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Characteristics of Smallholder Farm Households in Upper Egypt

Implications for nutrition-sensitive agricultural interventions

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TABLE OF CONTENTS

Abstract iv
1 Introduction 1
2 Data and Methods 3
3 Results 4
3.1 Demographic and socioeconomic characteristics 4
3.2 Agriculture 10
3.3 Health and nutrition 19
4 Conclusion 28
References 31

LIST OF TABLES

Table 1: Demographic characteristics of interviewed farm households 5
Table 2: Educational attainment of household head and spouse 5
Table 3: Literacy of mothers of children aged 0 to 5 years 5
Table 4: Main and secondary occupation of household head and spouse 6
Table 5: Food and non-food expenditure per capita, by item and expenditure quintile, average 7
Table 6: Monthly non-food expenditures per capita, by item and expenditure quintile, average 8
Table 7: Receipt of pensions of support from social programs by households 8
Table 8: Housing conditions 9
Table 9: Household asset ownership 10
Table 10: Farmland usage, by season 10
Table 11: Characteristics of cultivated fields, by season 11
Table 12: Access to irrigation infrastructure 12
Table 13: Field irrigation frequency during the planting period, by season 12
Table 14: Production patterns for common crops, by season 13
Table 15: Input use in the production of common crops, by season 14
Table 16: Type of fertilizers applied, percent of farm households applying fertilizer 15
Table 17: Type of pesticides applied, percent of farm households applying pesticides 15
Table 18: Access to tractors and hand sprayers 15
Table 19: Harvest yields and marketing of common crops, by season 16
Table 20: Governorate-average yields in 2013/14 season, based on data from the Ministry of Agriculture and Land Reclamation 17
Table 21: Batches harvested for common crops, number, by season 18
Table 22: Marketing of harvest batches for all marketed crops by season, percent of batches harvested 18
Table 23: Livestock ownership and number of animals owned 19
Table 24: Hygiene knowledge of mothers/caregivers 19
Table 25: Nutrition knowledge of mothers/caregivers 20
Table 26: Health knowledge of mothers/caregivers: Maintaining a healthy body weight 21
Table 27: Health knowledge of mothers/caregiver: Danger signs of pregnancy and child illness 21
Table 28: Health knowledge of mothers/caregiver: Children's nutrition 22

Table 29: Health knowledge of mothers/caregiver: Diarrhea 23
Table 30: Health knowledge of mothers/caregiver: Children's heath 23
Table 31: Infant and Young Child Feeding (IYCF) practices 26
Table 32: Anthropometric measurements of women aged 19 to 45 years 27
Table 33: Anthropometric measurements of children aged 0 to 59 months 28
Table 34: Anthropometric measurements of children aged 0 to 59 months, by age and sex 28

LIST OF FIGURES

Figure 1: Household services and sanitation 9
Figure 2: Consumption of the 12 food groups in the Household Dietary Diversity Score in the 24 hours preceding the survey, all households 24
Figure 3: Consumption of the 12 food groups in the Household Dietary Diversity Score (HDDS) in the 24 hours preceding the survey, households disaggregated by HDDS 24
Figure 4: Women's consumption of the ten food groups in the Minimum Dietary Diversity for Women (WDD-W) indicator in the 24 hours preceding the survey 25
Figure 5: Women's consumption of the ten food groups in the Minimum Dietary Diversity for Women (MDD-W) indicator in the 24 hours preceding the survey, disaggregated by MDD-W scores 25
Figure 6: Consumption by all children aged 6 to 23 months of the seven food groups in the Child Dietary Diversity Score (CDDS) in the 24 hours preceding the survey 27
Figure 7: Consumption by children aged 6 to 23 months of the seven food groups in the Child Dietary Diversity Score (CDDS) in the 24 hours preceding the survey, disaggregated by CDDS scores 27

ABSTRACT

This paper characterizes smallholder farm households in Upper Egypt based on data from a comprehensive farm household survey. The results from the descriptive analysis in combination with findings from the global literature provide recommendations on how agricultural projects can be leveraged for improving nutrition. The importance of focusing on nutrition is underlined by relatively high undernutrition and overnutrition rates among the surveyed farm households: almost 18 percent of children under five years of age are stunted and almost 25 percent of them are at risk of being overweight. Agricultural interventions can impact nutrition through six main pathways, which are: 1) providing direct access to food from own production; 2) providing a source of income from which food and other nutrition needs can be met; 3) affecting food prices; 4) affecting women's social status and empowerment; 5) affecting women's time use from participation in agricultural work; and 6) affecting women's health and nutrition from engagement in agricultural activities.

The surveyed farm households purchase in the market most of the foods that they consume, cultivating crops primarily for commercial sale. This finding suggests that access to food markets and the level of food prices are key determinants of food and nutrition security among smallholder farm households in Upper Egypt. The survey analysis also identified potential levers for increasing agricultural productivity, including promoting more efficient use of water, fertilizers, and pesticides and improving farming practices to narrow the productivity gap between small-scale farmers and medium and large-scale farmers. As the role of women in agricultural activities in Upper Egypt is limited, the gendered pathways for leveraging agriculture for improved nutrition are less relevant.

However, to achieve positive impact on people's diet or nutritional status that goes beyond income and price channels, programs that reach farm households in Upper Egypt should include education and behavioral change communication activities, including on themes related to breastfeeding, dietary diversity, physical activities, and sugar intake. For such activities to be effective, it is important to consider the low literacy levels in the population.

1 INTRODUCTION

Tackling the burden of malnutrition requires global and national commitment and multi-sectoral collaboration (FAO 2016; Development Initiatives 2018), as well as the implementation of effective interventions at scale. To meet global and national nutrition targets, nutrition-specific interventions need to be complemented with nutrition-sensitive policies and programs that address the underlying determinants of malnutrition (Bhutta et al. 2013; Ruel and Alderman 2013; WHO 2014). Given the multifaceted nature of malnutrition, nutrition-sensitive interventions appear to be particularly promising in four sectors: agriculture, social safety nets, early child development, and schooling (Ruel and Alderman 2013). The role of the agricultural sector for improving nutrition has attracted particular attention (e.g., IFPRI 2012, 2019), and an increasing number of developing country governments, development organizations, and donors have invested in nutrition-sensitive agricultural programs (e.g., SUN 2019; USAID 2019).

Agricultural interventions can impact nutrition through six main pathways, as identified by Ruel and Alderman (2013). These pathways are: 1) providing direct access to food from own crop and livestock production; 2) providing a source of income from the sale of commodities produced and from wages for agricultural labor; 3) affecting food prices through the interplay of demand and supply in local, national, and international food markets that impacts food affordability and substitution; 4) affecting women's social status and empowerment, which governs their access to and control over resources; 5) affecting women's time use from participation in agricultural work; and 6) affecting women's health and nutrition from engagement in agricultural activities. The three gender-specific pathways for leveraging agriculture for improved nutrition are especially important for the nutritional status of young children.

While there is broad consensus about the validity of these agriculture-nutrition pathways, there is relatively weak empirical evidence on how to effectively leverage agricultural interventions for improving nutrition outcomes, and especially at scale. Ruel et al. (2018) review recent empirical evidence from 2014 and 2017 on nutrition-sensitive agricultural programs in developing countries, including findings from observational studies and impact evaluations using experimental methods. Focusing on recent impact evaluation studies, which, unlike observational studies, allow for drawing causal inferences, Ruel (2019) offers lessons that are of particular relevance for program design and implementation. Recent nutrition-sensitive agricultural programs overall were better designed, targeted, implemented, and evaluated than earlier such programs that had been reviewed elsewhere (Berti et al. 2004; Masset et al. 2012; Ruel and Alderman 2013). Such programs can indeed be expected to significantly improve the diet and nutrition-related program outcome indicators. All of these reviews of nutrition-sensitive agricultural programs found consistently that, to achieve a positive impact on people's diet or nutrition, the programs have to be explicitly designed with such objectives in mind. This means that the programs require a strong diet or other nutrition-focused component for the targeted population group. The programs also need to be well implemented if they are to have nutritional impact.

Ruel et al. (2018) documented positive impacts of nutrition-sensitive agricultural programs on household and individual dietary diversity, as well as on individual micronutrient intake and status. Dietary and nutritional impacts can be enhanced when the agricultural program components are combined with interventions for nutrition and health-related behavioral change communication (BCC); women's empowerment; water, sanitation, and hygiene (WASH) improvement; and micronutrient fortification of common food products. However, the review found that positive impacts on childhood stunting are hard to achieve even in well-designed and implemented

programs. The authors observe that nutrition-sensitive agricultural programs, particularly those that aim at reducing child growth faltering, are complex and quite challenging to implement, as such programs must address both the various possible causes of linear growth retardation while also addressing the agricultural objectives of the program. Ruel (2019) therefore recommends that nutrition-sensitive agricultural programs focus on improving access to and intake of high-quality, nutritious diets for all household members rather than on reducing childhood stunting. Moreover, nutrition-sensitive agricultural programs should be carefully tailored to the specific context of the target population, including local food environments, economic conditions, cultural norms, gender roles, and existing nutrient gaps.

Against this background, we descriptively analyze the context in which smallholder farmers in Upper Egypt operate, as well as their household living conditions and wealth and the nutrition and health status of household members.[1] The objective of this paper is to improve the design and implementation of nutrition-sensitive agricultural programs in Upper Egypt. Specifically, it aims to identify potential levers and challenges along the pathways through which agricultural interventions can impact nutrition. The analysis caters particularly to programs that adopt an agricultural value chain development approach for promoting horticulture. Value chain development has been identified as one promising strategy to leverage agriculture to improve nutrition and to tackle both undernutrition and overnutrition simultaneously (Gomez and Ricketts 2013; Hawkes 2009; Hawkes and Ruel 2012; Ruel and Alderman 2013). The coexistence of undernutrition and overnutrition in Egypt is extremely pronounced when compared to any other country around the world (Ecker et al. 2016). In this paper, we focus on small-scale farmers producing selected vegetables or herbs and spices.

This paper expands the body of observational studies in the literature on nutrition-sensitive agricultural interventions and differs from existing studies in several ways.

- First, the literature provides little empirical evidence on agricultural programs for promoting nutrition-sensitive value chains and, even less, for horticultural produce. Out of the 44 impact evaluation and observational studies reviewed by Ruel et al. (2018), there is only one study on nutrition-sensitive value chains – this looked at milk production.
- Second, we study an agricultural production system that is largely neglected in the literature on nutrition-sensitive agricultural interventions. Given the nearly complete absence of rainfall, farming in Upper Egypt is only possible under full irrigation. Farmland is hardly ever left fallow, and farmers produce year-round in two or three cropping seasons. None of the studies considered in the literature review by Ruel et al. (2018) looks at agricultural conditions that are close to those in Egypt.
- Finally, the literature has largely neglected countries in the Middle East and North Africa (MENA), focusing much more on farming systems in Asia and Africa south of the Sahara. None of the studies reviewed by Ruel et al. (2018) are in the MENA region.

For our analysis, we use baseline data from a smallholder farm household survey conducted in six governorates in Upper Egypt in April and May 2018 after the main winter cropping season for 2017/18 was completed. The survey is unique in the sense that it is the first large household survey in Egypt that provides comprehensive information on both agriculture and nutrition, as well as on health.

The rest of the paper is organized as follows: Section 2 describes the household survey data and the methods used in our analysis. Section 3 presents the results of our analysis, and Section 4

[1] Upper Egypt comprises the southern governorates of Egypt located upstream of Cairo along the Nile river.

concludes the paper by discussing the implications of our findings for nutrition-sensitive agricultural interventions in Upper Egypt.

2 DATA AND METHODS

This paper reports findings from a farm household survey that was conducted in six Upper Egypt governorates: Assiut, Beni Suef, Luxor, Menya, Qena, and Sohag. The data were collected as the baseline for the evaluation study of the USAID-funded Food-Security and Agribusiness Support (FAS) project, which is a five-year project that started in July 2015. The main project objective is to increase the income of smallholder farmers through developing horticulture value chains.[2] The two secondary objectives are to enhance food security of farm households and to improve the nutritional status of women and young children. To achieve the project's objectives over its lifetime, FAS has four project components: (1) improved on-farm production of sustainable horticulture value chains, (2) more-efficient postharvest processes, (3) improved marketing of agriculture crops and products in domestic and export markets, and (4) improved nutritional status, especially for women and children through nutrition-sensitive messaging (USAID & VEGA 2015, VEGA 2015, VEGA 2016). The main target population is farm households that cultivate vegetables, herbs and spices, or fruits at small scale and sell the products for income generation.

The evaluation is designed to assess how well the FAS project attained the project objectives using a quasi-experimental matching method. The baseline survey collected information on farm households that were enrolled to the program for the first time in the summer 2017 and winter 2017/18 seasons (treatment group), and on non-FAS households who reside in the same villages. A farm household was part of the treatment group for the evaluation if the farmer signed an individual FAS-facilitated forward contract with a buyer or committed to a FAS-facilitated forward contract between the representing association and a buyer. To construct a valid counterfactual for this treatment group, non-FAS, horticulture-based smallholder farm households were randomly selected within the villages where the FAS partner associations are located. These comparison households were identified using a random walk method. To verify FAS beneficiary status and to randomly select the comparison farmers, a household listing survey was conducted prior to the farm household survey within the survey communities. Sampled households were restricted to farm households, with at least one member of the household being a smallholder farmer, owning less than 10 feddans of land, and having ever cultivated horticultural crops, i.e., fruits, vegetables, or herbs and spices. Data were collected in April and May 2018.

We identified the treatment group based on a list of FAS beneficiaries. FAS farmers are organized through their belonging to farmer associations or are members of a group of farmers who belong to the same agricultural cooperatives and are engaged in horticulture. FAS supports value-chain development for a large variety of crops, so support often is provided for the production of more than one herb or spice within a single association. We focus on the main value chains of green beans, onions, tomatoes, sweet potatoes, geraniums, and other herbs and spices, and on the FAS associations that are engaged in these value chains and have a substantial number of participating farmers. The survey sample included 34 FAS associations with at least 20 farmers in each.

In a next step, we stratified the sample. A stratum was defined as a group of farmers that (1) were all from one association, (2) were enrolled into FAS in the same agricultural season, and (3) were from the same village, if there were at least 20 farmers per village. The final sample

[2] Smallholder farmers are defined as farmers with a farm size of 10 feddans (1 feddan = 0.42 hectare = 1.038 acre) or less per household (CNFA 2016).

included farmers from 52 strata. In large strata, 40 farmers were randomly selected to be interviewed by applying a random selection algorithm to the FAS beneficiary lists, while in small strata all FAS farmers were selected. Additionally, up to 10 farmers per stratum were randomly selected to be interviewed if any of the selected farmers were unavailable at the time of the survey or refused to participate. The target sample size for the treatment group was 1,918 FAS farm households.

A random walk approach was used to identify the comparison households. Unlike in many previous surveys using the random-walk method, which defined the starting point at a central landmark in a cluster, e.g., main market, mayor's office, school, or bus stop, we defined the starting point flexibly to reduce the so-called "main street bias" (Galway et al. 2012; Bauer 2014, 2016). The starting point was the address of the last visited FAS farm household. FAS farm households and non-FAS farm households were visited alternately, starting with a FAS household. This procedure also increased the probability that a visited non-FAS farm household had agricultural and infrastructural conditions that were similar to the previously visited FAS farm household, yielding better matches in any matching estimation-based analyses. Applying walking route rules and the household listing questionnaire, one valid comparison household was randomly selected for each successfully interviewed FAS household. The sampling areas to apply the random-walk method were spatially limited by the boundaries of the villages where the FAS households were located. In strata with less than 50 selected FAS households, the sample was oversampled for every fifth comparison household by randomly selecting an additional comparison household. The targeted sample size for the comparison group was 2,111 farm households, equivalent to 110.1 percent of the targeted treatment households.

The baseline survey was administered to a total of 2,246 farm households, 1,129 enrolled in FAS and 1,117 in the comparison group. For the descriptive analysis in this paper, we pool the data from the treatment and comparison groups and present summary statistics for the combined dataset only. Mean difference tests between the groups, which are not presented here, indicate that there are no statistically significant differences between the two groups on key agricultural output variables, such as yields for the promoted horticultural crops, and on dietary and nutrition outcome indicators, such as household and individual dietary diversity and child and maternal nutrition.

3 RESULTS

The farm household survey captures indicators that represent important factors about household livelihoods, health and nutrition status, and agricultural activities. These factors are presented in this section, and their relation to nutrition-sensitive agricultural interventions is discussed.

3.1 Demographic and socioeconomic characteristics

On average, farm households in the sample had 5.1 members (Table 1), similar to the average farm household size observed from Egypt's nationally representative household income and expenditure survey (HIECS) in the Upper Egyptian governorates where the sample was selected (HIECS 2015). There were 1.2 women of reproductive age (15 to 49 years old) and 0.6 children under five years of age on average per household. The dependency ratio—the ratio of those who are typically not in the labor force (under 15 and older than 65 years) to those who are typically in it (between 15 and 64 years old)—was 0.8. This indicator is used, for example, to measure the availability of household resources for investments in human capital formation of young children (Hadley et al. 2011; Lam and Marteleto 2008). A dependency ratio of 0.8 indicates that the number of dependents does not exceed the number of potential earners. Income generating activities can have a positive impact on

household well-being for those with a dependency ratio less than 1.0, since these households are not labor constrained; which can also affect the children's nutritional status positively (Hadley et al. 2011).

Table 1: Demographic characteristics of interviewed farm households

	Percent or mean	Standard deviation
Household members, number	5.1	2.03
Adults (≥ 18 years old), number	2.8	1.21
Minors (< 18 years old), number	2.2	1.81
Dependency ratio	0.8	7.6
Women 15-49 years old, number	1.2	0.80
Children 0-59 months old, number	0.6	0.80
Male headed households, %	97.6	--
Age of household head, years	46.5	12.8
Age of spouse of head, years	39.3	11.2
Observations	2,246	

Source: Own estimation, based on farm household baseline survey data.

Average educational attainment of women in the sample is less than that of men. As Table 2 shows, 42.2 percent of household heads did not complete primary school, and about 30 percent did not receive any formal education. 60.1 percent of spouses did not complete primary education, and about half of them did not receive any formal education at all. In addition, more than half of the mothers of children 0 to 5 years old interviewed cannot read (57.5 percent), and less than one-third are able to read fluently (Table 3).

Table 2: Educational attainment of household head and spouse

	Percent
Share of households where household head:	
Has no education – never attended school	29.7
Has incomplete primary school – completed 1-5 grades of primary	12.5
Has completed primary school – completed grade 6 of primary	5.5
Has incomplete secondary school – completed any grades of preparatory or 1-2 grades of secondary	9.0
Has completed secondary school – completed grade 3 of secondary	30.8
Head has secondary school or more – completed secondary and attended higher education	12.3
Share of households where spouse:	
Has no education – never attended school	50.4
Has incomplete primary school – completed 1-5 grades of primary	9.7
Has completed primary school – completed grade 6 of primary	4.1
Has incomplete secondary school – completed any grades of preparatory or 1-2 grades of secondary	13.4
Has completed secondary school – completed grade 3 of secondary	17.1
Head has secondary school or more – completed secondary and attended higher education	5.0
Observations	2,114

Source: Own estimation, based on farm household baseline survey data.

Table 3: Literacy of mothers of children aged 0 to 5 years

	Percent
Cannot read at all	57.5
Can read a little	11.9
Can read everything	30.6
Observations	1,817

Source: Own estimation, based on farm household baseline survey data.

Farming plays an important role in the surveyed households, but this is done with little involvement from women. Given the selection of the sample for this study, all households have at least one person who identified farming as his or her primary occupation. Farming is mostly done by men – only a few women reported farming as their first or second occupation (Table 4). In most cases, the household head was the person who provided the information on farming activities in the household (95.4 percent). When asked about the main occupation of the household head, 78.6 percent of households reported farming, with a large share of these individuals farming on their own land (61.8 percent). In 12.3 percent of the surveyed households, the spouse reported farming as a main occupation, and 11.6 percent of the spouses reported it as a secondary occupation. Among those with a secondary occupation, the majority reported agriculture as their second occupation (70 percent). Furthermore, only 13.7 percent of households had at least one woman whose main occupation was in agriculture. These results show that women are not involved in agricultural activities as much as men, which has implications for women's involvement in agriculture-related decision-making, access to and control over productive resources, control of income, leadership, and time allocation (Alkire et al. 2013, Meinzen-Dick et al. 2019).

Table 4: Main and secondary occupation of household head and spouse

	Percent	Observations
Share of households where:		
Head is the main farmer and a main occupation is farming	95.4	2,246
Head farms own land as a main occupation	61.8	2,246
Head farms someone else's land as a main occupation	16.8	2,246
Head is public sector employee as a main occupation	12.4	2,246
Share of households where spouse has main occupation as:		
Farmer	12.3	2,114
Housewife	84.0	2,114
Share of households where:		
Head has secondary occupation	24.3	2,246
Spouse has secondary occupation	11.6	2,114

Source: Own estimation, based on farm household baseline survey data.

Food constituted 59.9 percent of total monthly expenditure among the surveyed farm households. Households purchased the majority of the food they consumed, whereas 19.6 percent of the value of food consumed on average came from own farm-produced food. The large majority of expenditure on food was for food consumed at home (93.4 percent). On average, households spent 6.5 percent of total food expenditures on outside-home foods. Within different food categories, households spent the most on animal source food (37.6 percent), followed by cereals (13.2 percent), fats and oils (11.3 percent), vegetables (10.0 percent), fruits (6.1 percent), and sugar (6.0 percent). Subsidized food items made up 12.7 percent of monthly per capita food expenditures.

When comparing expenditures across household expenditure quintiles, variation is seen in expenditure patterns. Food makes up 54 percent of total expenditures for households from the richest quintile, whereas those from the poorest household quintile spend 66 percent of their total expenditure on food (Table 5). Across all food items, per capita expenditures in absolute terms (in EGP) increase from poorer to richer quintiles. However, for most food items, there is little variation in terms of their share of food consumption. For example, all household groups spent on average about 10 percent of the value of total food consumption on vegetables and about 11 percent on fats and oils. Larger variation can be found for animal source food, where the share of consumption spent increases from poorer to richer quintiles; and for subsidized food where poorer households tended to spend a larger share of total food expenditures than did the richer households.

Table 5: Food and non-food expenditure per capita, by item and expenditure quintile, average

	Poorest quintile	2nd	3rd	4th	Richest quintile	All
Food expenditures, EGP	377.3	392.8	414.2	435.1	513.8	426.6
Food in total expenditure, %	*66.5*	*63.3*	*60.9*	*59.5*	*53.6*	*59.9*
Expenditures for food consumed at home, EGP	345.0	363.1	385.2	410.1	490.6	398.8
Food consumed at home, % share of food expend.	*91.4*	*92.4*	*93.0*	*94.3*	*95.5*	*93.5*
Cereals, EGP	51.5	51.0	53.6	55.6	69.5	56.2
Cereals, % share of food expenditures	*13.6*	*13.0*	*12.9*	*12.8*	*13.5*	*13.2*
Vegetables, EGP	37.8	39.2	42.7	44.5	50.0	42.8
Vegetables, % share of food expenditures	*10.0*	*10.0*	*10.3*	*10.2*	*9.7*	*10.0*
Animal source foods, EGP	138.2	147.3	152.2	162.8	200.9	160.3
Animal source foods, % share of food expenditures	*36.6*	*37.5*	*36.7*	*37.4*	*39.1*	*37.6*
Fruits, EGP	25.5	25.1	25.2	24.8	29.8	26.2
Fruits, % share of food expenditures	*6.8*	*6.4*	*6.1*	*5.7*	*5.8*	*6.1*
Sugars, EGP	21.3	23.1	24.6	27.8	31.4	25.6
Sugars, % share of food expenditures	*5.6*	*5.9*	*5.9*	*6.4*	*6.1*	*6.0*
Fats and oils, EGP	42.6	44.3	46.5	49.6	57.6	48.1
Fats and oils, % share of food expenditures	*11.3*	*11.3*	*11.2*	*11.4*	*11.2*	*11.3*
Subsidized foods, EGP	52.7	54.9	53.1	51.0	58.9	54.1
Subsidized foods, % share of food expenditures	*14.0*	*14.0*	*12.8*	*11.7*	*11.5*	*12.7*
Expenditures for food consumed outside home, EGP	33.2	29.7	29.1	25.0	23.2	28.0
Food consumed outside home, % share food expend.	*8.8*	*7.6*	*7.0*	*5.7*	*4.5*	*6.6*
Value of food from own production, EGP	79.0	75.1	76.2	75.8	111.4	83.5
Food from own production, % of total food consumption	*20.9*	*19.1*	*18.4*	*17.4*	*21.7*	*19.6*
Non-food expenditures, EGP	190.2	227.6	265.9	296.7	445.2	285.0
Non-food expenditure in total expenditure, %	*33.5*	*36.7*	*39.1*	*40.5*	*46.4*	*40.1*
Total expenditure on food and non-food, EGP	567.5	620.4	680.1	731.8	959.0	711.6

Source: Own estimation, based on farm household baseline survey data.

Richer households also spend more on non-food goods and services, compared to poorer ones. Expenditures on non-food goods complement the analysis of households' living standards, and for some categories, like healthcare, indicate if households devote resources to acquire goods and services that can contribute to improved health and nutrition (Gillespie, Harris, and Kadiyala 2012). Total per capita non-food expenditures represented 40.1 percent of total household expenditures on average, and the amount spent by the richest group in the sample was found to be more than double that of households in the poorest quintile.

We selected four categories of major non-food expenditures for further discussion: social events (weddings, funerals, and dowry), schooling (tuition fees, uniforms, books, and school supplies), healthcare (medicines, public and private hospitalization, pharmaceutic products, and health services in general), and energy (gas and electricity) (Table 6). The highest non-food costs are for healthcare expenditures. On average, households spent 20.0 percent of total non-food expenditures on healthcare. This burden was slightly higher for poorer households in relative terms, despite richer households spending significantly more than the poorest households. The second-highest non-food expenditures are on energy, which accounted for 15.1 percent of non-food expenditures for the average household in the sample. Similar to healthcare expenditures, poorer households spent a higher share on energy than richer households – the average household in the first quintile spent the equivalent of 20.6 percent of total non-food expenditures, whereas, those at the top quintile allotted only 10.5 percent. Average expenses per capita for schooling were 8.0

percent of total non-food expenses. A relatively modest 2.0 percent of non-food expenditures was spent on social events, although this share increased to 5.1 percent for the richest quintile.

Table 6: Monthly non-food expenditures per capita, by item and expenditure quintile, average

	Poorest quintile	2nd	3rd	4th	Richest quintile	All
Total non-food expenditures, EGP	190.2	227.6	265.9	296.7	445.2	285.0
Social events, EGP	0.7	2.6	4.1	5.2	22.5	7.0
Social events, % share of non-food expenditures	*0.4*	*1.1*	*1.5*	*1.8*	*5.1*	*2.5*
Schooling, EGP	6.4	11.9	16.6	28.6	50.0	22.7
Schooling, % share of non-food expenditures	*3.4*	*5.2*	*6.2*	*9.6*	*11.2*	*8.0*
Healthcare, EGP	46.9	52.4	51.7	60.2	74.1	57.1
Healthcare, % share of non-food expenditures	*24.7*	*23.0*	*19.4*	*20.3*	*16.6*	*20.0*
Energy, EGP	39.2	41.9	44.3	43.1	46.8	43.1
Energy, % share of non-food expenditures	*20.6*	*18.4*	*16.7*	*14.5*	*10.5*	*15.1*
Other non-food expenditure	97.0	118.8	149.2	159.6	251.8	155.1
Other non-food expenditure, % share non-food expend.	*51.0*	*52.2*	*56.1*	*53.8*	*56.6*	*54.4*

Source: Own estimation, based on farm household baseline survey data.

About one-third of households received income from pensions or social protection programs, but most households were registered in the food subsidy system. The amount of social protection received was equivalent to 23.3 percent of average total per capita expenditures observed for households in the sample (Table 7). 88.6 percent of households benefited from the food voucher program that provides beneficiaries with access to subsidized foods using smart cards. Among these households, 4.1 household members on average were registered in the food voucher program. This is consistent with national numbers for Egypt (Ecker et al. 2016).

Table 7: Receipt of pensions of support from social programs by households

	Estimate	Standard deviation	Obser-vations
Households in which anyone received any pensions or social programs during the past 12 months, %	33.9		2,246
Monthly amount received per household, EGP, mean	518.7 *	341.3	762
Monthly amount received per capita, EGP, mean	125.5 *	131.1	762
Households in which any member has a smart card, %	88.6		2,246
Number of members registered on smart card, mean	4.1	1.9	1,991

Source: Own estimation, based on farm household baseline survey data.

Few households paid rent on their accommodation, as the majority of interviewed households lived in their own home. Among the sample households, 85.7 percent lived in their owned house, whether solely or jointly owned, while 14.3 percent rented it or used it for free. Most families lived in a freestanding house or an apartment (60.3 and 35.7 percent, respectively), and only a small share of the households shared their dwelling with other families (5.2 percent). The average house had 3.3 rooms and was constructed mostly with bricks and concrete. For 82 percent of dwellings, concrete was used to construct the roof, and bricks were used to construct the walls for 95 percent. However, around one out of five families lived in houses with dirt floors (Table 8). Living in a house with dirt floor has been associated with parasitic infections, particularly among small children (Cattaneo et al. 2009; Miguel and Kremer 2004; Morales-Espinoza et al. 2003).

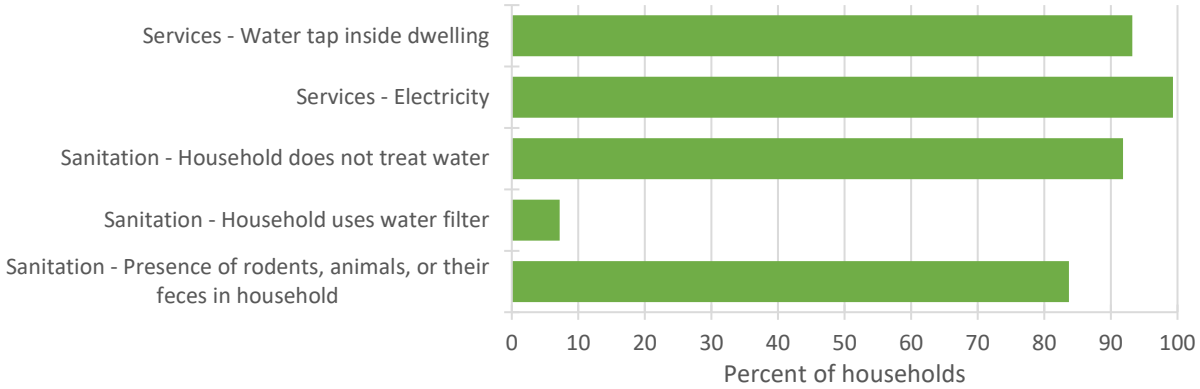
Table 8: Housing conditions

Home ownership	
Owned, %	75.5
Owned jointly, %	10.2
Rented or using for free, %	14.3
Type of dwelling	
Apartment, %	35.7
Free standing house, %	60.3
Single Room, %	4.0
Share dwelling, %	5.2
Rooms, number (SD)	3.3 (1.08)
Type of floor	
Dirt, %	19.9
Concrete or cement, %	38.7
Ceramic tiles, %	19.2
Cement tiles, %	22.2
Observations	2,246

Source: Own estimation, based on farm household baseline survey data.
Note: SD = standard deviation

Most households had water treatment facilities inside their households, but few households treated their water. Nine out of every 10 households had a tap inside their dwelling as a water source. However, only 8 percent of households treated the water they consumed, and in 83.7 percent of the households interviewed, the presence of goats, chickens, rabbits, rodents, or their feces was observed (Figure 1). Water, sanitation, and hygiene (WASH) interventions have a positive impact on children's health and nutrition (Ruel et al. 2018).

Figure 1: Household services and sanitation



Source: Own estimation, based on farm household baseline survey data.

Survey households own basic assets, such as refrigerators, but ownership of high-value appliances, such as air conditioners, freezers, or dishwashers, was rare. Practically all households owned a refrigerator (97.2 percent) and had access to electricity (99.3 percent), as this appliance is essential for food storage and, thus, the household's food security. Only a small proportion of households in the sample possessed any means of transportation, like a car or motorcycle. A total of 6.3 percent had a car, 22.3 percent owned a motorcycle, and 5.2 percent a motor tricycle (Table 9). With limited ownership of means of transportation, household's nutrition and food security depends on the availability of and access to (affordability) food in the local market.

Table 9: Household asset ownership

Major household assets owned, mean number (standard deviation)			**15.3 (2.9)**
Share of households owning, %			
Car, truck, or minibus	6.3	Mobile phone	92.3
Motorcycle or motor scooter	22.3	Computer	8.8
Motor tricycle	5.2	Internet	4.6
Bicycle	1.2	Television	98.9
Refrigerator	97.2	Satellite dish	98.2
Freezer	2.5	Radio	9.3
Stove	99.2	Bed	98.6
Oven	89.4	Mattress	98.5
Dish washer	0.2	Sofa	86.9
Fully-automatic washing machine	5.1	Chairs	75.8
Half-automatic washing machine	18.2	Table	76.7
Manual washing machine	78.9	*Tablia* (traditional low dining table)	76.9
Water heater	41.3	*Zeer* or *kola* (clay pot water cooler)	52.1
Air conditioner	3.9	Wrist watch	27.8
Electric fan	97.2	Gold/jewelry	25.3
Landline	1.2	Additional real estate	2.8
Smartphone	35.6	Microwave	0.4
Observations	2,246		

Source: Own estimation, based on farm household baseline survey data.

Mobile phones are owned by 92.3 percent of the households, and in one-third of households at least one member owns a smart phone. Ownership of computers and an internet connection is low at less than 10 percent for both. Almost all households reported owning a television and satellite dish, but less than 10 percent own a radio.

3.2 Agriculture

Surveyed farmers held on average 2.30 and 2.24 feddans of agricultural land in the summer 2017 and the winter 2017/18 seasons, respectively, including both cultivated and fallow land (Table 10). This land generally is in a single parcel or distributed over two fields. The agricultural land area of farmers who farmed during both the summer season 2017 and the winter season 2017/18 increased by an average of 7 percent for the winter season. This added land in the later season may have come from other farmers exiting or downscaling their farming operations, enabling remaining farmers to expand their operations, or from newly reclaimed land.

Table 10: Farmland usage, by season

	Summer season 2017		**Winter season 2017/18**	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**
Total agricultural land, feddans	2.30	2.88	2.24	2.69
Cultivated land as share of total land, %	96.6	12.4	99.7	3.9
Harvested land as share of cultivated land, %	94.3	17.8	62.8	40.8
Fields harvested, number	1.62	0.91	1.69	0.94
Agricultural land ratio: winter to summer season, n=1,925	1.07	0.71		
Observations	1,980		2,182	

Source: Own estimation, based on farm household baseline survey data.

Farmers cultivated almost all their farmland during the winter season (99.7 percent), and most of it during the summer season (96.6 percent). The low average share of fallow land points to the intensive nature of farming systems in Upper Egypt. However, it should be noted that, even if no crops are cultivated, most fields need to be irrigated to maintain both the soil quality and the irrigation channels and to prevent desertification.

The majority of interviewed farmers cultivate all year round – 85.7 percent of surveyed farmers cultivated their land during both the summer season 2017 and the winter season 2017/18.[3] Most farmers who cultivated crops during only one season did so during the winter season – 82.4 percent of such farmers. These households may have newly entered farming during the winter season by, for example, starting farms on reclaimed land in the desert.

Somewhat more than two-thirds of all fields were owned by the interviewed farm households, while the rest of the fields were mostly rented for cash payment (Table 11). The land rent was about EGP 7,800 per feddan, with no real price differences between seasons. Very few fields were cultivated under a sharecropping system – only 1.5 percent (49 fields) in the summer season 2017 and 2.1 percent (76 fields) in the winter season 2017/18, with most sharecropping arrangements being found in three districts – Samalot in Menya, Dar-el-Salam in Sohag, and Qeft in Qena. The most common arrangement under sharecropping is that the farmer hands over half of the harvest to the field owner as payment on the lease.

Table 11: Characteristics of cultivated fields, by season

	Summer season 2017		Winter season 2017/18	
	Mean	Standard deviation	Mean	Standard deviation
Field is …				
Owned by farming household, %	69.2		67.8	
Rented by farming household, %	29.3		30.1	
Located in New Lands, %	14.0		19.6	
Prepared by hired tillage service, %	93.3		90.9	
Irrigated by flooding, %	99.6		99.3	
Irrigated by canal/river water, %	79.2		75.4	
Field size, feddans	1.22	1.37	1.29	1.59
Land rent per season, EGP/feddan [a]	7,799	3,424	7,830	3,928
Tillage service costs, EGP/feddan [b]	541	397	553	330
Observations	3,202		3,678	

Source: Own estimation, based on farm household baseline survey data.
Note: [a] Estimates are for rented fields in the summer season (N = 934) and the winter season (N = 1,083).
[b] Estimates are for fields prepared by hired tillage service in the summer season (N = 2,987) and the winter season (N = 3,345).

Few cultivated fields are in the New Lands, the land areas reclaimed from the desert. Most cultivated fields are in the Old Lands located in the Nile Valley, where agricultural crops have been cultivated for thousands of years. Table 11 shows that a higher percentage of fields was in the New Lands in the winter season 2017/18 (19.6 percent) compared to the summer season 2017 (14.0 percent). This reflects land expansion among the interviewed farmers. The average field size in the New Lands is 1.2 to 1.3 feddans. Fields in the New Lands are significantly larger than in the Old Lands.

[3] There are nine households that reported to have not cultivated agricultural crops in the summer season 2017 and the winter season 2017/18. These households were dropped from the sample.

Almost all fields were irrigated by flooding. Modern water-saving irrigation technology, such as drip irrigation or sprinkler systems, was virtually absent among the interviewed farmers (Table 12). This makes diesel-powered water pumps vital for agricultural production. Over two thirds of the farmers own their pumps; all others who need water pumped into their fields pay for the service.

Table 12: Access to irrigation infrastructure

	Ownership		Renting (if needed)		Private lender	
	Percent	Obser-vations	Percent	Obser-vations	Percent	Obser-vations
Water pump	70.7	2,246	95.4	631	60.3	630
Drip irrigation	1.8	2,246	34.1	138	85.1	47

Source: Own estimation, based on farm household baseline survey data.

Somewhat more than three-fourths of all fields were irrigated with water taken from irrigation canals fed by the Nile or directly from the Nile and tributaries. The proportion of fields irrigated with water taken from boreholes and wells was higher during the winter season 2017/18 (24.2 percent) than the summer season 2017 (20.5 percent). This can be explained by the larger numbers of fields in the New Lands that were cultivated in the winter season. Several of the reclaimed land areas in the desert are irrigated by pumping fossil water from natural underground reservoirs. Generally, farmers follow a strict irrigation schedule that varies between seasons and across plant-growing stages depending on crop, evaporation levels, and water storage capacity of the soil. Table 13 shows that, during the crop planting period, 30 to 40 percent of all fields was irrigated at least once per day, and another 30 to 40 percent was irrigated every 6 to 10 days.

Table 13: Field irrigation frequency during the planting period, by season

	Summer season 2017	Winter season 2017/18
At least once per day, %	31.4	38.5
Every 2 to 5 days, %	8.5	6.5
Every 6 to 10 days, %	40.3	32.3
Less frequently, %	19.9	22.7
Observations	3,202	3,678

Source: Own estimation, based on farm household baseline survey data.

Most farmers within the sample produced cereals as their main crop, complementing cereal production with the production of vegetables, roots, and tubers, herbs and spices, fodder, or other seasonal non-food crops. Few farmers produced pulses and seeds, with peanuts being the most produced crop in this group. 88 and 68 percent of all farmers produced cereals in the summer season 2017 and the winter season 2017/18, respectively. Maize is the principal cereal grown in the summer, while wheat is the dominant cereal produced in the winter season. Table 14 shows that these farmers planted cereals on nearly 80 percent of their cultivated area in the summer season, and on about 60 percent in the winter season. Very few farmers produced fruits, and if so, they cultivated perennial fruit crops, such as tangerines, table grapes, and bananas.

Table 14: Production patterns for common crops, by season

	Farmers producing, %		Cultivated area per farmer producing, feddans						Crop area as share of total area cultivated by farmer, %	
			Summer season 2017			Winter season 2017/18				
	Summer season 2017	Winter season 2017/18	Mean	SD	N	Mean	SD	N	Summer season 2017	Winter season 2017/18
Cereals	*88.0*	*67.8*	*1.5*	*2.1*	*1,742*	*1.2*	*1.6*	*1,480*	*79.2*	*60.2*
Maize	87.6	2.0	1.5	2.0	1,735	1.1	1.5	44	79.3	46.4
Wheat		66.9				1.2	1.6	1,459		59.6
Vegetables, roots, & tubers	*25.2*	*33.7*	*0.9*	*0.9*	*498*	*1.4*	*2.2*	*736*	*48.5*	*55.9*
Green beans	17.8	7.7	0.9	0.8	352	1.1	0.9	168	49.2	48.5
Onions		19.8				1.2	1.5	432		45.4
Potatoes		6.1				1.4	1.7	133		44.0
Tomatoes		4.4				1.3	2.2	97		51.9
Herbs & spices	*9.8*	*20.2*	*1.6*	*1.4*	*195*	*1.7*	*1.8*	*441*	*65.6*	*64.5*
Basil	7.4	2.0	1.3	1.0	147	0.9	0.7	43	58.0	43.2
Fennel		6.3				2.1	2.2	137		67.8
Marjoram		5.7				1.7	1.3	124		60.2
Garlic		5.1				0.7	0.5	111		40.6
Pulses & seeds	*3.4*	*1.3*	*1.0*	*1.0*	*67*				*41.7*	
Peanuts	2.1		1.0	0.8	41				45.2	
Fruit trees	*0.5*	*0.3*								
Fodder & other non-food crops	*19.7*	*55.8*	*1.1*	*1.2*	*391*	*0.9*	*0.9*	*1,218*	*50.5*	*48.0*
Clover	10.3	49.3	0.8	0.9	203	0.7	0.6	1,075	46.4	42.9
Sugar beets		2.2				1.6	1.6	49		44.2
Observations	1,980	2,182								

Source: Own estimation, based on farm household baseline survey data.
Note: Crops are included if they are cultivated by at least 2 percent of all farmers by season. This is equivalent to at least 40 household observations per season; Crop and crop group estimates are reported if they are based on at least 40 household observations.

The winter season is the main season to produce vegetables, roots and tubers, herbs and spices, and fodder and other seasonal non-food crops. Vegetables were cultivated by about one-fourth and one-third of all farmers in the summer season 2017 and the winter season 2017/18, respectively. Vegetable farmers allocated roughly half of their cultivation area to vegetables, with a somewhat larger share in the winter season than in the summer season. The most common vegetables are green beans, onions, potatoes, and tomatoes. About 20 percent of all interviewed farmers cultivated herbs and spices in the winter season 2017/18, and about 10 percent in the summer season 2017. The most commonly cultivated herbs and spices were basil, fennel, marjoram, and garlic. Farmers of herbs and spices planted these crops on about 65 percent of their cultivated area in both the summer season 2017 and the winter season 2017/18. Meanwhile, fodder and other seasonal non-food crops were cultivated by more than half of all surveyed farmers in the winter season 2017/18 (55.8 percent) and by about one-fifth of farmers in the summer season 2017. The most common crops of this group were clover and sugar beets. Because of the lack of grassland, clover is produced as feed for medium and large livestock. Farmers that cultivate fodder and other seasonal non-food crops reserved about half of their cultivated area for producing these crops during both the summer and winter season.

Input use patterns show that highly intensive farming is practiced. Synthetic fertilizer use was nearly universal (Table 15). In the winter season—the main horticulture season, every farmer applied synthetic fertilizer on the most common vegetables and herbs and spices, except for garlic. The most common fertilizers are urea (or azote) and nitrate, both of which are available to government-supported farmers at subsidized prices from agricultural cooperatives (Table 16).

Pesticides use is also very common, especially in vegetable production. About 80 percent of farmers sprayed their green beans in the summer season 2017,[4] and around 90 percent of farmers applied pesticides to onions and tomatoes in the winter season 2017/18. Among the herbs and spices, pesticide application is most common for garlic and basil, while the relatively low application rate for fennel and marjoram production may be partly due to the fact that the harvest was not completed in all surveyed villages at the time of the farm household baseline survey. Among the different types of pesticides, insecticides are most commonly used (Table 17). The most common insecticides are Lambda, Malathion, and Lannate, which are also common products outside of Egypt.

Table 15: Input use in the production of common crops, by season

	Synthetic fertilizer		Pesticides		Hired workers		Observations	
	Summer season 2017	Winter season 2017/18	Summer season 2017	Winter season 2017/18	Summer season 2017	Winter season 2017/18	Summer season 2017	Winter season 2017/18
Maize	99.2	90.9	42.5	34.1	80.2	72.7	1,735	44
Wheat		99.7		44.2		83.8		1,459
Green beans	99.4	100.0	79.8	26.8	95.2	95.8	352	168
Onions		100.0		88.2		92.4		432
Potatoes		100.0		69.9		97.0		133
Tomatoes		100.0		91.8		76.3		97
Basil	99.3	100.0	46.9	67.4	94.6	100.0	147	43
Fennel		100.0		25.5		69.3		137
Marjoram		100.0		59.7		92.7		124
Garlic		99.1		76.6		89.2		111
Peanuts	100.0		31.7		75.6		41	
Clover	96.1	94.2	18.2	17.9	24.1	35.3	203	1,075
Sugar beets		100.0		24.5		85.7		49

Source: Own estimation, based on farm household baseline survey data.
Note: Crops are included if they are cultivated by at least 2 percent of all farmers by season. This is equivalent to at least 40 household observations per season. Crop estimates are reported if they are based on at least 40 household observations. The number of observations (N) refers to the number of farmers producing the specified crop.

[4] The substantially lower prevalence of pesticide application in the winter season 2017/18 than in the summer season 2017 requires further investigation. It may be that farmers use pesticides to prepare fields for the following season and that this field preparation had not yet been carried out before the survey was conducted.

Table 16: Type of fertilizers applied, percent of farm households applying fertilizer

	Percent
Urea/azote, subsidized	15.4
Urea/azote	23.4
Nitrate, subsidized	7.4
Nitrate	14.3
Super phosphate	18.7
Other synthetic fertilizers	5.1
Manure	15.8

Source: Own estimation, based on farm household baseline survey data.
Note: N = 8,050. The number of observations (N) denote the application of fertilizers on any field in the summer season 2017 or the winter season 2017/18.

Table 17: Type of pesticides applied, percent of farm households applying pesticides

	Percent
Lambda (insecticide)	19.0
Malathion (insecticide)	14.0
Lannate (insecticide)	7.2
Ridomil (fungicide)	8.4
Other pesticides	51.4

Source: Own estimation, based on farm household baseline survey data.
Note: N = 3,077. The number of observations (N) denote the application of pesticides on any field in the summer season 2017 or the winter season 2017/18.

Most farmers hired farm workers or agricultural machinery services to conduct specific tasks during crop production, such as for planting, weeding, spraying, or harvesting, in addition to land preparation. Especially in the production of vegetables and herbs and spices that are harvested all at once, almost all interviewed farmers hired farm workers during the summer season 2017 and winter season 2017/18 (Table 15). These workers were likely harvest hands in most cases. Outsourcing of farm labor was also very common for wheat and maize production. This likely is due to hiring agricultural machinery services, given the low level of ownership of tractors and other farm machinery, including tractor-mounted seeders and sprayers, fertilizer spreaders, and combine harvesters.

Table 18: Access to tractors and hand sprayers

	Ownership		Renting (if needed)		Private lender	
	Percent	Obser-vations	Percent	Obser-vations	Percent	Obser-vations
Tractor	9.2	2,246	98.8	2,015	73.3	2,008
Hand sprayer	36.3	2,246	96.8	1,337	69.3	1,328

Source: Own estimation, based on farm household baseline survey data.

Ownership of large agricultural assets, such as tractors, is low among the sample farm households, but access was nearly universal. Table 18 shows that less than 10 percent of the farmers own a tractor. Almost all farmers who use a tractor rent it when needed (98.8 percent); only a few farmers obtain a tractor for their use free of charge from neighbors, friends, or relatives. In almost three-fourths of all cases, the lender of the tractor or provider of the tractor service is a private entrepreneur. In all other cases, the lender is a neighbor, friend, or relative who will expect payment for the tractor service. Farmer associations and agricultural cooperatives do not seem to play a big role in providing tractor services in the surveyed communities, or at least none of the interviewed farmers rented from these organizations.

Smaller key horticultural assets, such as hand sprayers for pesticide application, are owned by more than one-third of the interviewed farm households. Similar to tractors, if hand sprayers are needed, almost all non-owning farmers (96.8 percent) rent them and mostly from private lenders (69.3 percent) or neighbors, friends, or relatives—not from associations.

All farmers who did not own a tractor and tillage equipment hired a service for land preparation, which typically includes ploughing and field leveling. More than 90 percent of all cultivated fields were prepared by hired machinery services in both seasons. The average cost of this service was around EGP 550 per feddan.

At the time of the farm household survey in April and May 2018, farmers had harvested 62.8 percent of their land cultivated during the winter season. Some farmers reported that they did not harvest all of their land cultivated during the summer season 2017. A possible explanation is that some fields were cultivated with perennial crops that did not (yet) produce harvests in that season. Table 19 reports the yields of the most commonly cultivated crops, for those crops for which a sufficient number of observations are available. In addition to means, medians are reported, since they provide better average estimates for skewed distributions resulting from outliers, for example.[5] Mean and median yields are close for all crops, except for basil. For green beans, both the ratio of seasonal means and the ratio of seasonal medians suggest that yields of the winter season 2017/18 exceeded yields of the summer season 2017/18 by around 67 percent.

Table 19: Harvest yields and marketing of common crops, by season

	Yield (mt/feddan)								Share of harvest sold (%)					
	Summer season 2017				Winter season 2017/18				Summer season 2017			Winter season 2017/18		
	Mean	SD	Median	N	Mean	SD	Median	N	Mean	SD	N	Mean	SD	N
Maize	1.9	1.4	1.7	1,624					28.8	37.3	1,679			
Wheat					1.8	1.0	1.8	670				16.0	31.3	670
Green beans	2.7	2.0	2.4	253	4.5	2.0	4.0	161	82.8	36.3	253	83.8	33.3	161
Onions					12.4	4.8	12.0	373				70.0	41.6	373
Potatoes					11.6	4.6	11.1	126				94.8	14.3	126
Tomatoes					12.8	8.0	12.0	87				96.0	5.5	90
Basil	7.3	10.4	2.0	141					98.0	14.2	147			
Marjoram					1.7	0.8	1.7	26				76.9	43.0	26
Garlic					6.6	3.9	6.0	110				83.9	32.0	110
Peanuts	0.7	0.4	0.7	41					93.8	21.9	41			
Sugar beets					30.3	8.2	30.0	21				100.0	0.0	25

Source: Own estimation, based on farm household baseline survey data.
Note: Crops are included, if they are cultivated by at least 2 percent of all farmers by season. This is equivalent to at least 40 household observations per season. Crop estimates are reported, if they are based on at least 20 household observations.

The shares of harvested quantities sold suggest that farmers cultivate crops largely for commercial purposes, keeping only small shares of the harvest for their own consumption. Among the common vegetables and herbs and spices, the lowest marketed share occurred for onions, at 70.0 percent. The shares of harvest sold range between around 83 percent for green beans and 98 percent for marjoram. Altogether, these estimates indicate a very high level of commercialization in horticulture. Meanwhile, the low-marketed shares for maize and wheat need to be interpreted cautiously. Cereals can be stored and sold several months after the harvest to fetch higher prices. Moreover, at the time of the survey, the wheat harvest was not completed in the survey area.

[5] Extreme values were dropped from the sample during data cleaning.

Comparable yield data are limited, and available data sources need to be interpreted very cautiously. The Ministry of Agriculture and Land Reclamation (MOALR) provided average crop-based estimates of total harvested quantity and total cultivation area by season and governorate for the agricultural year 2013/14 (MOALR 2015). Table 20 shows the cultivation area and harvest quantity estimates for the governorates where the farm household baseline survey was conducted. It also shows average yields derived from these estimates. Beyond the derived yields being rough estimates, the comparability of these average yields with average yields derived from the farm household baseline survey is somewhat limited, because the MOALR data also include very large agricultural farms that use modern agricultural inputs and technologies, including 'precision farming,' sprinkler and drip irrigation systems, and greenhouses for vegetable and herb and spice production. Hence, it should be expected that average yields reported by MOALR are above the average yields derived from the farm household baseline survey.

Table 20: Governorate-average yields in 2013/14 season, based on data from the Ministry of Agriculture and Land Reclamation

	Summer season 2013				Winter season 2013/14			
	Total production, mt	Total cultivated area, feddans	Average yield, mt/feddan	Govern-orates, number	Total production, mt	Total cultivated area, feddans	Average yield, mt/feddan	Govern-orates, number
Maize	2,112,986	699,580	3.0	5				
Wheat					2,010,312	736,013	2.7	5
Green beans	1,753	262	6.7	3				
Onions					512,205	34,235	15.0	5
Potatoes	645,766	64,832	10.0	5				
Tomatoes	373,416	20,362	18.3	5	154,742	8,625	17.9	1
Basil	59,217	3,374	17.6	2				
Marjoram	9,352	458	20.4	2				
Garlic								
Peanuts	12,924	9,801	1.3	5				
Sugar beets					1,525,815	56,504	27.0	2

Source: Own calculation, based on data from MOALR (2015).
Note: The governorates that provided crop estimates are Beni Suef, Luxor, Menya, Qena, and Sohag. Blank cells indicate that data are not available.

Comparison between yields confirm that MOALR yield estimates are higher than those of the farm households survey. All yields reported in Table 20 are considerably higher than corresponding yields in Table 19, except for potatoes and sugar beets. The yields from both sources appear to be within a reasonable range. Exceptions are basil and marjoram yields, which are much higher in the MOALR data.[6]

The most common crops are harvested in one batch (Table 21). Exceptions are basil and tomatoes. Most farmers picked basil three times to complete the 2017 summer season harvest. At the time of the farm baseline survey implementation, tomatoes were harvested two to three times during the winter season 2017/18, on average. The number of tomato harvest batch observations in Table 21 is lower than the number of tomato farmer observations in Table 14. This suggest that at

[6] MOALR-reported an average basil yield of 17.6 tons per feddan, which is extremely high. In comparison, basil leaf yields range from 6 to 10 tons per acre of fresh material in North Carolina, USA, and South Africa (NC State Extension 1997; DAFF 2012). Average marjoram yields of 20.4 tons per feddan, as reported by MOALR, also appear high. The reported average marjoram yield per season considerably exceeds reported yields of tomatoes and onions, for example, and that of wheat by almost seven-fold. Nevertheless, it should be noted that the marjoram harvest was not completed at the time of the farm household baseline survey. Consequently, the average yield reported in Table 19 likely understates the average seasonal yield.

the time of the survey the tomato harvest was not completed in all sample villages. It also explains the considerable difference between the mean and median of tomato harvest batches. Clover is often cut for fresh fodder as needed. Farmers cut clover four times per season on average.

Table 21: Batches harvested for common crops, number, by season

	Summer season 2017				Winter season 2017/18			
	Mean	SD	Median	N	Mean	SD	Median	N
Maize	1.3	1.1	1.0	2,608				
Wheat					1.0	0.2	1.0	764
Green beans	1.0	0.0	1.0	305	1.1	0.8	1.0	185
Onions					1.0	0.0	1.0	407
Potatoes					1.0	0.0	1.0	158
Tomatoes					2.3	2.2	1.0	92
Basil	2.7	1.5	3.0	145				
Marjoram					1.0	0.2	1.0	28
Garlic					1.0	0.0	1.0	120
Peanut	1.0	0.0	1.0	41				
Clover	4.1	1.1	4.0	96	4.3	1.0	4.0	1,024
Sugar beets					1.0	0.0	1.0	25

Source: Own estimation, based on farm household baseline survey data.
Note: Crops are included if they are cultivated by at least 2 percent of all farmers by season. This is equivalent to at least 40 household observations per season. Crop estimates are reported if they are based on at least 20 household observations. The number of observations (N) refers to the number of batches harvested. For maize and wheat, standard deviations (SD) not equal to zero are likely due to misreporting.

Farmers sell most of their harvest to a single buyer, such as a trader or a processor. Table 22 shows that a single buyer was the purchaser of most harvest batches of marketed products in the summer season 2017 and in the winter season 2017/18. Less than 5 percent of all marketed batches were sold directly to the end consumer in local markets. Additionally, most harvest batches were sold all at once—not sold in different stages to several buyers. These marketing patterns suggest that the interviewed farmers are well integrated in specialized value chains for most of the cultivated crops. Most farmers reported that they did not have any issues with the buyers of their harvested batches (88.5 percent in the summer season 2017 and 85.1 percent in the winter season 2017/18). Yet, in the case of 11.1 percent of all marketed batches of the summer season harvest and 13.9 percent of all marketed batches of the winter season (at the time of the farm household baseline survey), the farmer reported that receipt of payment was delayed or not made in time.

Table 22: Marketing of harvest batches for all marketed crops by season, percent of batches harvested

	Summer season 2017	Winter season 2017/18
Single buyer (trader or processor)	89.2	85.8
Consumer in local market	3.4	4.5
Other buyers	1.2	3.1
Several buyers of different type	6.1	6.5
Observations	2,202	1,635

Source: Own estimation, based on farm household baseline survey data.
Note: The number of observations refers to the number of batches harvested and marketed. The fewer observations during the winter season than the summer season indicates that the winter season harvest was not completed for all cultivated crops at the time of the farm household baseline survey

Besides farming, most interviewed farmers raise livestock, which indicates a diversified farming system. Table 23 shows that almost four out of five farmers raise poultry (mostly chicken),

with 19.2 birds on average. Even large livestock (mostly cattle, donkeys, and mules) are present in more than three-fourths of all farm households, with 3.1 animals held on average. Medium-sized livestock (including sheep and goats) are less common. Still, more than one-third of all farm households have goats or sheep, with an average herd size of 4.6 animals. Ownership of medium and large livestock in the farm household sample of this study is much higher than in the ELMPS sample used by Nin-Pratt et al. (2018a). The authors of that study found that only 9.2 percent of the farm households owns goats, and 6.6 percent own sheep. Among the large livestock, 21.7 percent of the farm households owns cattle, and 15.8 percent and 0.4 percent owns buffaloes and camels, respectively. Given widespread ownership of medium and large livestock among the interviewed farmers, manure is commonly used to fertilize fields.

Table 23: Livestock ownership and number of animals owned

	Ownership		Animals owned		
	Percent	N	Mean	SD	N
Poultry	78.5	2,246	19.2	13.2	1,764
Goats and sheep	34.4	2,246	4.6	4.4	773
Cattle, donkeys, mules, horses, and camels [a]	75.8	2,246	3.1	2.2	1,703

Source: Own estimation, based on farm household baseline survey data.
Note: [a] No ownership of buffaloes was reported.

3.3 Health and nutrition

In this section, we discuss mother's health and nutrition knowledge and practices and the status of theirs and their children's health. We assessed caregivers' knowledge on key nutrition and health-related topics, asked about child feeding practices, and assessed caregiver and household dietary diversity. Finally, anthropometric measures were taken for mothers/caregivers and children.

Table 24: Hygiene knowledge of mothers/caregivers

Handwashing practices	
Before meals, %	85.1
After using the bathroom, %	58.0
Before feeding a child, %	33.0
After cleaning children's bowel movements, %	27.1
Before food preparation tasks, %	42.9
After coming from the farm, %	12.4
After handling animals, %	15.3
After meal eating, %	10.9
Handwashing number of practices mentioned, average (standard deviation)	2.8 (1.2)
Handwashing products mentioned	
Soap, %	93.1
Powder detergent, %	26.0
Liquid soap, %	32.4
Dettol, %	2.4
Mentioned at least one type of soap (soap, powder detergent, or liquid soap), %	100.0

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 1,817 to 1,908.

When asked when hands should be washed, women listed an average of nearly three activities (Table 24). The large majority of caregivers knew that hands need to be washed before eating. Washing hands after using the bathroom was mentioned by 58.0 percent of the respondents. Other key moments to wash hands, such as before feeding a child or after cleaning children's bowel

movements, were mentioned by only a small proportion of women. Meanwhile, all respondents mentioned at least one type of soap as something to be used for washing hands.

With regards to the components of household diets, 94.0 percent of respondents mentioned at least one source of fat (Table 25). For iron-rich foods, close to half of the women mentioned liver, and 30 percent mentioned meat, chicken, and fish. Out of 10 women, nine listed examples of starches, with the majority identifying cereals; six could identify eggs, fish, chicken, beef, and milk as sources of protein; and seven identified at least one plant-based source of protein. The most commonly mentioned type of plant-based protein was fava beans, a staple crop in Egypt. With respect to the benefits of fruits and vegetables, almost 80 percent were able to mention at least one benefit, with more than half mentioning that such foods are a source of vitamins.

Table 25: Nutrition knowledge of mothers/caregivers

	Percent
Fats, mentioned at least one source	94.0
Iron-rich food	
Meat, poultry, and fish	29.7
Liver	46.8
Starches	
Cereals	75.2
Potatoes	65.6
Sweet potatoes	11.6
Mentioned at least one type of food rich in starch	90.4
Protein-rich food	
Knows that animal-source foods provide protein to the diet	62.6
Plant-based protein-rich food	
Fava beans	54.5
Beans (red, white, black)	20.3
Lentils	48.7
Chickpeas	16.9
Cowpeas	13.7
Peanuts	4.7
Mentioned at least one type plant-based food rich in protein	71.2
Benefits of fruits and vegetables	
Source of vitamins	55.9
Source of minerals	40.0
Source of fibres	6.9
Source of antioxidants	1.7
Mentioned at least one benefit	79.1

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 1,817 to 1,908.

When asked how to maintain a healthy body weight, answers were mostly related to eating healthy foods and maintaining a balanced diet and eating fruits and vegetables (Table 26). Only one-third mentioned reducing sugar or soft-drink intake, and very few mentioned the role of physical exercise or watching TV and playing electronic games.

More than half of the women had correct views on each of the questions asked with respect to how diet affects health. Most agreed that eating fruits and vegetables daily is good for health and that consuming a lot of sugar is bad for one's teeth. About 85 percent agreed that consuming lots of sugar and lots of fats and oil can make one overweight. Yet, only around half of the women agreed

or gave a neutral response to the statement that one does not have to worry about the kind of foods one eats.

Table 26: Health knowledge of mothers/caregivers: Maintaining a healthy body weight

Achieving a healthy weight	
Eat healthy foods/balanced diet, %	72.8
Eat fruits and vegetables, %	65.4
Minimize sugar and soft drink consumption, %	33.2
Minimize processed food intake, %	13.2
Regular physical exercise, %	12.5
Minimize watching TV or playing electronic games, %	1.9
Views on health and sugar consumption	
Disagrees with "I do not have to worry about the kind of foods to eat", %	55.1
Knows that "eating fruit and vegetables daily is good for your health" is correct, %	94.0
Knows that "eating too much fat and oil can make you fat" is correct, %	86.5
Knows that "consuming lots of sugars is good for your health" is incorrect, %	68.3
Knows that "consuming lots of sugars can make you fat" is correct, %	84.4
Knows that "consuming lots of sugars is bad for your teeth" is correct, %	91.1
Number of correct views, out of five, average (standard deviation)	4.2 (1.1)

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 1,817 to 1,908.

Most women could list at least two pregnancy danger signs, with vaginal bleeding and abdominal pain being most commonly mentioned (Table 27). Meanwhile, experiencing difficulty with vision or in breathing were mentioned by fewer than 14 percent of mothers. For signs of child illness for which a child should be taken to a medical facility right away, 80 percent of women could list two signs. However, some key danger signs, such as the child having breathing issues or bloody stools, were mentioned by fewer than 30 percent of the respondents.

Table 27: Health knowledge of mothers/caregiver: Danger signs of pregnancy and child illness

	Percent
Pregnancy dangers	
Vaginal bleeding	77.4
Vaginal discharge	32.9
High fever	42.4
Abdominal pain	59.4
Severe and persistent headache	28.8
Vision trouble	12.8
Difficulty breathing	13.2
Swollen body/face/hands	30.0
No fetal movement or changes in fetal movement	28.4
Could name at least 2 pregnancy danger signs	97.8
Danger signs of child illness	
Cannot drink or breastfeed	58.2
Getting sicker	44.0
Running a fever	61.9
Breathing fast	30.9
Trouble breathing	22.5
Bloody stools	11.7
Could name at least 2 child danger signs	79.9

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 955 to 961.

Knowledge and practices around breastfeeding can be improved (Table 28). All women believed that colostrum should be fed to the newborn, but, interestingly, only 58 percent of women thought that children should be fed immediately. The main reasons mentioned for feeding colostrum were related to the newborn's health and immunity. Notwithstanding the low levels of exclusive breastfeeding, a large number of women knew about the advantages of exclusive breastfeeding, with protecting the baby from diseases mentioned by three-quarters of the respondents and helping the baby's growth and breast milk being a complete food mentioned by about half of the women.

Table 28: Health knowledge of mothers/caregiver: Children's nutrition

	Percent
Breastfeeding colostrum	
Breastfeed right away	57.6
Should breastfeed colostrum?	99.4
Improves baby's health	71.5
Makes him/her more immune to diseases	60.6
Contains nutrients/helps children's growth	28.3
Helps baby have bowel movement (laxative)	10.4
Reasons for exclusive breastfeeding below 6 months of age	
Protect baby from diseases	76.1
Help baby's growth	56.4
Complete food during first 6 months	43.8
Less risk of pregnancy for mother	17.0
Postponement of period for mother	11.2
Breast milk is healthy and pure	22.0
Free	6.6
Reduction of medical costs	1.7
Age of introducing foods and drinks other than breast milk	
Age for introducing any liquids is 6 months	39.2
Age for introducing any food is 6 months	49.5
Reason for introducing food starting at 6 months	
Breast milk does not provide necessary nutrients	76.3
Breast milk does not contain enough energy	44.3
Cannot develop appropriately w/o other foods	16.2

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 955 to 961.

Knowledge about appropriate feeding practices for children is also inadequate. The correct age at which children should be introduced to liquids and foods other than breast milk was not well known: the correct age of six months was mentioned by only 39 percent of women when it comes to introducing liquids and by half of the women for the introduction of solid or semisolid foods. For children above six months of age, three-quarters of women mentioned that it is important for a child to consume other foods besides breast milk, because at this age breast milk alone does not provide the baby with sufficient nutrients.

Knowledge about preventing and treating diarrhea was limited, as well (Table 29). When asked about the reasons or circumstances under which a child should receive oral rehydration solution (ORS), almost all women mentioned diarrhea. Yet, even though around 85 percent of women could list at least two measures to take to prevent diarrhea, and women mentioned on average nearly three measures, key practices like using clean water, washing hands, and food safety were mentioned by no more than 60 percent. Knowledge about what to do when a child is suffering

from diarrhea was limited too. Women mentioned on average nearly two practices, but only around half mentioned critical practices such as providing ORS and ensuring sufficient liquid intake.

Table 29: Health knowledge of mothers/caregiver: Diarrhea

Diarrhea	
Child should take oral rehydration solution (ORS) for diarrhea, %	98.3
Diarrhea prevention	
Using clean water, %	52.0
Washing hands, %	51.4
Making sure food is clean, %	57.6
Cooking food well before presentation, %	30.9
Disposing all types of waste safely	19.3
Controlling/fighting flies, %	20.1
Breastfeeding, %	19.8
Improving feeding practices, %	11.2
Measles vaccination, %	7.7
Number of practices mentioned for preventing diarrhea, average (SD)	2.8 (1.4)
Could name at least 2 methods to prevent diarrhea, %	84.1
Actions for children's diarrhea	
Continue breastfeeding newborns, %	32.2
Provide the baby fluids frequently, %	51.3
Provide easily digestible food, %	29.9
Give the child an Oral Rehydration Solution (ORS), %	53.2
No medicines unless doctor consulted, %	14.7
Number of practices mentioned, average (SD)	1.8 (0.8)
Could name at least 2 practices to do for child suffering diarrhea, %	60.1

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 955 to 961. SD = standard deviation.

Women had different perceptions on the effects of poor nutrition on children. When asked about the potential effects of poor nutrition on children's health, about two-thirds mentioned fatigue. Anemia and wasting also were relatively commonly mentioned as effects of poor nutrition. However, only about 10 percent mentioned stunting and rickets (Table 30). The most frequently mentioned effect of poor nutrition on children's health was anemia, but few women were aware of its consequences. Impaired development, fatigue, and dizziness were stated by about 40 percent of women, while all other consequences were mentioned less frequently.

Table 30: Health knowledge of mothers/caregiver: Children's heath

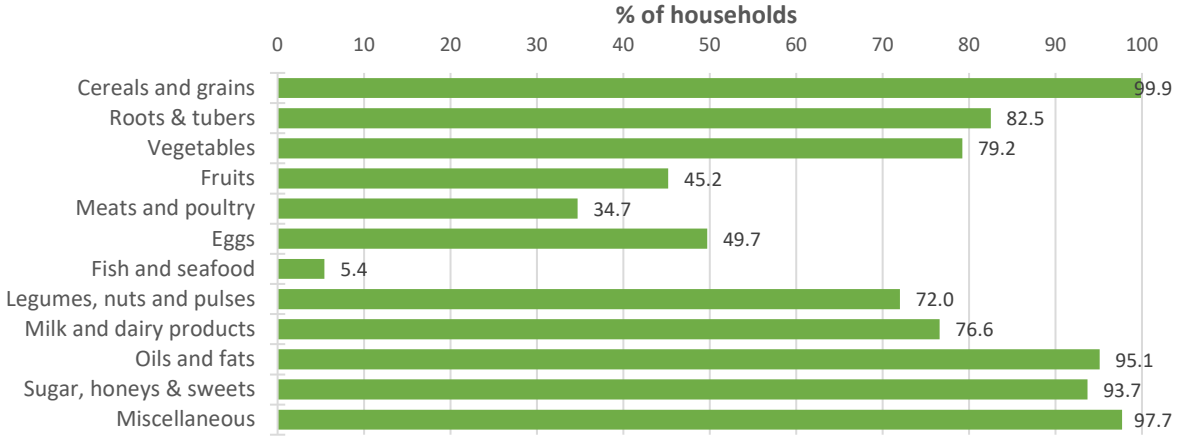
	Percent		Percent
Effect of poor nutrition on child:		**Consequences of child anemia:**	
Wasting	58.3	Impaired learning	9.3
Stunting	10.4	Impaired development	38.6
Rickets	12.1	Poor concentration	18.5
Anemia	58.9	Fatigue	38.2
Fatigue	63.2	Dizziness	38.7
Frequent sickness	15.2	Shortness of breath	17.6
		Rapid heartbeat	12.5

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 955 to 961.

Households' diets were dense in calorie-rich foods, but show signs of inadequate nutrient intake. On average, households reported consuming 8.3 out of 12 food groups in the 24 hours

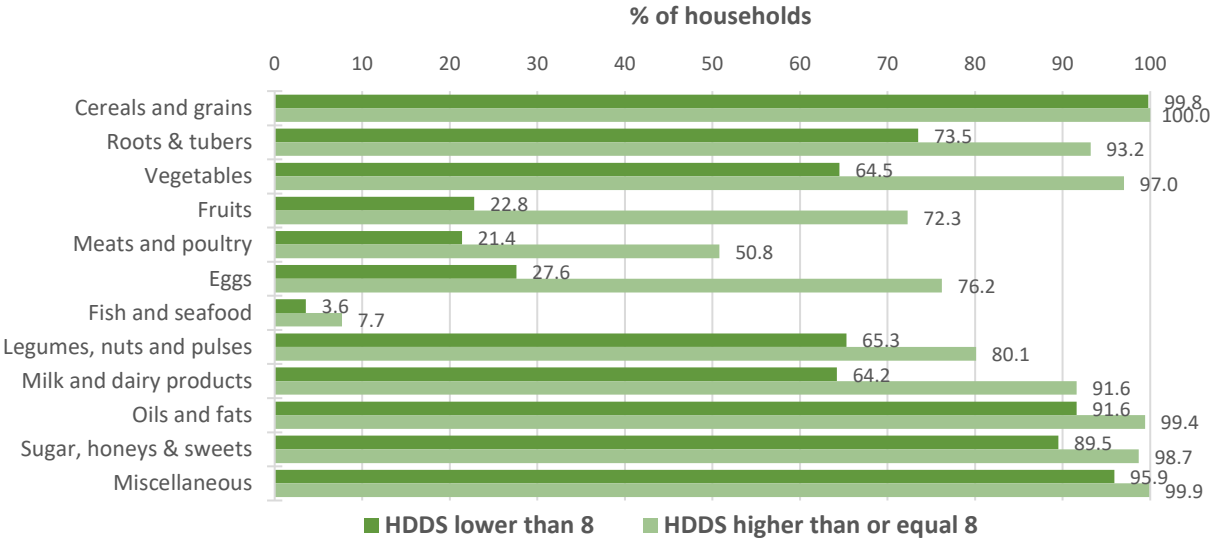
preceding the survey (Figure 2). 56.1 percent of the surveyed households consumed fewer than eight food groups. Nearly all households reported consuming cereals and grains; oils, and fats; and sugar, honey, and sweets. Animal-source food consumption varied by type: approximately three-fourths of all households consumed dairy; meat consumption was reported by only one-third of all households; fish consumption was rare. Comparing households that consumed fewer than eight food groups with those that consumed eight or more shows that the differences are largest for micronutrient-rich foods, such as fruits and vegetables and all animal-source foods, with low-diversity households much less likely to consume those food groups (Figure 3).

Figure 2: Consumption of the 12 food groups in the Household Dietary Diversity Score in the 24 hours preceding the survey, all households



Source: Own estimation, based on farm household baseline survey.

Figure 3: Consumption of the 12 food groups in the Household Dietary Diversity Score (HDDS) in the 24 hours preceding the survey, households disaggregated by HDDS

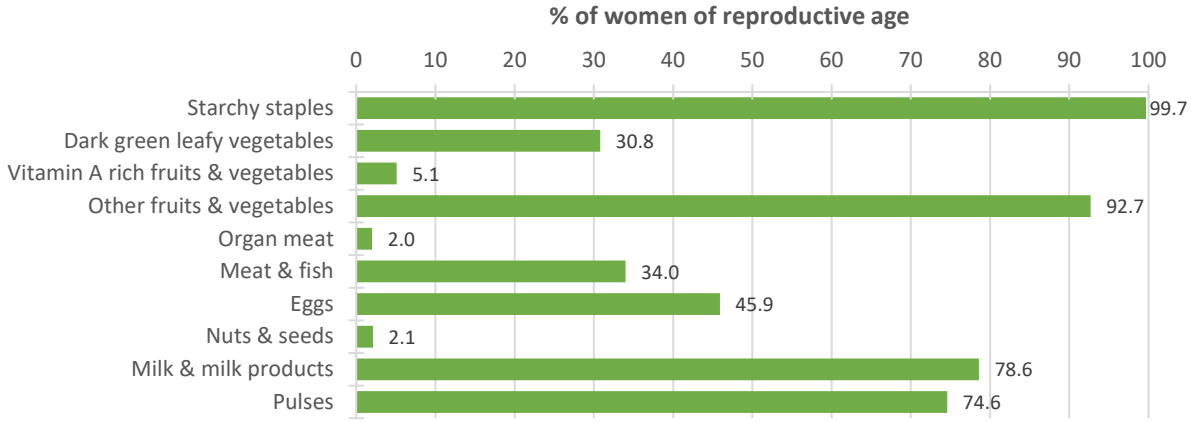


Source: Own estimation, based on farm household baseline survey.
Note: HDDS = Household Dietary Diversity Score

On average, women's dietary diversity was even less ideal than that of the households as a whole. Women consumed 4.7 food groups out of the 10 defined in the Minimum Dietary Diversity for Women (MDD-W) indicator (Figure 4) (FAO and FHI 360 2016). This is fewer than the five-food group cutoff. Around half of the women (53.2 percent) consumed at least five food groups. This suggests that a large proportion of women are likely to have inadequate micronutrient intakes.

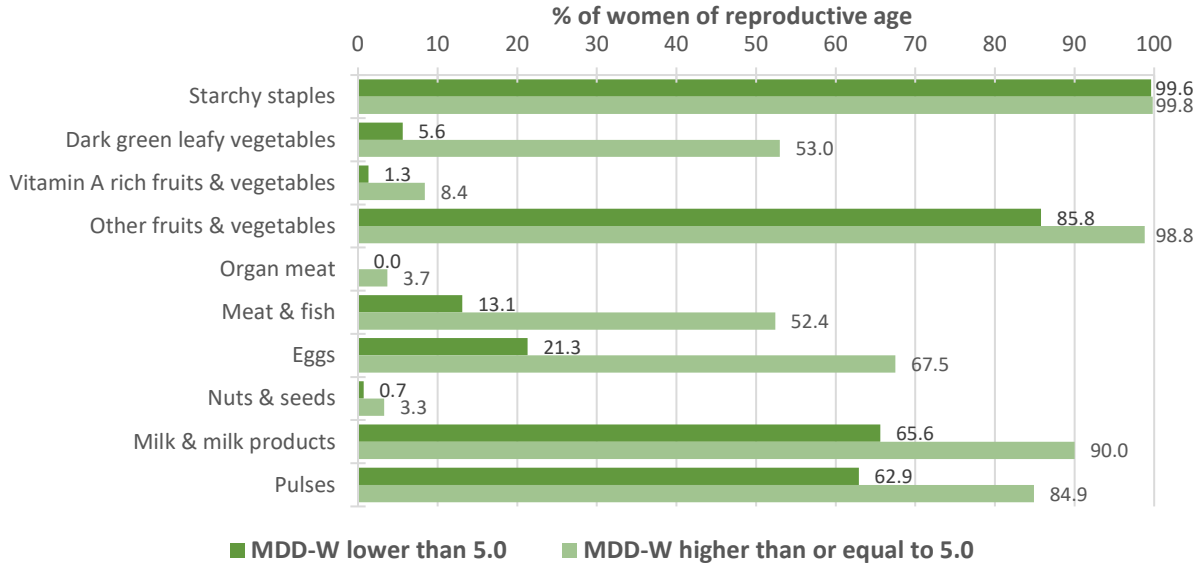
Nearly all women reported consuming starchy staples in the 24 hours preceding the survey and about 8 out of 10 women had consumed milk and dairy products. Consumption of meat and fish was uncommon. Few women reported consuming vitamin A-rich fruits and vegetables. Women consuming fewer than five food groups were much less likely to consume animal-source foods, dark-green leafy vegetables, and vitamin A-rich fruits and vegetables (Figure 5).

Figure 4: Women's consumption of the ten food groups in the Minimum Dietary Diversity for Women (WDD-W) indicator in the 24 hours preceding the survey



Source: Own estimation, based on farm household baseline survey.

Figure 5: Women's consumption of the ten food groups in the Minimum Dietary Diversity for Women (MDD-W) indicator in the 24 hours preceding the survey, disaggregated by MDD-W scores



Source: Own estimation, based on farm household baseline survey.
Note: MDD-W = Minimum Dietary Diversity for Women.

Children's feeding practices were also suboptimal. Nearly all of the children aged 0 to 23 months had ever been breastfed. However, only about one-third of infants under six months of age were exclusively breastfed during the 24 hours preceding the survey (Table 31) – about three-

quarters of these infants were predominantly breastfed.[7]. In addition, almost all children were still breastfed at one year of age, but this percentage dropped considerably by two years of age when only one-third were still being breastfed. The low rates of exclusive breastfeeding and continued breastfeeding explain why only half of all children received age-appropriate breastfeeding.

Table 31: Infant and Young Child Feeding (IYCF) practices

	Percent
Ever breastfed, 0 to 23 months	94.7
Exclusive breastfeeding, 0 to 5 months	36.4
Predominant breastfeeding, 0 to 5 months	72.7
Continued breastfeeding 1 year, 12 to 15 months	89.5
Continued breastfeeding at 2, 20 to 23 months	33.8
Age appropriate breastfeeding, 0 to 23 months	50.7
Bottle feeding, 0 to 23 months	11.7
Appropriate milk feeding frequency for non-breastfed, 6 to 23 months	5.9
Introduction of, semisolid/soft food, 6 to 8 months	61.3
Consumption of iron-rich foods, 6 to 23 months	22.9
Minimum dietary diversity, ≥ 4, 6 to 23 months	52.4
Minimum meal frequency, 6 to 23 months	42.9
Minimum acceptable diet, 6 to 23 months	21.9

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 55 to 453.

The use of bottles was low, with 12 percent of caregivers reporting having used a bottle to feed their child in the past 24 hours. Of children aged 6 to 8 months, about 60 percent had started eating complementary foods (the recommended age for introduction of complementary foods is six months). Additionally, only around one-fifth of children aged 6 to 23 months had consumed iron-rich food in the past 24 hours. Only around half of children in this age group had consumed foods from at least four different food groups in the past 24 hours, with only about 40 percent receiving the minimum number of meals recommended for their age.[8] Only one-fifth of all children aged 6 to 23 months were classified as receiving a minimal acceptable diet.[9]

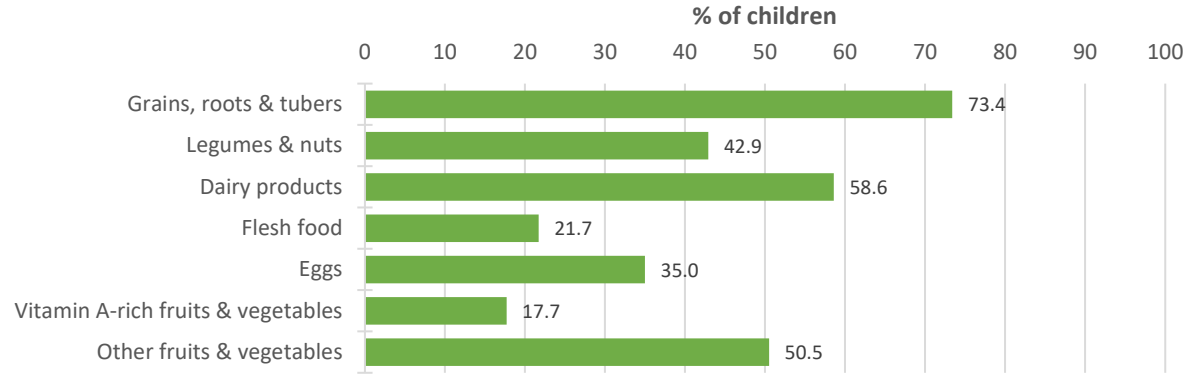
In total, less than half of all children aged 6 to 23 months consumed flesh food, eggs, vitamin A-rich fruits and vegetables, or legumes and nuts (Figure 6). When comparing the dietary diversity of children meeting the minimum of four groups of the seven food groups making up the Child Dietary Diversity Score (CDDS) with those who did not, large differences were found across all food groups (Figure 7). Consumption of flesh food and vitamin A-rich fruits and vegetables was particularly low at below 10 percent among children with a CDDS below four.

[7] *Predominant breastfeeding* means that the infant's predominant source of nourishment has been breast milk. The infant, however, may have also received liquids (water and water-based drinks, fruit juice) ritual fluids, and ORS, drops, or syrups (vitamins, minerals, and medicines).

[8] At least two for breastfed children aged 6 to 8 months, at least three for breastfed children 9 to 23 months of age, and at least four for non-breastfed children

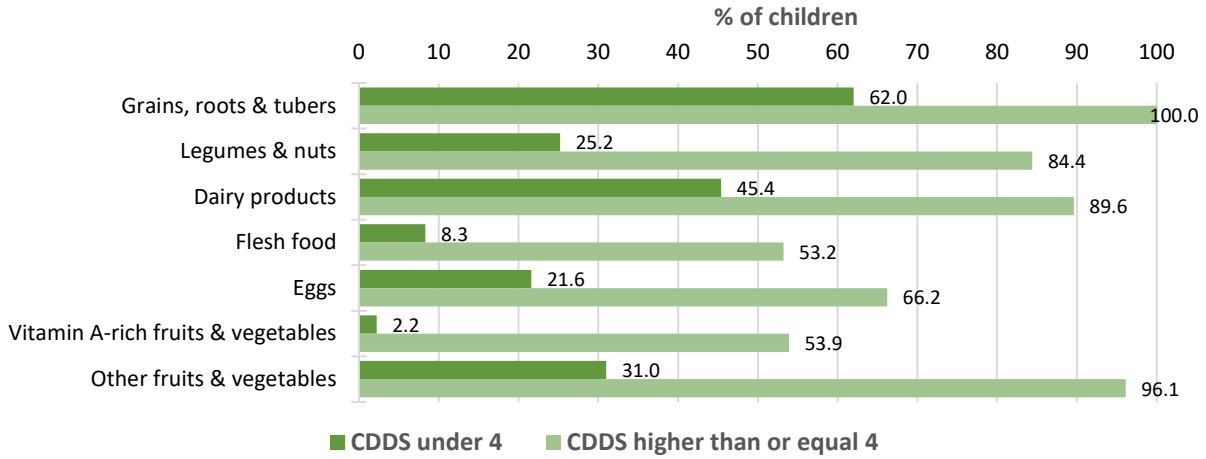
[9] As explained in the methods section, this indicator was calculated for both breastfed and non-breastfed children: for breastfed children it was defined as meeting both the minimum dietary diversity and the minimum meal frequency requirements, and for non-breastfed children, it was defined as having received at least two milk feedings, having consumed at least four food groups (out of six nutrient-rich food groups) and the minimum meal frequency in the past 24 hours.

Figure 6: Consumption by all children aged 6 to 23 months of the seven food groups in the Child Dietary Diversity Score (CDDS) in the 24 hours preceding the survey



Source: Own estimation, based on farm household baseline survey.

Figure 7: Consumption by children aged 6 to 23 months of the seven food groups in the Child Dietary Diversity Score (CDDS) in the 24 hours preceding the survey, disaggregated by CDDS scores



Source: Own estimation, based on farm household baseline survey.
Note: CDDS stands for Child Dietary Diversity Score

Overweight and obesity were prevalent among women of reproductive age in the sample. Among women 19 to 45 years of age, 35 percent were found to be overweight, and 28 percent were obese. Being underweight was uncommon (Table 32). Almost no women had a height below 145 cm, the cutoff often used to identify women at high risk of obstructed labor.

Table 32: Anthropometric measurements of women aged 19 to 45 years

Weight, kg, average (SD)	68.3 (14.4)
Height, cm, average (SD)	158.0 (5.3)
Height under 145 cm, %	0.9
Body mass index (BMI), average (SD)	27.3 (5.6)
Underweight (BMI < 18.5), %	2.1
Normal weight (BMI between 18.5 and 24.9), %	35.0
Overweight (BMI between 25.0 and 29.9), %	35.2
Obese (BMI ≥ 30.0), %	27.6

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 2,471 to 2,600. SD = standard deviation.

Both under-and over-nutrition were found to be prevalent among the surveyed children. The overall prevalence of stunting (HAZ < -2 SD) among all children under five years of age was 17.9 percent (Table 33). As is often observed, the prevalence of stunting in boys was higher than in girls, and the prevalence in younger children was lower than in older children, but these differences were statistically insignificant (Table 34). Similar sex- and age-related patterns were found for HAZ. Wasting was not observed in this population; the mean weight-for-height z-scores and BMIZ were above zero in the overall sample and in each of the subgroups. However, a problem of excess weight in children was identified: 27 percent of under-fives in the sample had a BMIZ above 1.0, which WHO has categorized as the threshold for being at risk of overweight.[10] In addition, 7.3 percent of all children were overweight, and 2.8 percent were obese. No significant differences were found between boys and girls or between children across the different age groups.

Table 33: Anthropometric measurements of children aged 0 to 59 months

Height-for-Age z-score (HAZ), average (SD)	-0.8 (1.4)
Weight-for Height z-score (WHZ), average (SD)	0.3 (1.2)
Body mass index z-score (BMIZ), average (SD)	0.3 (1.2)
Stunted, %	17.9
Wasted, %	1.7
Risk of overweight (BMIZ > 1), %	27.3
Overweight (BMIZ > 2), %	7.3
Obese (BMIZ > 3), %	2.8

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 1,203 to 1,219. SD = standard deviation.

Table 34: Anthropometric measurements of children aged 0 to 59 months, by age and sex

			Mean difference test				Mean difference test	
	<24 months	≥24 & <60 months	Standard error	Signi-ficance	Girls	Boys	Standard error	Signi-ficance
Height-for-Age z-score (HAZ), average (SD)	-0.6 (1.6)	-1.0 (1.3)	0.11	***	-0.7 (1.4)	-0.9 (1.3)	0.08	**
Weight-for Height z-score (WHZ), average (SD)	0.1 (1.2)	0.3 (1.2)	0.10	**	0.3 (1.1)	0.2 (1.2)	0.07	*
Body mass index z-score (BMIZ), average (SD)	0.2 (1.3)	0.4 (1.2)	0.10	**	0.4 (1.2)	0.3 (1.3)	0.07	
Stunted, %	15.6	19.1	2.44		16.7	19.1	2.44	
Wasted, %	2.5	1.4	0.99		0.8	2.8	0.84	**
Risk of overweight (BMIZ > 1), %	25.1	28.3	3.58		27.3	27.2	2.28	
Overweight (BMIZ > 2), %	7.7	7.1	2.30		7.1	7.6	1.06	
Obese (BMIZ > 3), $	2.0	3.2	1.51		2.6	3.1	0.86	

Source: Own estimation, based on farm household baseline survey.
Note: Sample size ranged from N = 402 to 409 for children 0-23.9 months; N = 800 to 810 for children 24-59.9 months; N = 622 to 629 for girls; and N = 580 to 590 for boys. The significance of mean difference is assessed by an estimation regressing the outcome variable on the group variable identifying beneficiary and comparison households. Standard errors (SE) are clustered at the village level. SD = standard deviation.
***, **, * Per the p-value of the coefficient estimate, mean difference is statistically significant at the 1, 5, and 10 percent level, respectively.

4 CONCLUSION

The results presented in this paper characterize smallholder farm households in Upper Egypt regarding a variety of socioeconomic, agricultural, nutrition, and health parameters. The detailed

[10] In a healthy population, we expect 15.9 percent of children to have a BMIZ above 1.

information presented should help donors and implementers of nutrition-sensitive agricultural programs to further increase the effectiveness of these interventions in Upper Egypt. The main findings of particular relevance to better leverage agriculture-nutrition linkages among Egyptian smallholder farm households can be summarized as follows:

Food consumption accounts for a large share of total household expenditure. The smallholder farm households of our sample spent on average about 60 percent of total household expenditure on food, with those in the bottom quintile devoting 67 percent. Monetary poverty is prevalent among smallholder farmers in Upper Egypt, and the financial resources available to spend on other necessities and to cope with economic shocks are quite limited.

Spending patterns reveal that these farm households purchase most of the food that they consume, rather than consuming what they produce. This suggests, first, that the own-consumption driven agriculture-nutrition pathway mentioned in the introduction is unlikely to be substantial for improving diets and nutrition through agricultural interventions in Upper Egypt. On the other hand, it implies that access to food markets and (both absolute and relative) food prices are key determinants of food and nutrition security among these smallholder farm households.

Even small-scale farmers in Upper Egypt—Egypt's poorest region—cultivate crops primarily and almost exclusively for commercial purposes. Only small quantities of produce are kept for own consumption, probably those portions of the harvest that are difficult to sell because of quality issues or other marketing constraints. Moreover, we find indications that harvests are aligned to market demand rather than home consumption needs. This implies that the second agriculture-nutrition pathway driven by farm income generation is likely critical for improving diets and nutrition among these households. This finding provides a nutrition-related rationale for promoting income-generating agribusiness. However, it may also mean that, ceteris paribus, quite similar interventions may be used with both farming and non-farming rural households to improve diets and nutrition outcomes. Regarding increasing farm incomes, our analysis reveals several potential levers for increasing agricultural productivity. These include promotion of more efficient water use (introducing drip irrigation and sprinkler systems and reforming irrigation-related subsidization policies), more efficient use of fertilizer and pesticides, and improved farming practices to narrow the productivity gap between small-scale farmers and medium and large-scale farmers.

Patterns of food consumption and dietary diversity further confirm that household income levels matter for dietary quality. Smallholder farm households in higher income quintiles have higher household dietary diversity scores than those in lower income quintiles. Moreover, better-off households spend more on food from groups with higher nutritional value, like animal-source foods, fruits, and vegetables. Yet, it is also observed that higher household income tends to be associated with overconsumption of calorie-dense foods, such as sugary and fatty foods, increasing the risk of overweight and obesity.

The women of the smallholder farm households who were interviewed, who are mostly the spouses of the main farmers, seem to have good general dietary and nutrition knowledge, but with some critical gaps. For example, only one-third of all women correctly noted that reducing sugar and soft-drink intake is important to control body weight, and very few women stated that a lack of physical activity is a key driver of unhealthy weight gain. This finding suggests that the nutritional impact of nutrition-sensitive agricultural programs could be leveraged by combining income-generating interventions with nutrition education and behavioral change communication interventions, as proposed by Ruel at al. (2018) and Ruel (2019). In our sample population, more than two-thirds of women are overweight or obese. This should be viewed against the background that farming populations are usually considered as relatively physically active and therefore at lower

risk of being overweight, at least among the household members involved in agricultural activities. However, only about 12 percent of the spouses of male farmers report engaging in any farming activities, while 84 percent consider themselves as housewives. Hence, the common perception of farm household members being physically active appears to be false in the case of Upper Egypt, where women generally do not participate in agricultural activities. Moreover, this finding implies that interventions that aim at improving nutrition through optimizing women's control over agricultural resources, empowerment in agriculture-related decision making, time use from participation in agricultural work, or other health and nutrition-related factors assuming large engagement in agricultural activities are unlikely to have large uptake and hence impact among Upper Egyptian smallholder farm households. Thus, the fourth, fifth, and sixth gendered pathways of leveraging agriculture for improved nutrition, mentioned in the Introduction, appear to be of little promise in the context of small-scale agriculture in Upper Egypt.

However, we find additional areas where behavioral change communication (BCC) interventions may be promising. These include improving common practices in infant and child feeding by addressing misconceptions. For example, even though all interviewed women knew that colostrum should be fed to newborns, and many of them were aware of the key health benefits for their children, less than 60 percent correctly reported that newborns should be breastfed immediately after birth. The women also knew about the importance of exclusive breastfeeding, but only about one-third of children below six months of age were reported to be exclusively breastfed in the first six months of life. Another alarming finding is that feeding practices for children 6 to 23 months of age were often inadequate. The diversity of the diet fed to these children was limited, meal frequency was largely suboptimal; and few children were fed iron-rich foods. Accordingly, we find that child malnutrition—in terms of both chronic undernutrition and overnutrition—is widespread among the surveyed farm households: almost 18 percent of children under five years of age were stunted, even as almost 25 percent were at risk of being overweight. Altogether, these findings imply that nutrition-specific interventions are needed among smallholder farm households in Upper Egypt, even if the impact of nutrition-sensitive agricultural interventions on children's diets and overall nutritional status may be limited. This finding is consistent with the recommendations of Ruel (2019) outlined in the Introduction.

However, it should be highlighted that a key challenge to any intervention to improve nutrition in Upper Egypt is the low literacy rate among smallholder farm households and, especially, women. 58 percent of all interviewed mothers of children aged 0 to 5 years could not read at all, and another 12 percent could read, but insufficiently. Thus, despite nearly universal mobile phone coverage, technology-based interventions that require reading skills, such as nutrition and health-related information and education through phone messages, are likely to have low uptake and, hence, impact, especially among the neediest. Face-to-face communication, hands-on training, and picture-based messaging are likely to offer more promising results, even though such approaches are significantly more resource-intense.

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