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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 at least from 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, & Umeta, 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, which highlights 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 system[1] in the Somali 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, 2018b). About 27 percent of the children under 5 in Somali are chronically under-nourished (or stunted) (Hirvonen et al., 2019) while 31 percent of the women 15-49 years of age are underweight (CSA & ICF, 2016).[3] Moreover, according to the Ethiopian Public Health Institute (EPHI), 13 percent of children 6-59 months are Vitamin A deficient (EPHI, 2016).

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[1] We call this a *sub* system analysis because due to data limitations, we do not assess consumer preferences and we are also 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 15 percent of the women in this age group in Afar are over-weight or obese.

This report is structured as follows. In the subsequent section we describe the data used 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 1,564 households in the Somali region. 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 FtF evaluation data sets to assess diets of adult women. The midline survey for the FtF evaluation was administered between June and July in 2015 in Amhara, Oromia, Somali, SNNP, and Tigray regions.[4] These data sets were collected to obtain midline 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), and localities that served as a control (i.e. did not benefit from the FtF program). The sample is large – 6,696 households - and widely distributed, the survey having

[4] Of note is that the endline was administered in 2018 but for security reasons, Somali region was not visited as a part of this survey. It is for this reason we rely on the midline survey in this report.

been implemented in 252 kebeles in 84 woredas. In Somali region, 369 households located 15 kebeles in 5 woredas[5] were interviewed. It is important to note that while these data sets are representative of the zone of influence within which the FTF program operates, they are not nationally or regionally representative.

To assess the market availability of nutritious foods, we use the PSNP-4 evaluation data. The latest (midline) round was administered in June/July 2018 in Afar, Amhara, Oromia, Somali, SNNP, and Tigray regions in localities that benefit from the PSNP program. In Somali region, 29 communities were visited in nine woredas. In each community, the team visited the local food market to assess food availability and prices.

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

[5] These five woredas were: Dolo Ado, Jijiga, Kebri Beyahe, Moyale, and Shinele.

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 the 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).

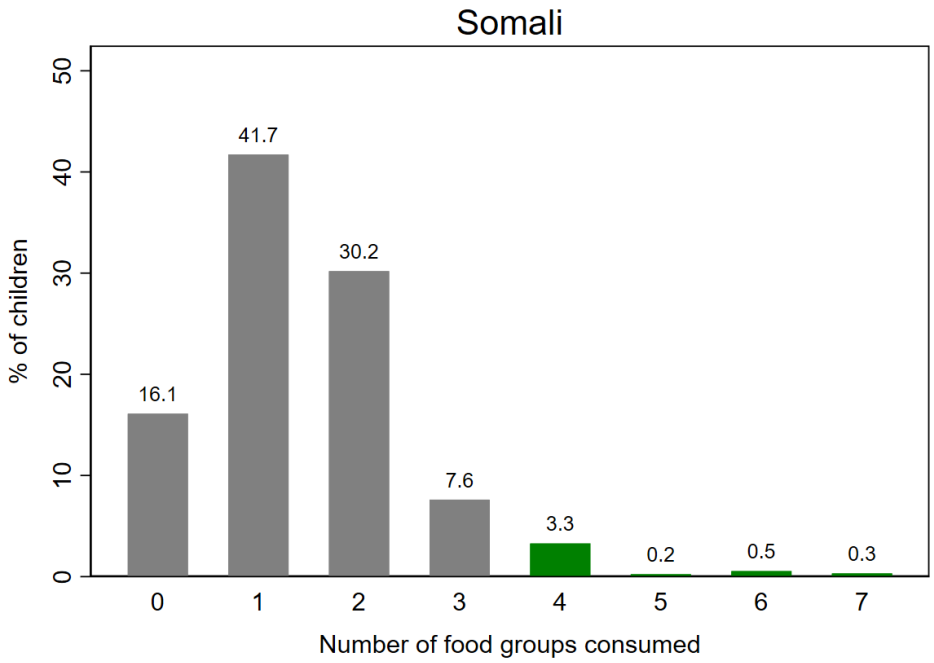
This relatively simple indicator is highly correlated with more detailed measures of food intake (Ruel, 2003) as well as with children's micronutrient intakes[6]. Moreover, several studies show strong correlations with this dietary diversity score and longer term measures of children's nutritional status (e.g. child stunting prevalence) in a number of countries including Bangladesh, Ethiopia, India, and Zambia (Jones et al., 2014).

In Somali, the average 6-23 month old child consumes from 1.5 food groups and only 4.0 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 somewhat more diverse in urban areas; 3.2 percent of the rural children and 11.7 percent of the urban children in the Somali region 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, we see that a large fraction of children (16 percent) did not consume from any food groups in the previous 24 hours. These are mostly children that were still exclusively or intensively breastfed[7] indicating that the initiation of complementary feeding is often delayed in the region. Meanwhile, 42 percent of the children consumed only from

[6] 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).
[7] Intensive breastfeeding: majority of the nutrition intake (80-100%) comes from breastmilk.

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 30 percent were two food groups shy from meeting the recommendation while 8 percent of the children were missing just one food group.

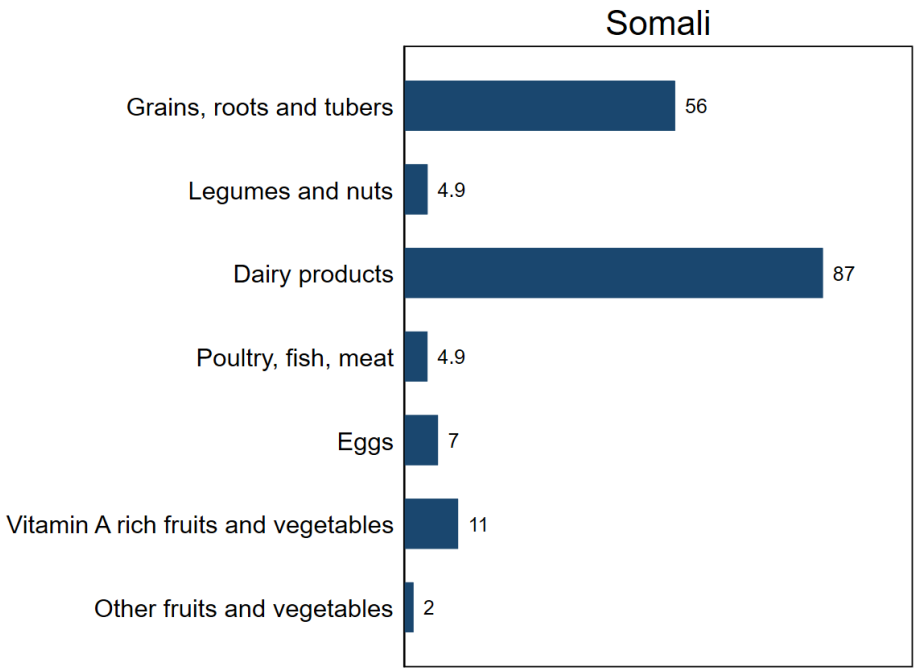
Figure 3.1. Distribution of children's dietary diversity score



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. Pastoralist and agro-pastoralism are important livelihoods in the region and therefore it is not surprising that food consumption among young children is concentrated on dairy products. Grains, roots, or tubers were consumed by 56 percent of the children. Consumption from other food groups was less common, the share of children consuming from these food groups ranging between 2 and 11 percent.

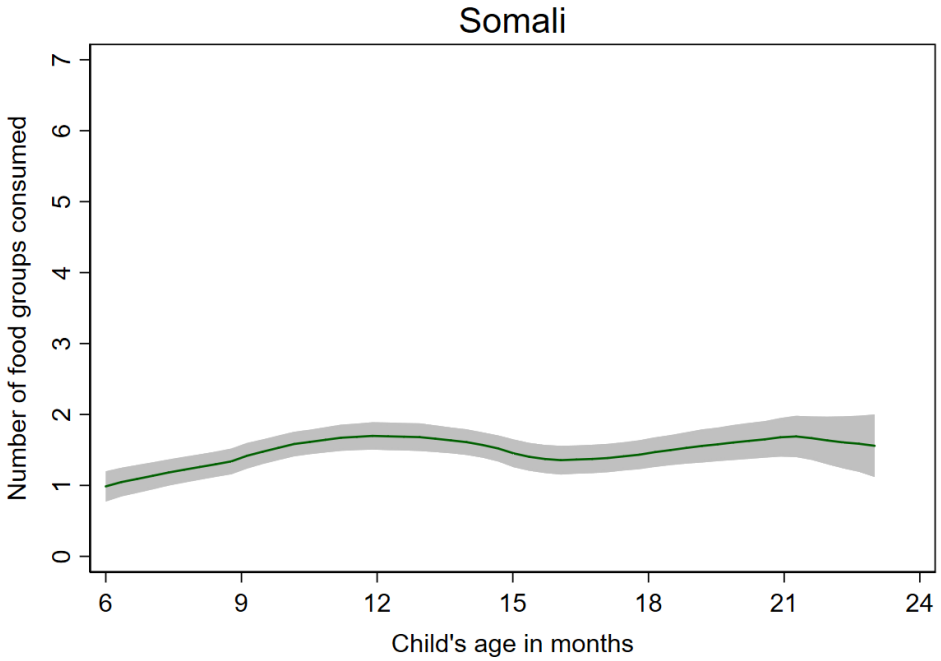
Figure 3.2. Percent of children consuming from different food groups



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

We then 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 child's age using local polynomial regression approach. Figure 3.3 shows how dietary diversity increases relatively sharply between 6-9 months suggesting 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). After this, the mean dietary diversity score remains stable and the average child in the 18-23 month age range consumes from one to two food groups.

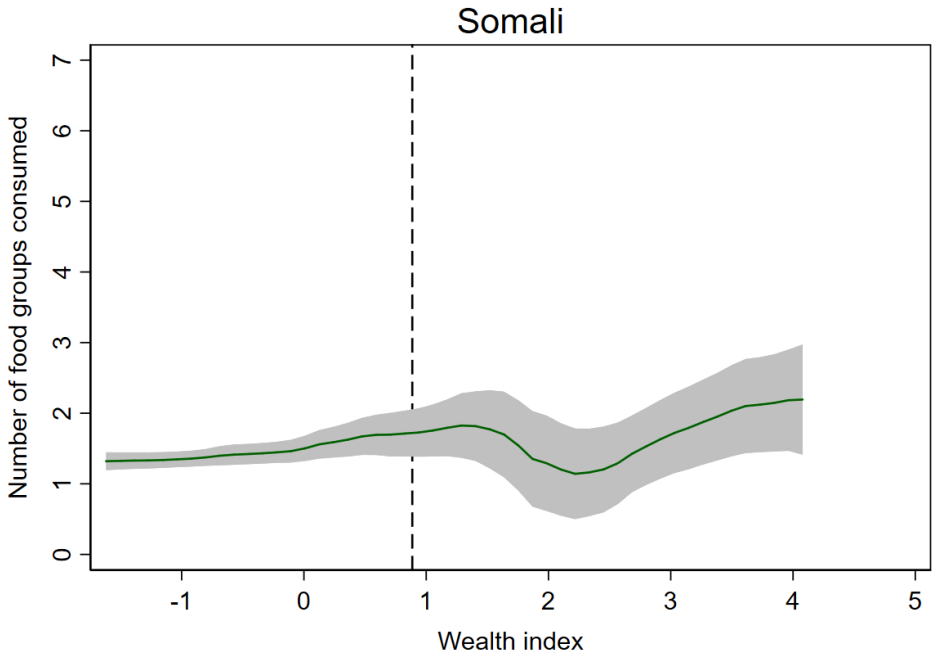
Figure 3.3. Relationship between child dietary diversity and child's age



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



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

Women's Dietary Diversity is measured as the mean number of food groups consumed. The focus here is on women of reproductive age (15-49 years old).The data available to us do not permit us to compute the indicator based on the recent FAO and FHI 360 (2016) guidelines. [8] 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[9]:

1. Grains, roots, and tubers;

2. Legumes and nuts;

[8] This is because the questionnaire did not separate nuts and seeds from legumes.
[9] Note that the FtF data do not allow us to construct the 10-food group indicator recommended by FAO and FHI 360 (2016) because the questionnaire did not separate nuts and seeds from legumes.

3. Dairy products (milk, yogurt, cheese);

4. Organ meat;

5. Eggs;

6. Flesh foods and other misc. small animal protein;

7. Vitamin A dark green leafy vegetables;

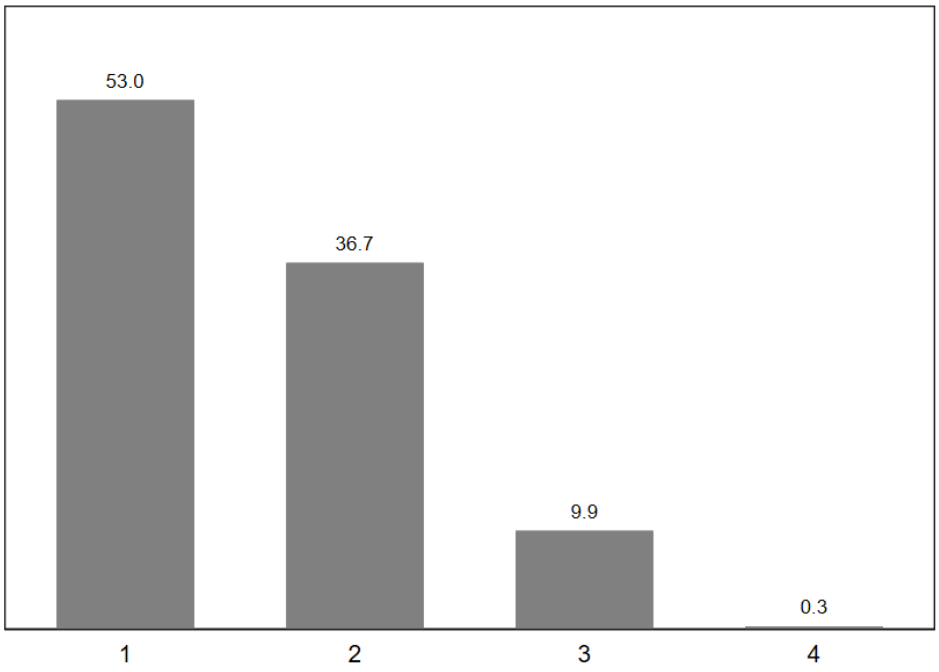
8. Other Vitamin A rich vegetables and fruits;

9. Other fruits and vegetables.

This yields a dietary diversity score ranging from 0 to 9. The indicator is particularly designed to capture micro-nutrient adequacy of the diet.

The average mother in the FtF-2016 sample consumed from 1.5 food group (out of nine). Figure 3.5 shows the full distribution of women's dietary diversity score in FtF woredas in June/July 2016. We see that none of the women consumed from more than four food groups. More than half consumed just from one food group, 37 percent from two food groups. About 10 percent consumed from three food groups and less than 1 percent consumed from 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 a few women met the recommended dietary diversity.

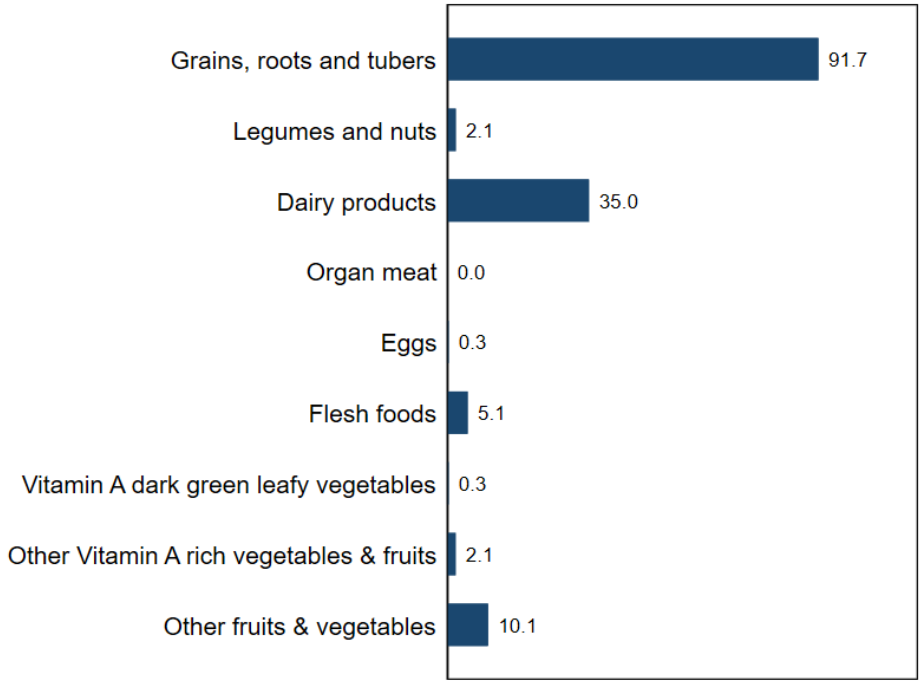
Figure 3.5. Distribution of women's dietary diversity score



Source: own calculation from FtF-2016.

Figure 3.6 shows the percent of women consuming from the nine food groups. More than 90 percent of the women consumed starchy staple foods. Dairy products were consumed by 35 percent of the women and 10 percent consumed fruits or vegetables that are not rich in Vitamin A. The consumption of other foods is rare.

Figure 3.6. Percent of women consuming from different food groups



Source: own calculation from FtF-2016.

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 is 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. [10]

Table 4.1 shows the daily total energy production per capita per these food groups. First, the total calorie production calories increased by 61 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 77 percent. Second, we see that the agricultural production is heavily concentrated on the production of grains, roots, and tubers that accounted for 90 percent of all calories produced in the region in 2015. [11] Dairy products account for 8 percent of the total calorie production. Strikingly, the remaining six food groups account only for about 2 percent of the total calories produced in the region. Finally, we note that the estimated total amount of energy and nutrients produced in the region is not sufficient to feed the region's population; see Table 4.2. Consequently, the region must be a net food importer.

[10] 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.

[11] 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).

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

	2011	2012	2013	2014	2015
Grains, roots, and tubers	219	316	396	338	388
Legumes and nuts	0.0	0.4	1.0	3.4	0.0
Dairy products	42	32	35	38	35
Poultry, fish, meat	5.7	9.7	3.1	4.7	4.7
Eggs	0.1	0.1	0.2	0.2	0.2
Vitamin A-rich fruits and vegetables	0.1	0.0	0.0	0.0	0.0
Other fruits and vegetables	0.2	4.4	0.9	4.1	3.7
Other foods	0.0	0.0	0.0	0.0	0.0
Total	**267**	**363**	**437**	**389**	**432**

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)	100.0
Protein (g)	99.9
Vitamin A(µg RAE)	44.6
Ascorbic acid (mg)	50.2
Iron (mg)	18.7
Zinc (mg)	55.1
Calcium (mg)	100.0
Thiamine (mg)	97.3
Niacin (mg)	99.1
Riboflavin (mg)	99.5

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 of which 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).

The PSNP survey teams visited 29 communities in rural Somali. 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.[12]

We group these market data sets using the 10-food group categorization often used to analyze women's dietary diversity (FAO & FHI 360, 2016), with the exception that we do not include the starchy staple food group in the analysis.[13]

Table 5.1 shows the market availability in the beans and peas food group. We see that market availability is a constraint for this food group: less than 39 percent of the markets had lentils, and

[12] 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.

[13] 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.

less than 15 percent of the markets had chickpeas. The availability of other items in this food group was even more limited.

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 (%)
Bean, white	0
Bean, brown	4
Cowpea	0
Horse bean	21
Chick pea	14
Lentils	29
Green bean	0

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

The market availability in the nuts and seeds food group is summarized in Table 5.2. We see that groundnut is available in 36 percent of the markets and fenugreek in 14 percent of the markets. Other items in this food group are hardly available.

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 (%)
Groundnut	36
Groundnut flour	0
Fenugreek	14
Vetch	4
Sesame	4

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

Table 5.3 shows the market availability for the items in the dairy food group. Fresh milk is available in more than 70 percent of the markets and powdered milk in 21 percent of the markets. Other dairy foods such as yoghurt and cheese are available in less than 10 percent of the markets visited by the PSNP enumerators.

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

Dairy (4 items in PSNP, 5 in FtF)	PSNP (%)
Fresh milk	71
Powdered milk	21
Yoghurt	7
Cheese	4

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

Beef was available in less than 40 percent of the markets (Table 5.4). Goat and mutton in 68 and 4 percent of the markets, respectively. Chicken was available in 22 percent of the markets while camel meat only in 6 percent of the markets.

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

Flesh foods (8 items in PSNP, 9 in FtF)	PSNP (%)
Dried fish	0
Fresh fish	0
Beef	36
Goat	68
Mutton	4
Chicken	4
Camel meat	14

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

Eggs are available in more than 60 percent of the markets (Table 5.5), while the availability of vitamin A-rich dark green leafy vegetables was poor (Table 5.6). Ethiopian kale (gommen) is available in 14 percent of the PSNP markets and only 7 percent of the markets had spinach.

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

Eggs (1 item in both surveys)	PSNP (%)
Eggs	64

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

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 (%)
Ethiopian Kale	14
Spinach	7

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

Table 5.7 shows the availability of foods under the other Vitamin A-rich vegetable and fruit group. Mangoes were found in nearly 40 percent of the markets and papayas in 11 percent of the markets at the time when the PSNP enumerators visited these markets. Carrot was available in 32 percent of the 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 (3 items in PSNP, 4 in FtF)	PSNP (%)
Carrot	32
Mango	39
Papaya	11

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

Other types of vegetables were widely available (Table 5.8). Most markets had onions, tomatoes, and green peppers. Lettuce was on sale in 14 percent of the markets but cauliflower and mushrooms were not available.

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

Other vegetables (6 items in both surveys)	PSNP (%)
Onion	93
Tomato	93
Mushroom	0
Lettuce	14
Cauliflower	0
Green pepper	79

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

Other fruits (that are not rich in Vitamin A) are not widely available in Somali (Table 5.9). Bananas were on sale in less than 50 percent of the markets. Oranges and cactus fruit were not available at the time the enumerators visited these markets, possibly because it was not the season for these fruits.

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

Other fruits (3 items in PSNP, 6 in FtF)	PSNP (%)
Banana	43
Orange	0
Cactus fruit	0

Source: Own calculation from PSNP-2018 (June-July 2018) survey.

6. Affordability of nutritious foods

In this section, we assess the affordability of nutritious foods in Somali. 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. [14]

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. [15]

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 foods and fruits	200
Other fruits and vegetables	300

Source: Willet 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

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

[15] 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, 2018a). 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 9,946 birr (CSA, 2018a). 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	9,946
Poorest quintile	3,992
2nd quintile	6,745
3rd quintile	8,986
4th quintile	11,930
Richest quintile	21,701

Source: CSA (2018a).

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 is the cheapest item in the dairy product category and camel meat in meat products. Depending on the month, pumpkin and Ethiopian kale are the cheapest items in the Vitamin A-rich fruits and vegetable category. Cabbage is almost always the cheapest in other fruit and vegetable category. There is more variation in 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	Lima beans	Cow milk	Camel Meat	Egg	Pumpkin	Cabbage
	July	Chick peas	Cow milk	Camel meat	Egg	Kale	Cabbage
	August	Vetch	Cow milk	Camel meat	Egg	Pumpkin	Cabbage
2015	September	Lima beans	Cow milk	Camel meat	Egg	Pumpkin	Cabbage
	October	Haricot beans	Cow milk	Camel meat	Egg	Pumpkin	Cabbage
	November	Haricot beans	Goat milk	Camel meat	Egg	Pumpkin	Cabbage
	December	Lima beans	Cow milk	Camel meat	Egg	Pumpkin	Cabbage
	January	Lima beans	Cow milk	Camel meat	Egg	Pumpkin	Cabbage
	February	Lima beans	Cow milk	Camel meat	Egg	Pumpkin	Cabbage
2016	March	Lima beans	Cow milk	Camel meat	Egg	Kale	Onion
	April	Lima beans	Cow milk	Camel meat	Egg	Kale	Cabbage
	May	Lima beans	Cow milk	Camel meat	Egg	Kale	Cabbage
	June	Haricot beans	Cow milk	Camel meat	Egg	Kale	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. [16] Following the EAT diet would mean that the average resident in Somali would spend 7 percent of their income on legumes and nuts, 17 percent on dairy, 33 percent on meat, 5 percent on eggs and 6 percent on Vitamin A-rich fruits and vegetables and 12 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 households may require special attention when nutrition-sensitive agriculture and other policies are planned.[17]

[16] 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.
[17] 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).

Despite the moderate emphasis on meat products in the EAT diet, consuming the recommended intake (71 grams) would be quite expensive in Somali. For the average resident in the region, this would mean spending 33 percent of their budget just on meat products. For the poorest households, a daily ration of 71 grams of meat would take 82 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 Somali, this would mean allocating 5 percent of the budget on eggs. For the poorest, the corresponding share would be 13 percent.

A Llarge 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 6 percent of the budget on these items at the mean income level. For the poorest, the corresponding share is 16 percent. Following the recommended intake for other fruits and vegetables would take 12 percent of the total budget at the mean income level and 29 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	6	3
Dairy products	17	42	25	19	14	8
Poultry, fish, and meat	33	82	48	36	27	15
Eggs	5	13	8	6	4	2
Vitamin A-rich fruit and vegs	6	16	9	7	5	3
Other fruits and vegetables	12	29	17	13	10	5
Total	**80**	**199**	**117**	**89**	**66**	**36**

Finally, pumpkin and cabbage were 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 A). 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 10 percent of the total budget. The corresponding share among the poorest households is 26 percent. As for other fruits and vegetables, 15 percent is needed at the mean income level and 38 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	10	26	15	11	9	5
Other fruits and vegetables	15	39	23	17	13	7

7. Conclusions

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

Children's and women's diets in the region are extremely monotonous. Only 4 percent of the children 6-23 months meet the WHO recommended dietary diversity (four food groups out of seven). None 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. Before doing so, we highlight that the Somali region is characterized by extremely challenging agro-climatic conditions. The lack of rainfall and absence of irrigation, in particular, limit the development of crop agriculture and as a result the region is a net-food importer (see section 4). This needs to be taken into account when nutritionsensitive agriculture strategies are drafted.

7.1. Legumes and nuts

The consumption of legumes or nuts among children and adult women is rare in Somali. Meanwhile, their market availability is poor and they are not affordable for many households. This is possibly because of limited production of legumes and nuts in the region. Given all this, this food group may have a limited potential for improving dietary diversity in the Somali region.

7.2. Dairy products

Dairy products are consumed by nearly 90 percent of the children and by about one-third of adult women. Meanwhile, their production level is relatively low, supplying only about 35 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 all this, increasing dairy consumption further in Somali, especially in rural areas, would require considerable investments.

7.3. Flesh foods

Few children and adult women consume meat products in Somali. The production of meat products is relatively low, supplying only about five calories per day per person. Furthermore, their market availability is relatively poor and meat products are not affordable for most households. All things considered, improving the availability and affordability of meat products is challenging in the Somali 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.

7.4. Eggs

Egg consumption is not widespread in Somali region. Also, their production levels are relatively low, supplying less than 0.5 calories per person per day. However, their market availability is relatively good with nearly 65 percent of the rural markets stocking eggs. They are also relatively affordable, and have 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 Somali region.

7.5. Vitamin A-rich fruits and vegetables

Vitamin A-rich fruits and vegetables are not consumed widely by children and adult women. Their market availability is relatively poor and affordability is an issue, especially for poorer households in the region. Therefore, Vitamin A-rich fruits and vegetables may not have a high potential for improving dietary diversity in Somali region.

7.6. Other fruits and vegetables

The consumption of other types of fruits and vegetables is also not common among children and women. Meanwhile, their availability in the region is good with most markets stocking onions and tomatoes, though the availability of fruits is limited. However, they are not affordable, especially for poor households. Therefore, other fruits and vegetables may also have a potential for improving dietary diversity in Somali, though their low production levels in the region may

require importing them from other regions. However, high perishability and the seasonal availability of these products should be taken into account.

7.7. 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, our estimates on crop production levels 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.

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

Table A1. Second Cheapest food item in each food group

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