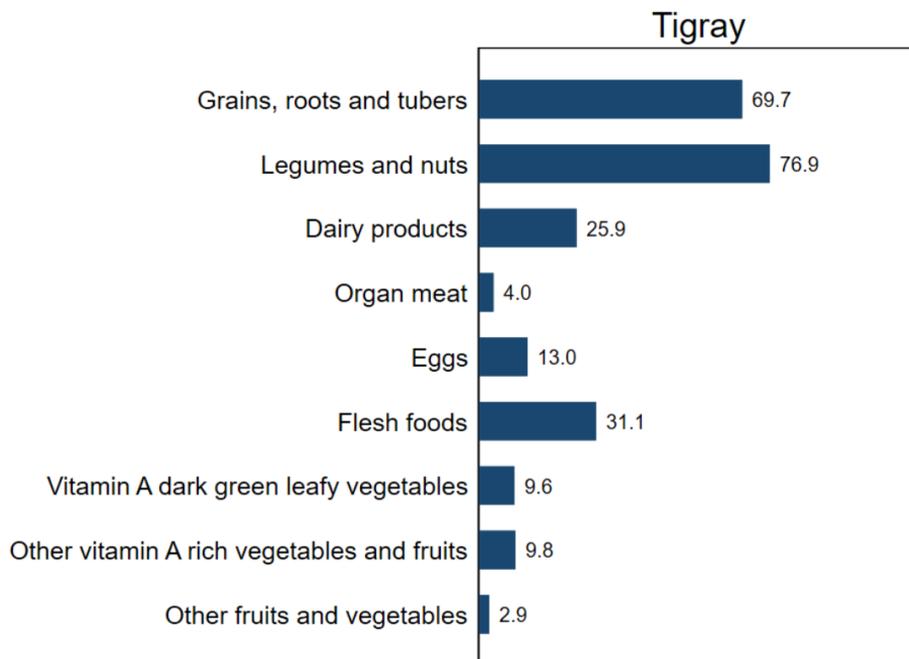
Figure 3.7. Distribution of women's dietary diversity score, FtF areas



Source: own calculation from FtF-2018.

Figure 3.8 shows the percent of women in the FtF areas consuming from the nine food groups. Compared to the PSNP sample, the women in FtF areas are somewhat less likely to consume grains, roots, and tubers and other vegetables. In contrast, the consumption of animal-source foods (dairy, flesh foods, and eggs) is more common in the FtF areas, possibly indicating differences in income levels between the two samples.

Figure 3.8. Percent of women consuming from different food groups, FtF areas



Source: own calculation from FtF-2018.

4. Food production from a nutrition perspective

In this section, we examine the agricultural production in the region from a nutrition perspective. Using CSA's agricultural sample survey data, we disaggregate the production into the seven-food groups used to measure children's dietary diversity in section 3.1. To capture the foods that are not categorized in the seven-food groups (e.g. red peppers, garlic, coffee, sugarcane, and honey), we add an additional food group and called it 'other foods.' We then convert the amounts produced to calories using the Ethiopian food composition tables (EPHI, undated) and FAO reject estimates which correspond to weight estimations of edible portions of foods produced to calculate energy supplied. The total energy are then divided by the total population for that

specific year reported in CSA (2013). Finally, the energy produced is expressed on a per day basis by dividing by 365 to enable comparison with daily requirements.⁶

Table 4.1 shows the daily total energy production per capita per these food groups. First, the total calorie production calories increased by 11 percent between 2011 and 2015. This increase was largely driven by the production of grains, roots, and tubers. In this food group, the amount of calories produced increased by 13 percent. Second, we see that the agricultural production is heavily concentrated on the production of grains, roots, and tubers that accounted for 85 percent of all calories produced in the region in 2015.⁷ Legumes and nuts account for 11 percent of the total calorie production. Strikingly, the remaining six food groups account only for about 4 percent of the total calories produced in the region. The production of Vitamin A-rich fruits and vegetables is particularly low in Tigray. The region's agricultural production would only provide 0.2 calories per day from this food group. Using the same data, Baye et al. (2019) calculate that this level of production would mean that 26 percent of the population in Tigray suffered from Vitamin A deficiency; see Table 4.2.

Table 4.1. Total energy production per capita per day, 2011-2015, by food categories

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------------------------------|--------------|--------------|--------------|--------------|--------------|
| Grains, roots, and tubers | 2,671 | 2,629 | 2,722 | 2,815 | 3,023 |
| Legumes and nuts | 402 | 387 | 332 | 316 | 391 |
| Dairy products | 75 | 66 | 83 | 75 | 96 |
| Poultry, fish, meat | 3.7 | 2.5 | 1.7 | 2.4 | 1.9 |
| Eggs | 5.8 | 6.2 | 9.0 | 8.2 | 15 |
| Vitamin A-rich fruits and vegetables | 0.1 | 0.3 | 0.3 | 0.2 | 0.2 |
| Other fruits and vegetables | 7.9 | 6.5 | 4.1 | 2.5 | 3.8 |
| Other foods | 11 | 12 | 14 | 15 | 10 |
| Total | 3,177 | 3,110 | 3,167 | 3,234 | 3,540 |

⁶ The implicit assumption here is that the availability of energy (and nutrients) is constant across seasons. This is unlikely to be the case: agricultural production in Ethiopia is largely rain-fed (Taffesse, Dorosh, & Gemessa, 2012), and therefore highly seasonal. Hirvonen, Taffesse, and Worku (2016) show how household energy intakes vary across seasons.

⁷ It is instructive to compare this production share to international dietary recommendations. For example, the recently developed diet recommendation by the EAT-Lancet commission recommends that only one-third of the total daily calories come from grains, roots, and tubers (Willett et al., 2019).

Source: Own calculation from CSA agricultural sample surveys. Amounts are kilocalories.

Table 4.2 Prevalence (%) of energy and nutrient gaps relative to population-adjusted estimated average requirements in 2015

| | % |
|--------------------------------|------|
| Energy (kcal) | 4.5 |
| Protein (g) | 0.0 |
| Vitamin A (μg RAE) | 25.7 |
| Ascorbic acid (mg) | 2.9 |
| Iron (mg) | 0.0 |
| Zinc (mg) | 0.0 |
| Calcium (mg) | 0.0 |
| Thiamine (mg) | 0.0 |
| Niacin (mg) | 0.0 |
| Riboflavin (mg) | 0.8 |

Source: Baye et al. (2019)

Several limitations need to be considered when interpreting the results presented in this section. First, these estimates ignore international trade in agricultural products. However, exports form only 2 percent of the total domestic production. Meanwhile, the FAO food balance sheet data indicates that less than 4 percent of the domestic food supply in Ethiopia comes from imports, out of which nearly all are cereals (Baye et al., 2019). Consequently, the estimates are likely to be slightly underestimated, especially for the energy produced in the country. Second, there are several factors which limit the extent to which the produced calories and nutrients are actually available for human consumption. These factors include post-harvest losses, food waste, seasonality of food production, food prices, food preparation, and intra-household distribution all affect what is actually consumed from what is produced. That said, the purpose of this exercise is to highlight what could be achieved with more efficient post-harvest handling, better market integration, storage and processing infrastructures along with improved consumer behavior.

5. Market availability of nutritious foods

In this section, we assess the availability of nutritious foods in rural markets. As shown by Sibhatu and Qaim (2017), nutritious foods, such as fruits, vegetables, meat and eggs, are largely sourced from markets in rural Ethiopia. The exception is dairy for which the markets are missing or poorly functioning (Hoddinott, Headey, & Dereje, 2015).

Together, the PSNP and FtF survey teams visited 81 rural communities in 27 woredas in rural Tigray. In each community, the team visited the local food market to assess food availability and

prices. A novel feature of these market surveys was that the enumerators recorded whether the food item is available in the market.⁸ Both surveys fielded a similar market questionnaire.

We group these data sets using the 10-food group categorization used to analyze women's dietary diversity in Section 3.2, with the exception that we do not include the starchy staple food group in the analysis.⁹

Table 5.1 shows the market availability in the beans and peas food group. We see that market availability is not a constraint for this food group; more than 80 percent of the markets have chick peas, horse beans, and lentils.

Table 5.1. Market availability of food items in the Beans and peas food group, by survey

| Beans and peas (7 items in both surveys) | PSNP (%) | FtF (%) |
|---|-----------------|----------------|
| Bean, white | 26.6 | 6.7 |
| Bean, brown | 29.7 | 0.0 |
| Cowpea | 87.5 | 46.7 |
| Horse bean | 82.8 | 86.7 |
| Chick pea | 85.9 | 93.3 |
| Lentils | 81.3 | 100 |
| Green bean | 3.1 | 0.0 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

The market availability in the nuts and seeds food group is summarized in Table 5.2. These numbers indicate that fenugreek and vetch are widely available whereas 22 percent of the markets or less had groundnuts or sesame.

⁸ Standard market surveys do not typically collect this information. As a result, the end-user of the data cannot be sure whether the price observation is missing because the item did not exist in the market or because of a data entry or other mistake.

⁹ It is tempting to compare these market availability findings to the production figures presented in Section 4. There are several factors at play why the market availability and agricultural output (measured in calories) figures seem out of sync. First, the market availability analysis does not consider price. Indeed, foods may be available in the markets but because of limited supply the prices are high, thereby excluding the poorest consumers from purchasing these items. We assess affordability in the next section. Second, for some of these items the calorie density (kcal/kg) is low. This is particularly the case for green leafy vegetables such as kale and spinach. Third, production of many fruits and vegetables is largely seasonal, which means that the total annual production may be low while the production (and hence) availability in one particular season is high. Fourth, some of the foods sold at the markets may come from other regions.

Table 5.2. Market availability of food items in the Nuts and seeds food group, by survey

| Nuts and seeds (5 items in both surveys) | PSNP (%) | FtF (%) |
|---|-----------------|----------------|
| Groundnut | 21.9 | 13.3 |
| Groundnut flour | 0.0 | 0.0 |
| Fenugreek | 89.1 | 80 |
| Vetch | 71.9 | 80 |
| Sesame | 7.8 | 0.0 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

Table 5.3 shows the market availability for the items in the dairy food group. Here we see considerable differences across the two surveys. More than 70 percent of the markets visited in the FtF survey had fresh milk whereas only 14 percent of the markets visited in the PSNP surveys had fresh milk. Large differences in the availability of powdered milk and yoghurt are also observed.

Table 5.3. Market availability of food items in the Dairy food group, by survey

| Dairy (5 items in both surveys) | PSNP (%) | FtF (%) |
|--|-----------------|----------------|
| Fresh milk | 14.1 | 73.3 |
| Powdered milk | 7.8 | 40.0 |
| Yoghurt | 12.5 | 33.3 |
| Cheese | 0.0 | 0.0 |
| Fermented milk (ergo) | 9.4 | 0.0 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

Table 5.4 shows the market availability for meat products (flesh foods). We see that fish products are not widely available in these markets. Only 14 percent of the markets in PSNP areas and 27 percent of the markets in FtF areas had beef. Other cut meat was rarely available in these markets. If the consumer wanted chicken, he or she had to buy a live chicken and slaughter it at home. Live chicken are available in most markets.

Table 5.4. Market availability of food items in the Flesh foods food group, by survey

| Flesh foods (9 items in both surveys) | PSNP (%) | FtF (%) |
|--|-----------------|----------------|
| Dried fish | 0.0 | 0.0 |
| Fresh fish | 4.7 | 0.0 |
| Beef meat (not live) | 14.1 | 26.7 |
| Goat meat (not live) | 4.7 | 0.0 |
| Mutton meat (not live) | 0.0 | 0.0 |
| Chicken meat (not live) | 1.6 | 0.0 |
| Chicken (live) | 92.2 | 93.3 |
| Camel meat (not live) | 0.0 | 0.0 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

Eggs are available in all markets (Table 5.5) but the availability of Vitamin A-rich dark green leafy vegetables varies (Table 5.6). Ethiopian kale (gommen) is available in less than half of the markets in Tigray while spinach is widely available.

Table 5.5. Market availability of food items in the Egg food group, by survey

| Eggs (1 item in both surveys) | PSNP (%) | FtF (%) |
|--------------------------------------|-----------------|----------------|
| Eggs | 100 | 100 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

Table 5.6. Market availability of food items in the Vitamin A-rich dark green leafy vegetable food group, by survey

| Vitamin A-rich dark green leafy vegetables (2 items in both surveys) | PSNP (%) | FtF (%) |
|---|-----------------|----------------|
| Ethiopian kale | 35.9 | 46.7 |
| Spinach | 90.6 | 80.0 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

Table 5.7 shows the availability of foods under the other Vitamin A-rich vegetable and fruit group. The availability of fruits in this category varies by season and may explain the reason why mangoes and papayas were not found in the markets when the FtF survey teams visited them. In the PSNP survey, mangoes were found in more than 60 percent of the markets and papayas in 53 percent of the markets. Carrots are widely available while pumpkin was on sale in more than half of the FtF markets but only available in less than 10 percent of the PSNP markets.

Table 5.7. Market availability of food items in the Other Vitamin A-rich vegetables and fruit food group, by survey

| Other Vitamin A-rich vegetables and fruits (4 items in both surveys) | PSNP (%) | FtF (%) |
|---|-----------------|----------------|
| Carrot | 98.4 | 73.3 |
| Mango | 62.5 | 0.0 |
| Papaya | 53.1 | 0.0 |
| Pumpkin | 9.4 | 53.3 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

Other types of vegetables are widely available (Table 5.8). Onions, tomatoes, lettuce, and green pepper were on sale in most markets. Cauliflower was less frequently available, none of the markets stocked mushrooms.

Table 5.8. Market availability of food items in the Other vegetable food group, by survey

| Other vegetables (6 items in both surveys) | PSNP (%) | FtF (%) |
|---|-----------------|----------------|
| Onion | 100 | 100 |
| Tomato | 100 | 100 |
| Mushroom | 0.0 | 0.0 |
| Lettuce | 93.8 | 80.0 |
| Cauliflower | 26.6 | 0.0 |
| Green pepper | 98.4 | 93.3 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

Other fruits (that are not rich in Vitamin A) are widely available in Tigray (Table 5.9). Bananas, oranges, and lemons were found from most markets in the PSNP and FtF localities. Cactus fruit was not available at the time when the PSNP and FtF surveys took place. Melons and avocados were available in less than one-third of the markets.

Table 5.9. Market availability of food items in the Other fruit food group, by survey

| Other fruits (6 items in both surveys) | PSNP (%) | FtF (%) |
|---|-----------------|----------------|
| Banana | 100.0 | 93.3 |
| Orange | 62.5 | 80.0 |
| Cactus fruit | 1.6 | 0.0 |
| Lemon (lomi) | 89.1 | 86.7 |
| Avocado | 32.8 | 6.7 |
| Melon | 14.1 | 20.0 |

Source: Own calculation from BMGF-PSNP (March-2019) and FtF (September-October 2018) surveys.

6. Affordability of nutritious foods

In this section, we assess the affordability of nutritious foods in Tigray. We use the seven-food group categorization used to assess children's diets in Section 2.1, except we omit the first food group: grains, roots, and tubers. We define affordability as the share of total income needed to consume the recommended daily amount of the food group.¹⁰

Ethiopia has not yet developed its own nutritional guidelines or eating recommendations. Therefore, we have to use international nutritional guidelines to determine the recommended intake for each food group. Here, we use the recently developed recommendations by the EAT-Lancet Commission on Food, Planet and Health (Willett et al., 2019). The EAT diet recommendations attempt to maximize health benefits while minimizing a diet's negative impact on environment. Hence, the diet recommendation puts more emphasis on plant-based foods (legumes, nuts, vegetables, and fruits), and less on meat and eggs.¹¹

Table 6.1 maps these recommendations to the six food groups.

Table 6.1. EAT-Lancet Commission's intake recommendations, by food group

| Food group | grams per day |
|--------------------------------|---------------|
| Legumes and nuts | 125 |
| Dairy products | 250 |
| Poultry, fish, and meat | 71 |
| Eggs | 13 |
| Vitamin A-rich fruits and vegs | 200 |
| Other fruits and vegetables | 300 |

Source: Willett et al (2019).

Of note is that nutritional needs vary by age, sex, and physical activity levels. The EAT-Lancet Commission's dietary recommendations are for healthy individuals 2 years or older. Infants and

¹⁰ These calculations do not account for refuse factors and therefore these affordability estimates should be considered as lower bound.

¹¹ As noted by Willett et al (2019), the recommended amount of animal source foods may be sub-optimal for many sub-Saharan African countries. More specifically, the authors write (p.10) that "[b]ecause many regions, such as sub-Saharan Africa, still face severe burdens of undernutrition and malnutrition, and growing children often do not obtain adequate quantities of nutrients from plant-source foods alone, the role of animal-source foods should be examined carefully".

young children (less than 2 years of age) are growing rapidly and therefore have very different requirements than others (Willett et al., 2019). The purpose of the affordability analysis carried out here is not to calculate the cost of an optimal diet for children or women. Rather we aim to provide a sense of the price of these foods relative to the household income levels in the region.

For income, we rely on CSA’s Household Consumption Expenditure (HCE) survey report for the region based on data collected between July 2015 and June 2016 (CSA, 2018b). The HCE survey does not record incomes, and, therefore, we proxy household incomes using CSA’s estimates of household consumption-expenditures. The mean annual per capita consumption expenditure in the region was estimated as 10,166 birr (CSA, 2018b). Table 6.2 shows the mean annual per capita consumption expenditure estimates for each quintile.

Table 6.2. Annual household per capita expenditure in 2015/16

| Statistic | Amount (birr) |
|------------------|----------------------|
| Mean | 10,166 |
| Poorest quintile | 3,853 |
| 2nd quintile | 6,516 |
| 3rd quintile | 8,782 |
| 4th quintile | 12,214 |
| Richest quintile | 24,487 |

Source: CSA (2018b).

We calculated the mean price in the region for food items using CSA’s monthly retail price data for the same period (2015/16). To address the seasonality in food availability and prices, we selected the cheapest item in each food group in each month. Table 6.3 below provides the list of the cheapest food items in each category. There is surprisingly little seasonality in the cheapest items. Irrespective of the month, cow milk emerges as the cheapest item in the dairy product category, beef in meat products, and cabbage as the cheapest in other fruit and vegetable group. The cheapest item varies more in the legumes and nuts category.

It is important to note that the set of foods picked as the cheapest one in Table 6.3 may not be widely available or traditionally consumed in the region. However, the purpose of this exercise is to calculate the minimum cost of the dietary recommendation. Any departure from these items means that the estimated cost will increase further.

Table 6.3. Cheapest food item in each food group

| Year | Month | Legumes and nuts | Dairy products | Poultry, fish and meat | Eggs | Vitamin A-rich fruits and vegs | Other fruits and vegetables |
|----------|-----------|------------------|----------------|------------------------|------|--------------------------------|-----------------------------|
| | Average | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| 2015 | July | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| | August | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| | September | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| | October | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| | November | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| | December | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| | 2016 | January | Peas mixed | Cow milk | Beef | Egg | Pumpkin |
| February | | Haricot beans | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| March | | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| April | | Haricot beans | Cow milk | Beef | Egg | Pumpkin | Cabbage |
| May | | Vetch | Cow milk | Beef | Egg | Kale | Cabbage |
| June | | Vetch | Cow milk | Beef | Egg | Pumpkin | Cabbage |

Note: Cow milk refers to unpasteurized milk, Kale is Ethiopian kale (gommen).

Source: Own calculation from CSA price data.

We then used the prices of the above food items to calculate the total annual cost of consuming the recommended serving reported in Table 6.1. To get the share of total income needed to meet the recommended intake, we divided the total annual cost of the recommended intake by the annual per capita consumption expenditure value divided by 365 (to get the daily cost per person).

Table 6.4 provides the results.¹² Following the EAT diet would mean that the average resident in Tigray would spend 7 percent of their income on legumes and nuts, 12 percent on dairy, 27 percent on meat, 4 percent on eggs, and 2 percent on Vitamin A-rich fruits and vegetables and 7 percent of other fruits and vegetables. These percentages are much higher for the poorest households for which many of these recommendations are out of reach. Therefore, the poorest

¹² It is worth noting here that as per the Engel's law, the average Ethiopian allocates a large fraction of their budget on food. Therefore the shares allocated to food are high, irrespective of which diet recommendation we use.

households may require special attention when nutrition-sensitive agriculture and other policies are planned.¹³

Despite the moderate emphasis on meat products in the EAT diet, consuming the recommended intake (71 grams) would be very expensive in Tigray. For the average resident in the region, this would mean spending 27 percent of their budget just on meat products. For the poorest households, a daily ration of 71 grams of meat would take 71 percent of their total budget.

The EAT-Lancet commission recommends consuming 13 grams of eggs every day. Considering that the local egg weighs about 35 grams, this means consuming two to three eggs per week. For the average resident in Tigray, this would mean allocating 4 percent of the budget on eggs. For the poorest, the corresponding share would be 10 percent.

Large part of the daily calories in the EAT diet comes from the consumption of fruits and vegetables. Here we have divided these into items that are rich in Vitamin A and other items. Consuming 200 grams of fruits and vegetables that are rich in Vitamin A would mean allocating a mere 2 percent of the budget on these items at the mean income level. For the poorest, the corresponding share is 5 percent. Following the recommended intake for other fruits and vegetables would take 7 percent of the total budget at the mean income level and 18 percent at income level of the poorest households.

Table 6.4. Percent of household income needed to meet the recommended intake, by income quintile

| | Mean income | Poorest quintile | 2nd quintile | 3rd quintile | 4th quintile | Richest quintile |
|---------------------------------|--------------------|-------------------------|---------------------|---------------------|---------------------|-------------------------|
| Legumes and nuts | 7 | 17 | 10 | 8 | 5 | 3 |
| Dairy products | 12 | 32 | 19 | 14 | 10 | 5 |
| Poultry, fish, and meat | 27 | 71 | 42 | 31 | 22 | 11 |
| Eggs | 4 | 10 | 6 | 4 | 3 | 2 |
| Vitamin A-rich foods and fruits | 2 | 5 | 3 | 2 | 2 | 1 |
| Other fruits and vegetables | 7 | 18 | 11 | 8 | 6 | 3 |
| Total | 59 | 153 | 91 | 67 | 48 | 25 |

¹³ It is important to note here that nutrition provisions have recently been integrated into Ethiopia's productive safety net program (PSNP) that covers 8 million poor rural people (Bossuyt, 2017).

Finally, pumpkin and cabbage were often identified as the cheapest items in their food groups (Table 6.3). These foods are not widely consumed in Ethiopia, perhaps because they can only be bought in large quantities (in terms of weight) and in absence of preservation technologies are not actually affordable. This prompts us to explore the sensitivity of these estimates considering the second cheapest item in the fruit and vegetable food groups (see Appendix B). These results are presented in Table 6.5. As expected, the percent of income needed to meet the recommended intake somewhat increases. For the average resident, following the EAT recommendation for Vitamin A-rich fruit and vegetables would cost 5 percent of the total budget. The corresponding share among the poorest households is 14 percent. As for other fruits and vegetables, 12 percent is needed at the mean income level and 32 percent at the income level of the poorest household.

Table 6.5. Percent of household income needed to meet the recommended intake for fruits and vegetables, second cheapest items, by income quintile

| | Mean income | Poorest quintile | 2nd quintile | 3rd quintile | 4th quintile | Richest quintile |
|---------------------------------|--------------------|-------------------------|---------------------|---------------------|---------------------|-------------------------|
| Vitamin A-rich foods and fruits | 5 | 14 | 8 | 6 | 4 | 2 |
| Other fruits and vegetables | 12 | 32 | 19 | 14 | 10 | 5 |

7. Conclusions

This report has analyzed the consumption, production, market availability, and affordability of nutritious foods in the Tigray region of Ethiopia. In this section, we summarize these findings.

Children's and women's diets in the region are extremely monotonous. Only 13 percent of the children 6-23 months meet the WHO recommended dietary diversity (four food groups out of seven). Four percent of the women meet the recommended dietary diversity for adult women (five food groups out of 10). Further analyses suggest that one reason for poor dietary diversity among infants and young children is delayed initiation of complementary foods. Other possible explanations include misperceptions around when to introduce certain foods to young children as well as poor affordability of certain foods, such as ASFs.

Nearly 38 percent of children would need to add one or two additional food groups to their diet to meet the four-food group recommendation. Should this happen, the share of children achieving the minimum dietary diversity would increase to 42 percent. With this in mind, the

following passages discuss the non-starchy staple food groups and their potential of reaching the most households in the region to improve dietary diversity.

7.1. Legumes and nuts

Legumes and nuts are widely available in the markets and their production is at relatively reasonable level, supplying nearly 400 calories per person per day. They are also widely consumed by young children and adult women. Therefore, and considering the dietary gaps with respect to other food groups, legumes and nuts have a limited potential for improving dietary diversity in Tigray.

7.2. Dairy products

Dairy products are not widely consumed among children and women in Tigray. The production data suggests that dairy products supply about 100 calories per day per person. Furthermore, their market availability and affordability are poor. While dairy is an important source of many nutrients and highly beneficial input for child growth (Headey, Hirvonen, & Hoddinott, 2018), their commercial value chains are extremely complex, requiring refrigeration or industrial processing (e.g. powder or ultra-high temperature processing) to maintain food safety. Given this, increasing dairy consumption further in Tigray would require considerable investments.

7.3. Flesh foods

Very few children and adult women consume meat products in Tigray. Their production is relatively low, supplying only about 2 calories per day per person. Furthermore, their market availability is poor and meat products are not affordable for most households. High adherence to Orthodox fasting practices that prohibit consumption of and contact with animal-source foods for large part of the year further complicate matters. We discuss the role of Orthodox fasting below. All things considered, improving the availability and affordability of meat products is challenging in the Tigray region and will require innovative solutions. Dried shredded or powdered meat products hold promise as they simultaneously solve several issues regarding perishability, affordability (can be sold in small portions) and acceptability (does not require home slaughtering during fasting).

7.4. Eggs

Egg consumption is not widespread in Tigray. Also their production levels are relatively low, supplying 15 calories per person per day. However, their market availability is good with most

rural markets stocking eggs. They are also relatively affordable. Eggs have a very high nutritional content and recent evidence suggests eggs have a high potential for reducing stunting rates in poor countries (Headey et al., 2018; Iannotti, Lutter, Bunn, & Stewart, 2014; Iannotti et al., 2017). Therefore, eggs could have a high potential for improving dietary diversity in Tigray.

7.5. *Vitamin A rich fruits and vegetables*

Despite their relatively good availability and affordability, Vitamin A-rich fruits and vegetables are not frequently consumed among children and adult women. Therefore, Vitamin A-rich fruits and vegetables could have a high potential for improving dietary diversity in Tigray. However, high perishability and the seasonal availability of these products should be taken into account.

7.6. *Other fruits and vegetables*

The consumption of other types of fruits and vegetables is frequent among women but only consumed by about 10 percent of the young children. Their availability in the region is good with most markets stocking onions, tomatoes, and bananas. They are also reasonably affordable, though perhaps out of reach for the poorest households. Therefore, other fruits and vegetables may also have a potential for improving dietary diversity in Tigray. However, high perishability and the seasonal availability of these products should be taken into account.

7.7. *Orthodox fasting*

One key challenge in increasing ASF consumption in Ethiopia relates to religious fasting practices. This is particularly the case for the Orthodox Christians who comprise 95 percent of the population in Tigray (Central Statistical Agency [Ethiopia], 2010). The Ethiopian Orthodox Tewahedo Church allocates 110-115 days of fasting per year for common people and a total of 220 days for priests and other people associated with the church. During the fast, devout Orthodox Christians follow a vegan diet by refraining from consuming meat or other animal products (eggs, dairy products).

Young children and pregnant and lactating women are exempted from fasting. To underline this, in January 2016, the Ethiopian Orthodox Church together with USAID issued a press release instructing women and children to abstain from fasting during the first 1,000-day period.¹⁴

¹⁴ <https://et.usembassy.gov/pr-01122016> (accessed 8 September 2018).

Still, children are perceived to be influenced by fasting practices because adults in the households do not want to prepare foods containing ASF. A qualitative formative study conducted during the Lent fasting period in the Amhara region highlights this but also points out that eggs and milk were considered more acceptable to be fed to children as they required less preparation – and perhaps more importantly, did not require slaughtering (Kim et al., 2018).

To address these issues, behavior change interventions will need to carefully tailor the messaging during the fasting periods. Given the caregiver acceptability and market availability, it may be strategic to focus the behavior-change messages more on eggs and dairy instead of meat products. An alternative strategy would be to promote lightly processed and preserved meat products (e.g. dried meat) so that no slaughtering is required. Finally, the Alive & Thrive project has successfully involved religious leaders to improve feeding practices in the Amhara region.¹⁵ This seems like a good model to follow also in Tigray.

7.8. *Limitations*

This study has limitations. First, although we use geographically widespread surveys to assess women's dietary diversity, in the absence of regionally representative data, we cannot be sure whether the statistics reported here represent the region as a whole. Second, the same issue applies for market availability. Third, Tigray is a large heterogeneous region covering different agro-ecological zones. This heterogeneity is imperfectly captured in this report. Nutrition-sensitive agriculture programs need to take this into account by tailoring the interventions to the prevailing agro-ecological conditions in the program areas. Finally, our estimates on crop production levels in the region are limited to the production during the main rainy seasons. Significant crop production outside the rainy seasons in the region (e.g. using irrigation) would mean that production levels are under-estimated.

¹⁵ See <https://www.aliveandthrive.org/resources/alive-thrive-engages-church-leaders-to-improve-nutrition-in-ethiopia-amhara-region/> (accessed 9 September, 2018).

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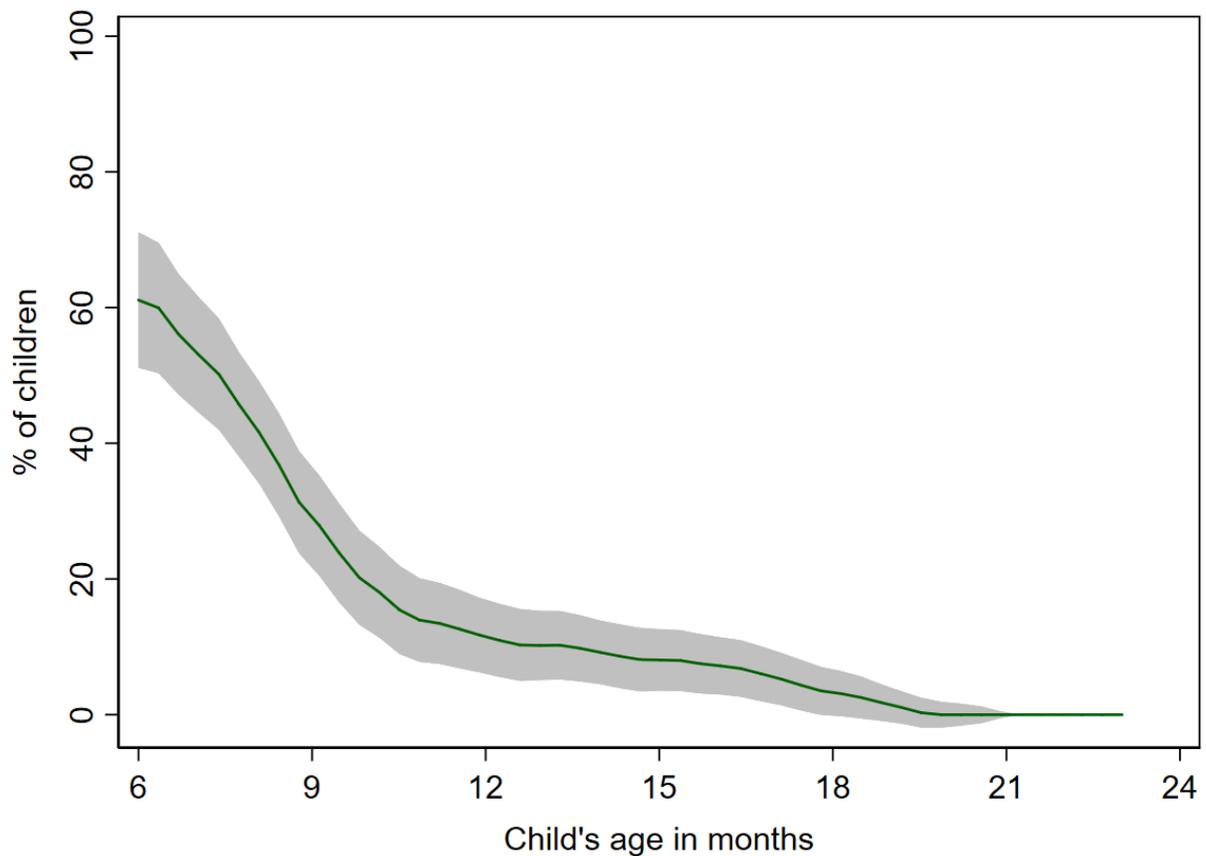
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Appendix A: Initiation of complementary feeding in PSNP areas of Tigray

Figure A1 shows a polynomial regression that regresses the likelihood that the child did not consume from any of the seven-food groups against the child's age in months. We see that most of these 'zero DDS' children are young. About half of the children 6-8 months of age have zero dietary diversity. The share declines as children grow older but even at 12 months, about 20percent of the children are still not consuming from any of the seven food groups.

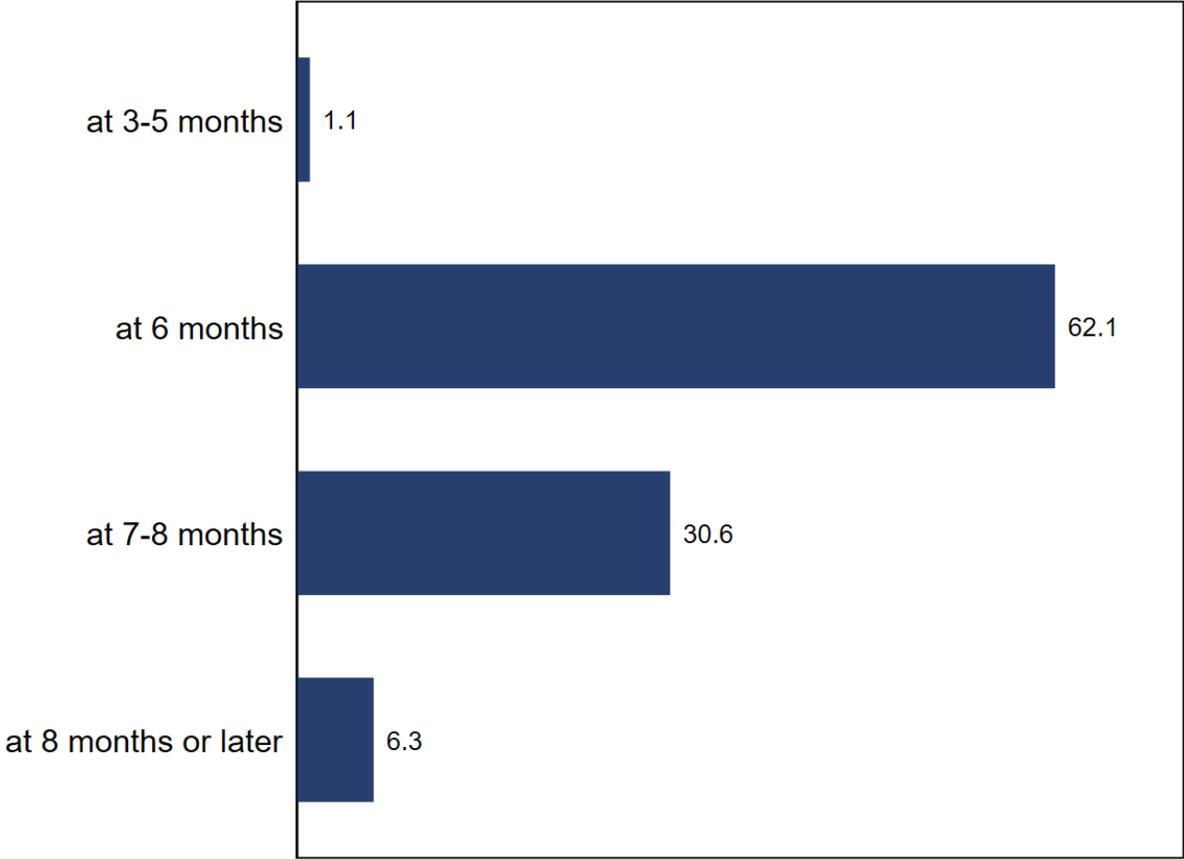
Figure A1: Relationship between the share of children with zero dietary diversity and child's age (in months), in PSNP areas of Tigray



Note: Local polynomial regression. N= 660 children (6-23 months of age) from Tigray (PSNP woredas). March-2017 survey round.

The BMGF-PSNP survey included a series of questions about the caregivers' nutrition knowledge. One of the questions asked the age in which the child should start receiving foods in addition to breast milk. The responses to this questions are summarized in Figure A2. We see that more than 60 percent of the caregivers think that complementary feeding should begin when children turn 6 months, in line with WHO recommendations. However, a large fraction (37 percent) of the caregivers think that this should happen later.

Figure A2: Caregiver knowledge: "At what age should a baby first start to receive foods (such as porridge) in addition to breast milk?", in PSNP areas of Tigray



Note: N = 651 mothers from Tigray (PSNP woredas). March-2017 survey round.

Appendix B: Recalculating affordability considering the second cheapest food items in fruit and vegetable categories

Table B1. Second Cheapest food item in each food group

| Year | Month | Vitamin A rich fruits and vegg | Other fruits and vegetables |
|-------------|--------------|---------------------------------------|------------------------------------|
| | Average | Spinach | Tomato |
| 2015 | July | Ethiopian Kale | Onion |
| | August | Spinach | Tomato |
| | September | Ethiopian Kale | Cactus |
| | October | Spinach | Cactus |
| | November | Spinach | Lemon |
| | December | Ethiopian Kale | Tomato |
| | 2016 | January | Spinach |
| February | | Ethiopian Kale | Tomato |
| March | | Spinach | Tomato |
| April | | Spinach | Onion |
| May | | Spinach | Onion |
| June | | Ethiopian Kale | Onion |