Assessing the Role of Women Empowerment for Food Security and Nutrition: Empirical Evidence from Tunisia and India

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Marco Kruse

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Name of supervisor: Prof. Dr. Matin Qaim

Name of co-supervisor: Prof. Dr. Meike Wollni

Name of co-supervisor: Prof. Dr. Stephan von Cramon-Taubadel

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Summary

Equality for women in all areas of life is not only a fundamental human right, but is also a crucial prerequisite for achieving human development goals. Women constitute half of the world population and about 43 percent of the agricultural labor force, which makes the importance of research into the role of women for human development seemingly self-explanatory. But as of today, the global community is far from reaching its objective of universal gender equality. In many parts of the world, women are facing discrimination and low levels of participation in many areas, which has critical implications for all members of society. Moreover, the position of a woman is critical for the well-being of the individuals living in her close environment, especially children. Women, mainly as mothers, play an important, if not the most important, role in the livelihoods of their own children, as they are usually their primary caregivers.

Analyzing the determinants of under- and malnutrition is one of the central objectives in development research. In 2017, about 821 million people were undernourished worldwide, with most of those living in Africa and Asia alone. Twenty-two percent of all children in the world are stunted, while almost eight percent are wasted and more than five percent are overweight. Every country in the world is at least affected by one of these so called burdens of malnutrition. Although it is almost consensual that a strong position of women has a positive influence on diets and nutritional outcomes, little is known about the specific pathways of this relationship. In this dissertation, the primary focus is on studying and understanding the role of women empowerment for food security, nutrition and health of households and individuals in developing countries. Analyzing the relationship between women empowerment and nutrition is particularly sensitive to the definition and measurement of the used indicators. As there is no universal definition, indicators of women empowerment can be defined in relative or absolute terms, and they can differ from each other regarding their construction, scope, and interpretation. Analogically, a wide range of possible assessment tools for food security and nutrition exists, ranging from measures of dietary quality and caloric intake, over anthropometric measures, to clinical measures using blood samples, all of which measuring nutrition from different angles and perspectives.

The first essay of this dissertation focuses on analyzing the role of women empowerment for food security and nutrition of Tunisian farm households. Although there are already a few studies analyzing the relationship between women empowerment and nutrition, until now

there is no empirical evidence in the Arab context. Gender roles in Arab societies are significantly different from other societies; the traditional role of a woman is that of a devoted mother and wife, while the man is considered as the main caretaker and ultimate decision-maker of the family. Furthermore, North African countries are increasingly confronted with a double burden of malnutrition, with increasing rates of obesity and persistently high levels of micronutrient deficiencies. In this essay, women empowerment is assessed by applying the recently developed methodology of the Women Empowerment in Agriculture Index (WEAI). Women empowerment is measured by ten indicators within five domains of empowerment, which helps to identify areas in which women are particularly disempowered. Food security and nutrition are assessed both at the household and the individual level, using 7-day and 24-hour food recall data to construct indicators of dietary diversity. We ultimately use the aggregated empowerment index and five additional indicators of empowerment to empirically analyze the relationship between those indicators and dietary diversity. We find that women empowerment has a statistically significant and positive effect on both household dietary diversity and dietary diversity of female respondents. Apart from the aggregated empowerment indicator, especially the economic dimension of women empowerment, measured as the level of input into decisions on income and input into credit decisions of the female respondent, significantly increase dietary diversity. We conclude that women empowerment substantially contributes to shaping and improving patterns of food consumption in Tunisian farm households.

The second essay examines the role of women empowerment for the nutritional status of children and nutritional inequality within Indian households. In the Indian society, many social norms and practices reinforce patterns of discrimination against women. While most parts of India can be characterized as patriarchal, Indian families tend to have a preference for sons, and daughters are often perceived as liabilities. With about 38 percent India has one of the highest rates of stunted children under the age of five years, ranking the country114th out of 132 countries in the Global Nutrition Report. Previous studies analyzing the relationship between women empowerment and nutrition typically use cross-sectional data and establish causality by using instrumental variables. Here we are able to exploit a large representative panel data set from India, allowing the use of estimation techniques that account for heterogeneous effects and causality inferences. Furthermore, differences in nutritional outcomes within households are usually assessed by introducing dummy variables capturing specific attributes of children like gender or birth order. In contrast, we develop a measure of

nutritional differences between children within the same household to investigate whether women empowerment can straighten nutritional inequality within households. To measure women empowerment, we construct an index including 16 different indicators within four dimensions of empowerment. As a measure of child nutritional status, we use anthropometric measures to calculate the height-for-age Z-score (HAZ) of children, and to measure nutritional inequality between siblings, we calculate the difference between the HAZ of a child and the average HAZ of her siblings. We are able to show that nutritional differences between siblings within the same household exist in terms of birth order and gender of the child. We also demonstrate that women empowerment has a significantly positive and causal effect on children's HAZ. Furthermore, women empowerment significantly decreases nutritional inequality between siblings within the same household, indicating that the position of women has crucial implications for the well-being of the worst-off children within households.

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List of abbreviations

5DE	Five Domains of Empowerment
BMI	Body Mass Index
CRE	Correlated Random Effects
FAO	Food and Agriculture Organization of the United Nations
GPI	Gender Parity Index
HAZ	Height-for-Age Z-Score
HDDS	Household Dietary Diversity Score
ICARDA	International Center for Agricultural Research in the Dry Areas
IHDS	India Human Development Survey
IFPRI	International Food Policy Research Institute
IV	Instrumental Variable
OLS	Ordinary Least Squares
OPHI	Oxford Policy and Human Development Initiative
POLS	Pooled Ordinary Least Squares
SC	Scheduled Caste
SDG	Sustainable Development Goals
ST	Scheduled Tribe
UN	United Nations
USAID	United States Agency for International Development
WAZ	Weight-for-age Z-Score
WDDS	Minimum Dietary Diversity for Women
WHZ	Weight-for-height Z-Score
WEAI	Women Empowerment in Agriculture Index
WHO	World Health Organization
SLP	School Lunch Program

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1. General introduction

1.1. Background

'*Empowering women is key to building a future we want*.' (Amartya Sen). Severe gender inequality is observed in most parts of the world, including South Asia and North Africa (Drèze and Sen, 1991; Alkire et al., 2013; O'Hara and Clement, 2018). Even in the more developed societies of the world, women constitute a substantially smaller share in political representation and in higher management of large companies and enterprises than their male counterparts. Furthermore, women are on average paid lower wages in regular jobs and occupations (Kantola, 2009; Mitra et al., 2015). Gender inequality is not perpetuated exclusively through differential access to and control over material resources, but gender norms and stereotypes reinforce gendered identities and constrain the behavior of women and men in ways that lead to inequality (Ridgeway, 2011). Worldwide, one in five girls and women aged between 15 and 49 years who have been or are currently married report domestic violence by a spouse within the previous 12 months. Furthermore, one in four women between 20 and 24 years of age report to have been married before the age of 18 years, and women spend about three times the amount of their time on unpaid domestic labor than men (UN DESA, 2017).

Gender equity is not only desirable in its own right, but it is to be seen as a means to an end, as a prerequisite to overall human development and wealth. Women empowerment brings about changes in decision-making that can be beneficial to overall development (Duflo, 2012). Within the scope of the Sustainable Development Goals (SDG), gender equality (SDG 5) is singled out as one of the most important factors in achieving all of the 17 SDGs. In this dissertation, we focus on matters of food security and nutrition as outcome dimensions, which directly relate to SDG 2 ("Zero Hunger") and SDG 3 ("Good Health and Well-Being"). The global community has set their goals to end hunger and to prevent all forms of malnutrition by 2030, but as of today, these goals are still far from being reached. While the number of chronically malnourished people in the world has increased from 777 million in 2015 to 821 million in 2018, more than 150 million children under the age of five years suffer from stunted growth and more than 50 million children under five years of age are affected by wasted growth (FAO et al., 2018, IFPRI, 2018). Apart from these forms of chronic hunger, other forms of malnutrition exist, such as micronutrient malnutrition or obesity.

South Asia is of particular concern with respect to undernutrition, as about one third of the undernourished people live in that region (FAO et al., 2018). India has one of the highest rates of undernourished children in the world with prevalence in stunting of about 38 percent and about 15 percent in prevalence of wasted children (IFPRI, 2018). Tunisia, as a part of the North African region, faces a different pattern of undernourishment. Although general food security is not an issue in this region, especially women face a considerable double burden of malnutrition: while more than 60 percent of Tunisian women are overweight, as much as 32 percent of adult women in Tunisia are considered obese. At the same time, almost one in three Tunisian women of reproductive age is affected by iron deficiency anemia (IFPRI, 2017).

Tunisia and India also are also both of interest concerning matters of gender equality. In both countries, gender roles are by and large defined by a traditional paradigm: biological differences between men and women determine the distribution of roles and responsibilities between the two genders (Latreille, 2008; Batra and Reio Jr., 2016). While marriage is the central institution within the society, men are the main providers within the family and remain the ultimate decision-makers, whereas women's roles and interactions with the society are mediated by their husbands (Augustin, 2012).

1.2. Problem statement

Women empowerment can have significant implications for food security and nutrition in many ways, which is why studying this particular relationship has gained a lot of attention in the development literature (Haddad and Hoddinott, 1994; Lepine and Strobl, 2013; Imai et al., 2014). It has been well demonstrated that households do not necessarily pool their incomes and particularly women may have different preferences than men with regards to the investment of additional resources (Alderman et al., 1995; Lundberg et al., 1996). Empirical literature shows that women invest substantially higher amounts of resources into the well-being of their family members, compared to their male counterparts (Duflo, 2012). Furthermore, it has been found that women might also invest more into particularly healthy types of food (Duflo and Udry, 2004).

However, studying the role of women and their level of empowerment heavily relies on the definition and conceptualization of empowerment. According to Kabeer (1999), women empowerment should be seen as '... the process by which those who have been denied the

ability to make strategic life choices acquire such an ability.' (p. 435). However, developing the tools to analyze this process is challenging. Gender equality is a multidimensional concept, and different dimensions of equality depend on a number of factors and are highly context-specific. For example, women may experience some level of power in participating in decisions on income, but at the same time lack ownership of critical resources to exercise real power. Akter et al. (2017) point out that in order to design meaningful policies targeting gender inequalities, it is important to acknowledge the specific contexts in which certain policies are developed. Therefore, studying gender equality and women empowerment in different contexts is critical to evaluate specific needs and constraints with respect to gender. It follows that addressing both the context-specificity as well as the multidimensionality of women empowerment in the development context is critical in examining the relevance of empowerment for outcomes such as food security and nutrition.

There is a growing body of literature investigating the linkages between women empowerment, food security and nutrition, and a woman's 'power' has been measured by various indicators in empirical literature. Many studies focus on proxy measures of empowerment such as education, the share of household income held by women, or physical capital in the form of assets (Haddad and Hoddinott, 1994; Doss, 1999; Duflo, 2004). More recently, empirical research tried to conceptualize women empowerment and acknowledge its multidimensionality. Lepine and Strobl (2013) for example developed a measure of a woman's bargaining power by asking individuals in rural Senegal about who in the household makes decisions with regards to the wife's health, the children's health, the schooling of children, what to cook and other matters. Subsequently, they empirically analyzed how this measure of a woman's bargaining power relates to child nutritional status and found that female bargaining power has a significant effect on child nutritional status. Another example of such a measure is the Women Empowerment in Agriculture Index (WEAI) (Alkire et al., 2013). The WEAI analyzes women empowerment in agriculture within five domains of empowerment, i.e. production, resources, income, leadership, and time. It has thereafter been used in a number of studies and contexts to analyze women empowerment in general, and the relationship between women empowerment and nutrition in particular (Sraboni et al., 2014; Malapit et al., 2015; Malapit and Quisumbing, 2015; Zereyesus, 2017). The general picture is that the positive relationship between a strong position of women and nutritional outcomes can be confirmed in various contexts. However, virtually all of these studies either focus on South Asia or Sub-Saharan Africa, but very little evidence exists for the Arab region.

Therefore, we collected extensive data on household food security, dietary diversity and detailed information related to gender roles in rural Tunisia. We analyze these data with respect to the level of women empowerment and nutrition in Tunisian farm households, and particularly focus on the relationship between women empowerment and dietary diversity. The results can help to further understand patterns of intra-household resource allocation, dietary patterns and women empowerment and more specifically to understand the role of women in the Arab culture.

Apart from analyzing differences in outcomes related to the well-being of children *between* households, another approach is to investigate differences between individuals *within* the same household. Empirical literature suggests that children within the same household often do not experience similar amounts of care and resources, especially in developing countries, but resources are rather allocated unevenly across siblings, typically by birth order and gender (Behrman, 1986; Horton, 1988; Ota and Moffatt, 2007; Azam et al., 2012). In India, especially girls with older siblings are particularly vulnerable to being neglected (Pande, 2003; Raj et al., 2015). While daughters usually leave the parental home after marriage and stay with their grooms' families, the practice of dowry poses a financial burden after marriage of daughters, which is especially problematic for comparatively poor families (Sen and Drèze, 2002). Evidence shows that girls receive less childcare, are breastfed for shorter periods of time and receive less vitamin supplementation (Barcellos et al., 2014).

Empirical studies focusing on differences between children within households usually analyze disaggregated data in a descriptive manner and include dummy variables into their empirical specifications to examine specific group effects, such as birth order or gender (Pande 2003; Sraboni et al., 2014; Barcellos, 2014; Raj et al., 2015). We argue that patterns of intra-household inequalities in outcomes can be better examined by actually constructing a measure of inequality within households and using it as dependent variable. To the best of our knowledge, this dissertation is the first that uses such a measure to analyze the role of women empowerment for explaining differences in nutritional outcomes within households. Furthermore, we are not aware of any study analyzing linkages between women empowerment and nutritional outcomes using panel data.

1.3. Research objectives and approach

This dissertation comprises two essays addressing the linkages between women empowerment, food security and nutrition. The first essay in Chapter 2 uses data from a comprehensive household survey in rural Tunisia. We examine the level of women empowerment by using the methodology of the WEAI and investigate the relationship between different measures of women empowerment and food security and nutrition of households and women in the sample. In the second essay in Chapter 3, we use two rounds of nationally representative household survey data from the Indian Human Development Survey (IHDS) to identify a causal relationship between measures of women empowerment and nutritional status of children, and also examine possible effects of women empowerment on nutritional inequalities between siblings within households. Specifically, we aim to answer the following questions:

1. What is the level of women empowerment in general, and in which specific areas are women particularly disadvantaged?
2. What is the situation of food security and nutrition in Tunisia and India?
3. Is there a relationship between women empowerment and different measures of food security, nutrition and nutritional status?
4. Are there differences between the indicators of women empowerment, and if so, which are the areas that matter most for analyzing the connection between women empowerment and nutrition?
5. Can women empowerment also straighten nutritional differences between children within the same household?

The first three questions are addressed in both essays, question four is particularly examined in the first essay and question five is dealt with in the second essay. The findings of this research have the potential to give critical insights into intra-household allocation of resources and decision-making. Furthermore, they may contribute to policy-making aiming at improving food security and nutrition and emphasize the relevance of increasing opportunities for women to contribute to human development in general and to improve the livelihoods of individuals living in their households in particular.

1.3.1. Data

Data for this research stem from two different sources. The first essay uses data from a comprehensive household survey in the central-northern parts of Tunisia, which was part of the collaborative project '*Mind the Gap - Improving Dissemination Strategies to Increase Technology Adoption by Smallholders*' between the University of Goettingen and the International Center for Agricultural Research in the Dry Areas (ICARDA). Data collection was carried out by a team of researchers (including the author) from the University of Goettingen between October and December 2016. A total of 700 households in 70 villages of the Tunisian governorates of Kairouan and Zaghouan were collected with the help of local enumerators. Besides questions on household demographics and agriculture, the questionnaire covered detailed questions on gender relations and decision-making, which were administered to both the main female and male decision-makers in the household. Because of the sensitive nature of these questions, the respondents were interviewed separately and also by different enumerators, typically a male enumerator for the male respondent, and a female enumerator for the female respondent. Data on household food security and nutrition were administered to the person most responsible to food preparation.

For the second essay, two waves of secondary data from the Indian Human Development Survey (IHDS), a nationally representative household survey from India were used (Desai et al., 2010, 2015). The interviews were carried out between 2004-05 and 2011-12 in face-to-face interviews typically interviewing the head of the household, where 34,621 households were interviewed in both survey rounds. Furthermore, ever-married women aged 15-49 years were interviewed with regards to health and nutritional status, education, family planning, fertility, marriage and gender relations in the household and community.

This dissertation is structured as follows. Chapter 2 presents the first essay, dealing with the effects of women empowerment on the food security and nutrition in Tunisian farm households. In Chapter 3 the second essay is presented, which analyzes the role of women empowerment for child nutritional status and nutritional inequalities within households in India. Chapter 4 draws a broader conclusion and is followed by the References and the General Appendix, which contains excerpts from the questionnaire used in the 2016 household survey in Tunisia.

2. Women empowerment and nutrition in Tunisian farm households[1]

Abstract

Empowering women increases their bargaining power within the household, which often also leads to more resources being allocated to nutrition and health with positive outcomes for the well-being of household members. However, a woman's level of autonomy in intra-household decision-making and related effects on family well-being are highly context-specific. We analyze the relationship between women empowerment and nutrition in smallholder farm households in Tunisia, contributing to the limited literature available on this topic for the Arab region. The analysis uses gender-disaggregated data collected through a primary survey. Different dimensions of women empowerment are examined using the Women Empowerment in Agriculture Index (WEAI). Nutrition effects are evaluated with household-level and individual-level data on dietary diversity. Results indicate that more than 30 percent of the women in the smallholder households feel disempowered. We find a strong positive association between women empowerment and dietary diversity, also after controlling for various other factors that may influence nutrition, such as household living standard, education, market access and farm production diversity. Further disaggregated analysis suggests that different domains of women empowerment matter jointly for nutritional quality.

Keywords: women's empowerment, gender, nutrition, Tunisia, North Africa

[1] This chapter is co-authored by Jutta Werner (JW) and Matin Qaim (MQ). MK developed the research idea, collected the survey data in 2016, did the data analysis and wrote the essay. JW and MQ commented at the many stages of the research and contributed to writing and revising the final essay.

2.1. Introduction

Intra-household decision-making in the context of economic and human development is an issue that is not yet sufficiently understood. Women play a major role in agricultural production, accounting for 43 percent of the agricultural labor force (FAO, 2011). Women also make many of the food production and consumption decisions and are therefore crucial for rural economic development (Duflo, 2012; de Brauw 2015). Women's level of autonomy in intra-household decision-making is highly context-specific and depends on a large number of factors. A growing body of literature has evaluated factors of women empowerment in developing countries by looking at gendered income generation and control (Anderson and Eswaran, 2009), bank account ownership (Bushra and Wajiha, 2015), education (Samarakoon and Parinduri, 2015), membership in local groups (Chiputwa and Qaim, 2016; Lecoutere, 2017; Meemken and Qaim, 2018) or access to agricultural markets (Gupta, Pingali and Pinstrup-Anderson, 2017). Overall, there is a broad consensus that a key component of women empowerment is enhancing women's abilities to make strategic life choices (Malhotra and Schuler, 2005; Duflo, 2012).

However, women empowerment is not only an end in itself, but it can also affect economic efficiency and the well-being of different household members. Empirical evidence suggests that households do not necessarily pool their income or allocate their resources in a pareto-efficient way (Thomas, 1990; Lundberg, Pollak and Wales, 1996; Udry, 1996; Haddad, Hoddinott and Alderman, 1997). This can create a gender gap in the control of economic resources within the household, with critical implications for agricultural productivity and various other development outcomes (Doss, 2006; FAO, 2011). For instance, studies have shown that women spend income differently than men; often women spend more on dietary quality, nutrition and health with positive effects on the well-being of children and other family members (Duflo and Udry, 2004). Hoddinott and Haddad (1994) showed that the income share held by women has positive effects on child nutritional status in Côte d'Ivoire. Other studies showed positive effects of women empowerment on dietary quality and nutrition in Senegal (Lepine and Strobl, 2013), Kenya (Fischer and Qaim, 2012), Ghana (Malapit and Quisumbing, 2015; Zereyesus, 2017), Bangladesh (Sraboni et al., 2014), Nepal (Malapit et al., 2015) and India (Imai et al., 2014).

We contribute to this body of literature by analyzing the relationship between women empowerment and nutrition in Tunisian farm households. A focus on a country in the Arab

region is particularly interesting, as little related evidence exists for this part of the world. Results from other regions do not necessarily hold due to the specific role of women in the Arab culture (Badr, 2010; Sinha, 2011; Augustin et al., 2012). In the Arab region, the role of women in agriculture is largely defined by a traditional patriarchal gender paradigm, determining the relationship between men and women in the public and private spheres of social life. The institution of marriage is central, and within this institution, the role of women is that of a devoted wife, mother and homemaker (Augustin et al., 2012). Men are considered to be the main providers of the family holding and the ultimate decision-making power, while a woman's public appearance and interactions in social life are usually channeled through her husband. These norms are particularly relevant for rural households, where women rarely own land and typically have very limited access to other productive resources such as agricultural inputs and services such as credit and extension (Badr, 2010; Augustin et al., 2012). In terms of nutrition, while rates of calorie deficiency are relatively low in the Arab region, micronutrient deficiencies and low dietary quality are widespread and contribute to a high burden of nutrition-related diseases (Musaiger et al., 2011; Development Initiatives, 2018).

In Tunisia, despite major achievements in reducing food insecurity, a double burden of malnutrition – with the coexistence of micronutrient deficiencies and obesity – is a health challenge of rising importance. The prevalence of anemia in women of reproductive age increased from 28 percent in 2011 (International Food Policy Research Institute, 2015) to 31 percent in 2014 (International Food Policy Research Institute, 2017). At the same time, almost two-thirds of the women and more than half of the men are either overweight or obese (Development Initiatives, 2018). The status of women in rural Tunisia has changed to some extent over the past few decades, even though traditional gender roles continue to prevail (Mellouli, 2007; Sinha, 2011). While women account for an increasing share of the agricultural labor force, men are usually still considered the managers of family farms (Latreille, 2008). Women are predominantly engaged in tasks such as feeding and milking of animals, planting of vegetables and harvesting of various crops, in addition to their domestic tasks such as house cleaning and child care (Latreille, 2008).

We use primary survey data collected in two governorates of Tunisia to address three specific research questions: First, what is the level of women empowerment in smallholder farm households? Second, what is the situation of food security and dietary quality in these farm households? Third, to what extent does women empowerment influence food security and

dietary quality? Given the evidence from other world regions, we hypothesize that women empowerment is positively associated with dietary quality, also after controlling for other relevant factors. This hypothesis will be tested with different sets of regression models.

Women empowerment is measured using the recently developed Women Empowerment in Agriculture Index (WEAI) (Alkire et al., 2013). WEAI is a survey-based index that is calculated with data from the primary male and female decision-makers within the same household. In addition to calculating an aggregate empowerment index, we also use the WEAI framework to identify in which particular domains women are disempowered and to examine which domains matter most for food security and dietary quality. Food security and dietary quality are calculated with household-level and individual-level food consumption data that were also collected as part of the survey. We use the household dietary diversity score (HDDS) as an indicator of food security and the women's dietary diversity score (WDDS) as an indicator of women's dietary quality. While HDDS captures the types of foods consumed at the household level, WDDS additionally captures issues of intra-household food distribution, which may also be influenced by women empowerment.

2.2. Material and methods

2.2.1. Data and study area

Data for this research were collected through a survey of smallholder farm households in the governorates Zaghouan and Kairouan, located in central-northern Tunisia. This region is characterized by a semi-pastoral agricultural system. Virtually all farms in this part of Tunisia are involved in sheep production. In addition, most of them grow barley primarily as animal fodder, and some also grow wheat, olives, and a few other fruits and vegetables. In this study, we focus on smallholder households, as these are the poorest and most affected by food insecurity and low dietary quality. In the study region, farm size is mostly defined in terms of the number of sheep owned. We define smallholders as farm households owning less than 40 sheep. We randomly selected 70 villages in the two governorates and then randomly selected 10 smallholders in each village, resulting in a total of 700 observations.

The interview-based survey was conducted in late 2016 using a structured questionnaire that was developed and pretested for this purpose. The interviews were carried out by Tunisian

enumerators, who were trained and supervised by the researchers. We collected data at household and individual levels, interviewing the household head and his/her main spouse. Because of the sensitive nature of interviewing people on gender relations and women empowerment, we sent two enumerators – one female and one male – into each household. The two enumerators interviewed the male and female respondents separately. This may have helped to reduce possible response bias. In addition to gender aspects, detailed data on general household characteristics, agricultural practices, and other economic activities were also collected. Food consumption data at the household level were collected through a 7-day recall, which was answered by the person responsible for food preparation in the household. To capture individual-level diets, we administered a 24-hour dietary recall separately for male and female respondents.

Due to the need to always interview two individuals in each household, we were unfortunately not able to collect complete data for all 700 smallholder households. In a significant number of households, we were not able to interview female spouses leading to incomplete data especially for the WEAI part and for individual diets. We only have complete WEAI data for 478 households and complete individual-level dietary data for 467 households. However, it is important to note that data incompleteness is not due to women refusing or not being allowed by their husbands to participate in the study. In fact, very few women refused to participate in the interview. The main reason is rather that heavy rains occurred during the survey period and made access to some of the farms impossible. In those cases, we invited the male respondent to a meeting place – such as a coffee shop in the next small town – to conduct the interview. For female respondents such interviews outside of the household were not possible due to cultural restrictions. Table A2.1 in the appendix compares general household and individual characteristics – like household location, infrastructure access, household size, or age and education of male and female respondents – for the full sample with 700 observations and the reduced subsample with 478 observations. The differences in mean values are very small. None of the mean differences is statistically significant, so we conclude that the reduced subsample is an unbiased representation of the full sample. Overall, the data are representative for smallholder sheep-barley systems in central-northern Tunisia.

2.2.2. Measuring food security and dietary quality

Dietary diversity scores count the number of different food groups consumed over a defined period of time (Kennedy et al. 2010; Heady and Ecker, 2013; Maxwell et al. 2014). These scores can be calculated at the household level, where they are mostly used as indicators of food security and economic access to food, or at the individual level, where they are mostly used as proxies of individual dietary quality.

We use the 7-day household-level food consumption data to calculate the household dietary diversity score (HDDS), which is a common indicator of food security. The HDDS is calculated based on the following 12 food groups (Kennedy et al., 2011): cereals; white tubers and roots; vegetables; fruits; meat; eggs; fish and other seafood; legumes, nuts and seeds; milk and milk products; oils and fats; sweets; spices, condiments and beverages. Thus, the HDDS can take values between 0 and 12. There is no generally agreed cut-off below which households are considered food insecure (Kennedy et al., 2011), as the absolute values also depend on the recall period chosen. However, larger HDDS values imply higher levels of household food security and dietary diversity.

We use the 24-hour dietary recall from the interviews with female respondents to calculate the women's dietary diversity score (WDDS). As the WDDS is calculated at the individual level, it also takes into account issues of intra-household food distribution, which the HDDS does not. The WDDS is calculated based on the following 9 food groups (Kennedy et al., 2011): starchy staples; dark green leafy vegetables; other vitamin A rich fruits and vegetables; other fruits and vegetables; organ meat; meat and fish; eggs; legumes, nuts and seeds; milk and milk products. Other food groups, such as oils and fats, sweets, or beverages and condiments are not included, as they contribute little to micronutrient intakes. Hence, the WDDS focuses particularly on dietary quality. As for the HDDS, there is no generally agreed cut-off for the WDDS below which dietary quality is considered critical. However, the WDDS is similar to the minimum dietary diversity score for women, where a minimum of five food groups per day is considered a threshold for adequate micronutrient supply (FAO and FHI 360, 2016). Recent research showed that dietary diversity scores for women are significantly correlated also with individual-level dietary diversity scores for children and other household members (Fongar et al., 2019). Hence, the WDDS may be a suitable proxy for individual-level dietary quality in the sample households more generally.

2.2.3. Measuring women empowerment

Proper measurement of women empowerment is a difficult task because the concept of empowerment is multifaceted. Kabeer (1999, p. 436) defines empowerment as the '… ability to make choices…', while exercising choice has three interrelated dimensions: resources as preconditions of empowerment; agency, which describes the process of empowerment; and achievements, which are the outcomes of empowerment. We use the WEAI approach that was recently developed by the International Food Policy Research Institute (IFPRI), the Oxford Policy and Human Development Initiative (OPHI), and the United States Agency for International Development (USAID) (Alkire et al., 2013). WEAI offers a way of measuring a woman's empowerment by focusing on the agency dimension of empowerment. WEAI does not only take into account the domestic sphere, but also considers productive and economic spheres (Malapit and Quisumbing, 2015). In that sense, WEAI differs from other measures of empowerment that focus primarily on intra-household bargaining and decision-making. Unlike WEAI, some of the earlier measures of empowerment also did not compare men and women within the same household.

WEAI is composed of two sub-indices. The first is the 'five domain empowerment' (5DE) sub-index, which measures the empowerment of women in five domains, namely (i) decisions about agricultural production, (ii) access to productive resources, (iii) control over income, (iv) leadership in the community and (v) time allocation. Empowerment in these five domains is measured through ten different indicators (Alkire et al., 2013). A woman is considered 'empowered' when she has adequate achievements over the five domains[2]. The second WEAI sub-index is the 'gender parity index' (GPI), which considers intra-household inequality between the primary female and male decision-makers. GPI measures the relative parity of the female and male respondents, as a percentage of women lacking gender parity relative to their male counterparts in the households, accounting for the gap in empowerment between men and women for households without gender parity. At the aggregate level (for the sample as a whole), WEAI is calculated as a weighted sum of both sub-indices. More details on how WEAI is constructed and validated can be found in Alkire et al. (2013).

[2] For the 5DE sub-index, an adequacy cut-off is selected to identify who is empowered. Following Alkire et al. (2013), when the adequacy cut-off is at 80 percent, a woman is considered empowered if her adequacy score is higher than 80 percent. In other words, the woman has adequate achievements in four of the five domains or enjoys adequacy in some combination of the weighted indicators that sum up to 80 percent or more.

2.2.4. Regression analysis

To investigate the association between women empowerment and food security and dietary quality, we estimate regression models of the following type:

$$DDS = \beta_0 + \beta_1 WE + \beta_2 X + \beta_3 H + \beta_4 C + \varepsilon, \quad (1)$$

where DDS is the household-level or individual-level dietary diversity score, WE is a measure of women empowerment, X is a vector of variables to control for individual, household and contextual factors and ε is a random error term. In separate regressions, we use six different variables to capture women empowerment (Table 2.1). These build on the WEAI data collected for each household. The first WE variable is the empowerment score that combines the female responses for the five empowerment domains. The other five WE variables use the response data for each of the five empowerment domains separately (see Table 2.1 for variable descriptions). We hypothesize that women empowerment is positively associated with food security and dietary quality, which would mean positive and significant estimation coefficients forβ_1. Using different WE variables in separate regressions will help to test whether all or only some of the different domains of women empowerment are relevant for the dietary outcomes. As the WE variables are measured in different units and scales, we will also calculate elasticities to facilitate comparison.

Table 2. 1 Description of empowerment variables

Variable	Description
Empowerment score	5DE empowerment score of the female respondent, which is the weighted average of achievements in the ten indicators of the WEAI. It increases in empowerment and ranges from zero to one
Input into agricultural decisions	Total number of agricultural activities (such as food and cash crop farming, livestock raising) in which the female respondent reports to have at least some input into decisions
Input into credit decisions	Dummy variable equal to one, if the female respondent reports to participate in decisions on credit in at least one source of credit
Input into income decisions	Total number of domains (such as agricultural production and marketing, household expenditures, salary and employment) in which the female respondent reports to have at least some input into decisions regarding the use of household income
Speaking in public	Dummy variable equal to one, if the female respondent reports to feel at least somewhat comfortable in speaking in public
Leisure time	Respondent's self-assessment regarding her satisfaction with the available time for leisure activities on a five-point scale.

In terms of the control variables, X, we include typical socio-demographic variables such as age and education of the household head and household size, as well as living standard and wealth indicators such as per capita household consumption values and the land area cultivated. We also control for farm production diversity in terms of the number of different crop and livestock species produced. Previous research with data from different countries showed that farm production diversity can positively affect dietary diversity, as smallholder households often consume a significant share of what they produce at home (Jones et al., 2014; Sibhatu, Krishna and Qaim, 2015). In the context of our study, farm households mainly cultivate barley as fodder for their sheep. However, many also cultivate food crops, such as wheat, oat, beans, almonds, olives, tomatoes, and other vegetables and fruits. Finally, we control for distance to the closest market, as much of the food consumed in the smallholder households is purchased from the market, and for unobserved regional characteristics through a governorate dummy variable.

2.2.5. Possible endogeneity

In order to interpret the effects of women empowerment on food security and dietary quality in a causal sense, WE in the regression models would have to be exogenous, which may not be the case. One possible source of endogeneity could be reverse causality, which seems unlikely in our case: we do not expect that dietary diversity would have any significant effect on women empowerment. Another possible source of endogeneity is unobserved heterogeneity, which is more likely in our context, as it cannot be ruled out that unobserved factors influence women empowerment and dietary diversity simultaneously. We tried to address this issue by using an instrumental variable (IV) approach, but unfortunately were not able to find valid instruments for women empowerment. One instrument that we tried was the age difference between the female and male respondents. A smaller difference in age could possibly result in higher female bargaining power. A second instrument that we tried was the difference in education between the respondent and his/her sibling with the highest educational attainment. Differences in education between siblings could possibly relate to the distribution of bargaining power prior to marriage, which in turn might also influence the bargaining power after marriage. Unfortunately, both variables are not sufficiently correlated with the women empowerment variables. Other variables that we tried did not fulfil the exclusion criterion.

Against this background, we will interpret the estimation results primarily as associations without making strong claims of causality. It should be mentioned, however, that a few earlier studies that had analyzed the relationship between women empowerment and nutrition in different geographical contexts were able to use IV approaches (Lepine and Strobl, 2013; Sraboni et al., 2014). These earlier studies found that ordinary least squares (OLS) and IV models led to similar estimates, only that the OLS results were underestimated. We use these earlier findings to argue that endogeneity bias – if existent in our case – would likely not overturn the results. Nevertheless, some caution is warranted and additional research would be required for making robust causal inference.

2.3. Results

We start the presentation of the results by looking at descriptive statistics for various individual-level and household-level variables, including general socioeconomic characteristics as well as the main variables of interest, namely dietary diversity and women empowerment. Further below, we will then present and discuss the regression estimates, including the calculation of elasticities for easier comparison of the effect sizes.

2.3.1. Socioeconomic characteristics

Table 2.2 presents descriptive statistics for the key variables included in the analysis. The average sample household has around five members and cultivates 5.6 hectares of land. Most of this land is cultivated with barley and other grains under rain fed conditions and with low productivity due to the dry climate. The average production diversity is 3.8. Most of the households are male-headed (96%), and the male household heads have a much higher level of education than their female spouses. In terms of market access, the average distance to the closest food or agricultural market is about 14 kilometers, implying that market visits have to be planned with proper transportation. The villages and communities in the study area are quite dispersed. Also within the villages, households are dispersed; it is not uncommon that a household is more than one kilometers away from the next one.

Table 2. 2 Descriptive statistics

Variables	Mean	Std. dev.	Min.	Max.
Household characteristics				
Household size (members)	5.278	2.018	1	15
Distance to nearest market (km)	13.66	10.17	0	70
Production diversity (species count)	3.833	1.646	1	9
Total cultivable land area (ha)	5.585	7.145	0	80
Monthly consumption per capita (TND)	648.217	1992.343	16.667	40638.67
Regional dummy (Zaghouan=1)	0.331	0.471	0	1
Individual characteristics				
Age of household head (years)	55.05	13.86	20	93
Sex of household head (male)	0.960	0.196	0	1
Years of schooling of household head	4.360	4.113	0	17
Age of female respondent (years)	49.60	13.20	20	84
Years of schooling of female respondent	1.858	3.159	0	17
Dietary diversity				
Household dietary diversity score (HDDS)	9.211	1.693	2	12
Women's dietary diversity score (WDDS)	4.970	1.762	1	9
Women empowerment				
Empowerment score (5DE)	0.631	0.135	0.100	0.933
Input into agricultural decisions	3.709	2.252	0	9
Input into credit decisions	0.119	0.324	0	1
Input into income decisions	3.540	2.081	0	9
Speaking in public	0.759	0.428	0	1
Leisure time	3.314	1.464	1	5
Observations: 478				

2.3.2. Dietary diversity

Table 2.2 also shows descriptive statistics for the food security and dietary quality variables. A mean value of 9.2 for the HDDS implies that the average household consumed about 9 food groups during the 7-day recall period. This is similar to other recent research that had used 7-day recall data to assess household dietary diversity among smallholders in different countries of sub-Saharan Africa (Sibhatu et al. 2015; Fongar et al. 2019). In other words, average dietary diversity is relatively low in rural Tunisia, which may be related to market distance and a relatively low diversity of foods produced on the own farm.

With around five food groups consumed on average, the WDDS is still much lower than the HDDS. This should not surprise because of the shorter recall period for the WDDS calculations (24 hours instead of 7 days) and the fact that only the foods that the primary

female adult consumed are considered. Moreover, as explained above, the total number of food groups considered for the WDDS is smaller than that for the HDDS because less nutritious foods are not included. The WDDS data point at low dietary quality. Forty percent of the women in our sample consume fewer than five food groups per day, which is often used as a threshold for micronutrient adequacy (FAO and FHI 360, 2016; Fongar et al., 2019). Twenty-two percent of the women even consume fewer than four food groups per day, which points at widespread micronutrient deficiencies.

Table 2.3 provides additional insights into the composition of the dietary diversity scores and the different food groups consumed. For the HDDS, food groups like cereals, vegetables and oils and fats were consumed by almost all of the households during the 7-day recall period. Several other nutritious food groups – such as fruits, fish, and especially legumes, nuts and seeds – were consumed much less widely. At the individual level, starchy staples were consumed on a daily basis by most of the female respondents, whereas many of the more micronutrient-dense foods were consumed much less frequently. Especially dark green leafy vegetables, which are important sources of provitamin A and iron, were consumed by only one-quarter of the female respondents during the 24-hour recall period. Animal source products, as well as legumes, nuts and seeds, were not consumed by 30-60% of the females on a regular basis.

Table 2. 3 Proportions of households/individuals consuming different food groups

No.	HDDS	Mean	WDDS	Mean
1	Cereals	0.996	Starchy staples	0.989
2	White tubers and roots	0.980	Dark green leafy vegetables	0.253
3	Vegetables	0.992	Other vitamin A rich fruits and vegetables	0.660
4	Fruits	0.745	Other fruits and vegetables	0.820
5	Meat	0.799	Organ meat	0.064
6	Eggs	0.743	Meat and fish	0.642
7	Fish and other seafood	0.410	Eggs	0.533
8	Legumes, nuts and seeds	0.190	Legumes, nuts and seeds	0.373
9	Milk and milk products	0.816	Milk and milk products	0.630
10	Oils and fats	0.964	-	-
11	Sweets	0.628	-	-
12	Spices, condiments and beverages	0.950	-	-

2.3.3. Women empowerment

Descriptive statistics of the women empowerment variables that we use in the regression models are shown in the lower part of Table 2.2. The empowerment score, which uses all ten indicators of the five domains of empowerment (5DE), has a mean value of 0.63, implying that women have adequate achievements in about six out of ten empowerment indicators when taking the average over all sample households. Looking at the different domains of empowerment, on average women feel to have any input into agricultural decisions in less than four (3.7) out of nine agricultural activities. Only 12 percent of the female respondents feel to have any input into decisions on credit, suggesting that financial resources in particular are mainly in the hands of the male decision-makers. Furthermore, female respondents feel to have any input in less than four out of nine spheres of income-related decisions. And around one-quarter of the women do not feel comfortable speaking in public, suggesting that participation in public and political discourse is a challenge for many of them.

While we use the individual household observations of women empowerment as explanatory variables in the regression models, it is still interesting to also use the data for calculating the WEAI for the sample as a whole, as shown in Table 2.4. As explained above, the WEAI is a weighted sum of the 5DE and the GPI sub-indices, both of which are also shown in Table 2.4. The 5DE sub-index of 0.646 implies that around 35 percent of the women feel disempowered related to the five domains when applying the common 80 percent adequacy cut-off. The GPI of 0.876 implies that around 12 percent of the female respondents live in households in which no parity in empowerment between male and female adults is achieved. Weighting these sub-indices yields a WEAI of 0.669 for our sample from rural Tunisia. This is lower than what recent empirical estimates of the WEAI found for rural women in Bangladesh (0.76), Guatemala (0.70) and Uganda (0.80) (Alkire et al., 2013). As the WEAI calculations depend on subjective responses to specific empowerment questions, comparisons across countries should not be over-interpreted. Nevertheless, comparatively low levels of women empowerment in rural Tunisia are in line with the traditional patriarchal gender paradigm that is still observed in large parts of the Arab region.

Table 2. 4 Aggregate indicators of women empowerment

Five domains empowerment index	0.646
Gender Parity Index	0.876
Women Empowerment in Agriculture Index	0.669

Table 2.5 shows how the five domains and 10 indicators contribute to women disempowerment. The two domains leadership and time allocation together account for 61 percent of total disempowerment, followed by access to resources (22.5 percent), production decisions (11.7 percent) and income control (4.8 percent). In terms of the indicators, the indicator that contributes most to disempowerment is group membership (23.7 percent), followed by workload (23 percent) and access to credit (15.5 percent). It is important to note that these numbers rely on the weights and adequacy cut-offs of the WEAI methodology and do not reflect the indicators' or domains' relevance for nutrition, which is analyzed below.

Table 2. 5 Percentage contributions of domains and indicators to disempowerment

Domain	Percentage contribution	Indicator	Percentage contribution
Production	11.7	Input into productive decisions	4.7
		Autonomy in production	7
Resources	22.5	Ownership of assets	3.6
		Purchase, sale and transfer of assets	3.3
		Access to and decisions on credit	15.5
Income	4.8	Control over use of income	4.8
Leadership	30	Group membership	23.7
		Speaking in public	6.4
Time	31	Workload	23
		Leisure time	8
	100		100

2.3.4. Regression results

Tables 2.6 and 2.7 show the regression results for the associations between women empowerment and dietary diversity at household and individual levels. In Table 2.6, the HDDS is the dependent variable in all models. The six models shown are all identical with the only exception that different measures of women empowerment are used as explanatory variables. In column (1) of Table 2.6, the empowerment score that aggregates all five empowerment domains is used as explanatory variable. The empowerment score is positively and significantly associated with household dietary diversity, as expected. This means that women empowerment has a positive influence on household food security, also after controlling for living standard and other possible confounding factors.

Table 2. 6 Women empowerment and household dietary diversity

Variables	(1) Empower-ment score	(2) Input into agricultural decisions	(3) Input into credit decisions	(4) Input into income decisions	(5) Speaking in public	(6) Leisure time
Empowerment variable of female respondent	1.102**	-0.0106	0.737***	0.102***	0.417**	0.0977*
	(0.545)	(0.0329)	(0.222)	(0.0355)	(0.170)	(0.0501)
Age of household head	0.0590	0.0647*	0.0593*	0.0602*	0.0652*	0.0598*
	(0.0359)	(0.0360)	(0.0356)	(0.0357)	(0.0357)	(0.0359)
Age of household head squared	-0.000497	-0.000554*	-0.000505	-0.000518	-0.000551*	-0.000514
	(0.000317)	(0.000318)	(0.000313)	(0.000314)	(0.000315)	(0.000316)
Years of schooling household head	0.0502**	0.0551***	0.0539***	0.0515***	0.0521***	0.0493**
	(0.0197)	(0.0196)	(0.0194)	(0.0195)	(0.0195)	(0.0198)
Household size	0.104***	0.0995***	0.107***	0.106***	0.106***	0.102***
	(0.0382)	(0.0383)	(0.0379)	(0.0380)	(0.0381)	(0.0381)
Per capita consumption (ln)	0.302***	0.300***	0.288***	0.313***	0.304***	0.297***
	(0.0906)	(0.0910)	(0.0900)	(0.0904)	(0.0905)	(0.0907)
Total land in ha(ln)	0.0157	0.0177	0.0364	0.0222	0.0249	0.0111
	(0.0661)	(0.0664)	(0.0658)	(0.0658)	(0.0660)	(0.0662)
Production diversity	0.252***	0.263***	0.252***	0.228***	0.243***	0.260***
	(0.0613)	(0.0626)	(0.0608)	(0.0619)	(0.0614)	(0.0612)
Distance to nearest market	-0.0183**	-0.0190**	-0.0167**	-0.0184**	-0.0188**	-0.0168**
	(0.00742)	(0.00745)	(0.00738)	(0.00738)	(0.00739)	(0.00748)
Regional dummy (Zaghouan = 1)	-0.561***	-0.597***	-0.601***	-0.520***	-0.576***	-0.593***
	(0.162)	(0.161)	(0.160)	(0.162)	(0.161)	(0.161)
Constant	4.754***	5.367***	5.366***	5.053***	4.955***	5.158***
	(1.071)	(1.054)	(1.027)	(1.034)	(1.043)	(1.038)
Observations	478	478	478	478	478	478
R-squared	0.165	0.158	0.177	0.173	0.169	0.165

Coefficient estimates of OLS regressions are shown with standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.

The other columns in Table 2.6 show results with disaggregated empowerment indicators for each of the five empowerment domains. All of the empowerment indicators have positive and statistically significant coefficients, except for one, namely the indicator related to female input into agricultural decisions. Overall, these results suggest that several of the empowerment domains play a role for household food security, even though the effects seem to vary. The coefficient magnitudes for the different empowerment indicators as shown in Table 2.6 cannot be compared because of different measurement scales. For better comparison, we calculate elasticities for each of the indicators below.

In Table 2.7, the WDDS is the dependent variable in all models. The results for the different empowerment indicators are very similar to those in Table 2.6, underlining that women empowerment not only matters for household food security but also plays a significant role for women's dietary quality. This is true for the aggregate empowerment score as well as for the disaggregated indicators referring to the different empowerment domains.

Table 2. 7 Women empowerment and women's dietary diversity

Variables	(1) Empower-ment score	(2) Input into agricultural decisions	(3) Input into credit decisions	(4) Input into income decisions	(5) Speaking in public	(6) Leisure time
Empowerment variable of female respondent	1.134*	0.106***	0.533**	0.146***	0.465**	0.0947*
	(0.583)	(0.0344)	(0.235)	(0.0367)	(0.186)	(0.0530)
Age of household head	0.111***	0.128***	0.115***	0.109***	0.118***	0.114***
	(0.0388)	(0.0384)	(0.0385)	(0.0382)	(0.0385)	(0.0387)
Age of household head squared	-0.0009**	-0.001***	-0.0009***	-0.0009**	-0.0009***	-0.0009***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Years of schooling household head	0.0504**	0.0558***	0.0539**	0.0535***	0.0516**	0.0510**
	(0.0211)	(0.0208)	(0.0209)	(0.0207)	(0.0209)	(0.0211)
Household size	0.0243	0.0146	0.0216	0.0245	0.0271	0.0207
	(0.0390)	(0.0386)	(0.0388)	(0.0384)	(0.0389)	(0.0389)
Per capita consumption (ln)	0.253***	0.241***	0.237**	0.275***	0.265***	0.245***
	(0.0921)	(0.0916)	(0.0921)	(0.0911)	(0.0920)	(0.0922)
Total land in ha(ln)	-0.0591	-0.0540	-0.0418	-0.0501	-0.0512	-0.0615
	(0.0708)	(0.0703)	(0.0708)	(0.0698)	(0.0705)	(0.0709)
Production diversity	0.330***	0.291***	0.330***	0.281***	0.319***	0.337***
	(0.0632)	(0.0644)	(0.0631)	(0.0639)	(0.0633)	(0.0632)
Distance to nearest market	-0.0159**	-0.0142*	-0.0146*	-0.0152*	-0.0161**	-0.0145*
	(0.00795)	(0.00792)	(0.00796)	(0.00785)	(0.00792)	(0.00801)
Regional dummy (Zaghouan = 1)	-0.200	-0.221	-0.229	-0.144	-0.225	-0.226
	(0.170)	(0.168)	(0.169)	(0.168)	(0.169)	(0.169)
Constant	-0.736	-0.725	-0.136	-0.535	-0.628	-0.335
	(1.139)	(1.109)	(1.099)	(1.091)	(1.113)	(1.105)
Observations	467	467	467	467	467	467
R-squared	0.147	0.158	0.150	0.169	0.152	0.146

Coefficient estimates of OLS regressions are shown with standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Interestingly, also female input into agricultural decisions is positive and significant in the WDDS model (column 2 of Table 2.7), which was not the case in the HDDS model. A possible interpretation is that with more input into agricultural decisions, women are able to influence farm and household decisions such that more micronutrient-rich foods are produced and consumed. Note that the WDDS differs from the HDDS not only in terms of considering intra-household distribution of foods, but also in terms of the food group classification, with the WDDS putting more emphasis on micronutrient-rich foods (Table 2.3).

The control variables in Tables 2.6 and 2.7 mostly show the expected signs. Education of the household head (years of schooling) has a positive and significant effect on HDDS and WDDS in all models. Better education typically means higher awareness of nutrition and health issues, which is important for healthy diets. Likewise, household living standard (measured in terms of the value of per capita consumption) is positively and significantly associated with HDDS and WDDS. It is a well-known fact that households increase their dietary diversity and nutrition quality with rising living standards. Household size is

positively associated with HDDS but not with WDDS, which is plausible. More household members with different needs and preferences mean more food diversity at the household level, but not necessarily at the individual level. Production diversity has positive and significant coefficients in all models in Tables 2.6 and 2.7, suggesting that farm diversity translates into dietary diversity, probably through the subsistence pathway. However, the negative and significant coefficients for market distance suggest that market purchases also matter for household and individual dietary diversity.

2.3.5. Elasticity estimates

For better interpretation and comparison of the magnitude of the estimated effects, we calculate elasticities for all effects of women empowerment on household and individual dietary diversity. The elasticity estimates are shown in Tables 2.8 and 2.9. In addition to women empowerment, we also show elasticities for some of the other key determinants of dietary diversity, including per capita consumption values, farm production diversity and market distance. Most of the effect sizes are relatively small, and the elasticities do not add up to one, suggesting that several other factors not considered here also influence people's diets and nutrition. Nevertheless, the estimates reveal some interesting patterns. By comparing the elasticities in Tables 2.8 and 2.9 it is revealed that all factors, including women empowerment, have stronger effects on individual dietary diversity (Table 2.9) than on household dietary diversity (Table 2.8). This is unsurprising because the HDDS captures only the types of foods that enter the household, whereas the WDDS with individual-level data additionally captures issues of intra-household distribution, which is also positively affected through women empowerment. Apart from the consistently larger absolute values of the elasticities in Table 9, the results are similar to those in Table 2.8, so we confine the interpretation to the results for individual dietary diversity in Table 2.9. A one percent increase in the aggregate women empowerment score leads to a 0.15 percent increase in women's dietary diversity (Table 2.9, column 1). This aggregate effect is larger than the effects of the individual empowerment domains (columns 2-6), suggesting that several of the empowerment domains matter for improved nutrition. In other words, women empowerment has a particularly positive effect on nutrition when women are empowered in terms of several domains. Among the different empowerment domains, female control of income has the largest effect: a one percent increase in the number of income domains that a woman feels to have some input in increases her dietary diversity score by 0.1 percent (column 4). Other

empowerment domains with relatively large positive effects on dietary diversity are input into agricultural decisions (column 2) and speaking in public (column 5).

Comparing the magnitude of the women empowerment elasticities with those of the other influencing factors also shows an interesting picture. Out of the factors considered, household living standard (per capita consumption) has the largest effect on dietary diversity. This makes sense because economic resources are typically a strong determinant of food security and nutrition. Strikingly, however, out of the variables considered, aggregate women empowerment has the second largest effect and hence seems to be more important for dietary diversity in smallholder households than farm production diversity and market distance.

Table 2. 8 Elasticity estimates of household dietary diversity

Variables	(1) Empowerment score	(2) Input into agricultural decisions	(3) Input into credit decisions	(4) Input into income decisions	(5) Speaking in public	(6) Leisure time
Empowerment variable of female respondent	0.0754**	-0.00426	0.00894***	0.0385***	0.0341**	0.0350*
	(0.0372)	(0.0133)	(0.00252)	(0.0133)	(0.0137)	(0.0178)
Per capita consumption (ln)	0.143***	0.142***	0.136***	0.148***	0.144***	0.141***
	(0.0428)	(0.0430)	(0.0426)	(0.0427)	(0.0427)	(0.0428)
Production diversity	0.0474***	0.0494***	0.0474***	0.0427***	0.0456***	0.0489***
	(0.0113)	(0.0115)	(0.0112)	(0.0114)	(0.0113)	(0.0113)
Distance to nearest market	-0.0275**	-0.0284**	-0.0251**	-0.0277**	-0.0283**	-0.0253**
	(0.0113)	(0.0113)	(0.0112)	(0.0112)	(0.0113)	(0.0114)
Observations	478	478	478	478	478	478

Note: Calculated from base regressions. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 2. 9 Elasticity estimates of women's dietary diversity

Variables	(1) Empowerment score	(2) Input into agricultural decisions	(3) Input into credit decisions	(4) Input into income decisions	(5) Speaking in public	(6) Leisure time
Empowerment variable of female respondent	0.146*	0.0798***	0.0119**	0.103***	0.0725**	0.0643*
	(0.0748)	(0.0252)	(0.00479)	(0.0253)	(0.0284)	(0.0356)
Per capita consumption (ln)	0.224***	0.214***	0.210**	0.244***	0.234***	0.216***
	(0.0812)	(0.0808)	(0.0813)	(0.0806)	(0.0812)	(0.0813)
Production diversity	0.114***	0.100***	0.113***	0.0967***	0.110***	0.116***
	(0.0209)	(0.0214)	(0.0209)	(0.0213)	(0.0210)	(0.0209)
Distance to nearest market	-0.0447*	-0.0400*	-0.0411*	-0.0430*	-0.0455**	-0.0407*
	(0.0230)	(0.0229)	(0.0230)	(0.0227)	(0.0230)	(0.0231)
Observations	467	467	467	467	467	467

Note: Calculated from base regressions. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

2.4. Conclusion

Achieving gender equity and women empowerment are top priorities for international development (United Nations Development Program, 2016). Previous research showed that women play a central role in agriculture, and that women's level of empowerment has crucial implications for their own well-being and that of other family members and society at large. In this paper, we have analyzed women empowerment and its association with diet and nutrition outcomes in rural Tunisia, using primary data from a gender-disaggregated survey of smallholder farm households. The data are representative of smallholder households in the sheep-barley systems of central-northern Tunisia. In particular, we have addressed three research questions. First, what is the level of women empowerment in smallholder farm households? Second, what is the situation of food security and dietary quality in these farm households? Third, to what extent does women empowerment influence food security and dietary quality?

Concerning the first research question, we have used the Women Empowerment in Agriculture Index (WEAI) to measure aggregate women empowerment. We have calculated an aggregate WEAI of 0.67 for our sample from rural Tunisia, which is in the lower range of values recently estimated for several countries in Asia and sub-Saharan Africa (Alkire et al., 2013). In other words, women empowerment in Tunisian smallholder households seems to be relatively low in an international comparison. More than 30 percent of the women in our sample feel disempowered in terms of the five empowerment domains considered in the WEAI framework. Concerning the second research question, we used the household dietary diversity score (HDDS) as an indicator of household food security and the women's dietary diversity score (WDDS) as an indicator of individual dietary quality. While insufficient access to food quantity is not a widespread issue in Tunisia, average dietary diversity is relatively low among smallholder households. A significant proportion of the women remain below critical levels of dietary diversity for micronutrient adequacy. While we did not analyze dietary data from children and other household members, recent research showed strong correlations between dietary diversity indicators for women and children in the same households, so that the WDDS data can be used as a proxy for individual-level diets more generally.

Concerning the third research question, we have developed and estimated several regression models to analyze the associations between different measures of women empowerment and

dietary diversity. The estimation results suggest a strong positive association between women empowerment and dietary diversity. The effects of women empowerment on WDDS are larger than those on HDDS. This is plausible because the HDDS only captures the types of foods that enter the household, whereas the individual-level WDDS additionally captures intra-household distribution, which is positively affected through women empowerment, too. Comparing the effects of different empowerment domains, female input into decisions about the use of household income has a particularly strong effect on dietary diversity. Other women empowerment domains, such as input into agricultural decisions and feeling comfortable when speaking in public, have positive and significant effects on WDDS as well. But the aggregate women empowerment score, which combines the different empowerment domains, has the largest positive effect on nutrition, suggesting that it is important to promote improvements in various dimensions of women empowerment simultaneously. After living standard (measured through per capita consumption), women empowerment seems to be the second most important correlate of household-level and individual-level dietary diversity. In other words, promoting women empowerment seems to be an effective strategy not only to improve gender equity, but also to improve dietary quality and nutrition in the small farm sector of Tunisia.

While our results on the association between women empowerment and nutrition are in line with other recent studies conducted in different geographical settings (Lepine and Strobl, 2013; Sraboni et al., 2014; Malapit et al., 2015; Zereyesus, 2017), we are not aware of related previous work in Tunisia, or the Arab region more generally. Confirming the general findings from other regions with data from the Arab region is an important contribution to the literature because of the specific role of women in the Arab culture that is still largely defined by a traditional patriarchal gender paradigm. More work is required to better understand how women empowerment can be promoted and harnessed for broader sustainable development in different geographical and cultural settings.

2.5. Appendix A2

Table A2. 1 Comparison of reduced versus full sample

Variables	Reduced sample	Full sample
Age of household head	55.05	54.85
	(13.86)	(13.82)
Sex of household head	0.960	0.933
	(0.196)	(0.25)
Years of schooling of household head	4.360	4.272
	(4.113)	(4.102)
Age of female respondent	49.60	49.615
	(13.20)	(12.97)
Years of schooling of female respondent	1.858	1.885
	(3.159)	(3.277)
Household size	5.278	5.151
	(2.018)	(2.177)
Distance to nearest market (km)	13.66	13.417
	(10.17)	(9.537)
Production diversity	3.883	3.753
	(1.646)	(1.646)
Regional dummy (Zaghouan=1)	0.331	0.314
	(0.471)	(0.465)
Observations	478	700

Note: Variable mean values are shown with standard deviations in parentheses. None of the mean differences between the full and reduced sample is statistically significant at $p<0.1$ or lower.

3. The role of women empowerment for explaining child nutrition and nutritional inequality within Indian households

Abstract

A woman's position within her own household is seen as a key determinant of household food security, as well as the health and nutritional status of her children. While empirical evidence suggests that there are significant differences in health and nutrition outcomes between children even within households, it is unclear whether the level of empowerment a woman experiences also has the potential of compensating for nutritional differences between her children. Here, we examine the effects of women empowerment on both the nutritional status of children in general and on nutritional inequality between siblings in particular. We use nationally representative household survey data from the two waves of the Indian Human Development Survey (IHDS). Regression results confirm a highly significant and positive relationship between women empowerment and height-for-age Z-scores (HAZ) of children. Moreover, we are able to show that women empowerment has a significant effect on nutritional inequalities between siblings. Differences of HAZ between siblings are significantly lower in households where the mother experiences a comparatively high level of women empowerment. By disaggregating our measure of women empowerment, we demonstrate that especially women who face comparatively low restrictions on their ability to move around freely are able to significantly contribute towards reducing nutritional inequalities between their children.

Keywords: women's empowerment, gender, nutrition, India

3.1. Introduction

The allocation of resources within households has gained a lot of scientific attention within the past two decades. Especially in developing countries, where resources tend to be scarce, studying intra-household decision-making and resource allocation can provide critical insights into preferences of household members and the process of decision-making. In many developing countries, child nutritional status within households varies by birth order and gender of the child, indicating differential preferences of parents with regards to the investment into their children. Empirical evidence suggests that competition between siblings exists in education, health care and nutrition (Behrman 1986; Horton, 1988; Ota and Moffatt, 2007; Azam et al., 2012). Especially in India, where son preference is a widespread phenomenon, girls with older siblings are most vulnerable to discrimination within their households in terms of resources allocated towards them (Pande, 2003; Raj et al., 2015). Evidence shows that compared to boys, girls in India generally receive less childcare, are breastfed for shorter periods of time and do not receive as much vitamin supplementation (Barcellos et al., 2014), which is all likely to have crucial implications for the well-being and nutritional status of female children.

The position of women within their households is particular relevant for studying investments into health and nutritional outcomes of children. Women usually act as primary caregivers of their families and are predominantly responsible for tasks like food preparation and cooking, giving them a crucial role for maintaining household food security and health environment (Haddad et al., 1997). Another reason why women empowerment plays a significant role for nutritional outcomes of children is that in the absence of income pooling, men tend to allocate additional resources towards investments into production or personal consumption, while women use a larger proportion of income for expenditures on food, health care and clothing (Alderman et al. 1995). There is a growing body of literature empirically investigating the links between women empowerment, food security and nutrition. Haddad and Hoddinott (1991) for example show that a higher share of household income held in the hands of women as a measure of bargaining power leads to improved nutritional status of children. Other studies produce similar results using measures of a woman's education (Imai et al., 2014), bargaining power (Lepine and Strobl, 2013), or empowerment (Sraboni et al., 2014; Malapit et al, 2015; Zereyesus, 2017). But a woman's position within her household may not only generally increase nutritional outcomes of children, but also straighten inequalities between

siblings. Especially the most vulnerable members of the household are likely to benefit from a strong position of the mother, giving her the ability to autonomously manage the essential resources needed to provide nutrition security (Quisumbing et al., 1995). Pande and Malhotra (2006) for example emphasize that a mothers' education plays a critical role in reducing son preference in India, and Horton (1988) argues that educated mothers might be more efficient in producing child health and also may be more aware of inequalities between their children. More empowered women have the ability to invest more into food consumption and health care, which likely increases the availability of resources for the worst-off children in the household and straightens inequalities between siblings.

Two gaps in the existing literature on women empowerment and nutrition are addressed in this article. First, previous studies usually rely on cross-sectional data for analyzing this relationship, while we are able to exploit panel data to address potential unobserved heterogeneity and also analyze possible dynamic properties of the link between women empowerment and nutritional status. Second, existing literature usually focuses on analyzing nutritional status in absolute terms, but in this study we address the issue of intra-household inequalities with respect to child nutritional status by introducing a measure of nutritional inequality between siblings. This is not only interesting with respect to its relationship with women empowerment, but can also provide useful insights into dynamics of resource allocation and nutrition within households in general. More specifically, we aim to answer the following research questions: (i) What is the nutritional status of children in India? (ii) Are there nutritional inequalities between siblings? (iii) What is the level of women empowerment? And (iv) are there associations between women empowerment and child nutritional status and nutritional inequality and is women empowerment able to straighten differences in nutritional status between children within households? Our analysis is based on two waves of nationally representative household data from the Indian Human Development Survey (IHDS). We use information on gender roles and decision-making to construct a women empowerment index based on 16 indicators covering four dimensions of empowerment. As an indicator of nutritional status, we use height-for-age Z-scores (HAZ) and to measure nutritional inequalities between siblings, we calculate the difference between the HAZ of a particular child and the average HAZ of all the woman's children living in the same household.

3.2. Material and methods

3.2.1. Data

Data for this research are used from the two rounds of the publicly available IHDS by Desai et al. (2010, 2015). The first round of interviews was completed in 2004-05 and the second round was carried out in 2011-12. Of the 41,554 households in the first round, 34,621 households were re-interviewed in the second survey round. The IHDS is a nationally representative, multipurpose dataset containing detailed information on numerous topics, including information on women empowerment and child nutritional status, where questions on women empowerment were asked separately to women aged 15-49.

For the analysis, the unit of observation is one particular child within a household, while the final sample comprises a total of 4,354 children in 1,938 households for each sample round, where crucial information in the scope of this article is available for all observations in both rounds. First, the sample is restricted to households with complete information on women empowerment and child anthropometric measures. Second, as this study attempts to analyze the relationship between women empowerment and nutritional inequality between siblings, the sample is restricted to children who have at least one sibling. Children in the sample are aged 0-13 years in the first round and 6-18 years in the second round.

3.2.2. Measuring child nutritional status and inequality

In this article, the relationship between women empowerment and child nutritional status and nutritional inequality between siblings will be analyzed. For this purpose, we use two different dependent variables. Both variables are based on anthropometric data provided by the IHDS dataset. Anthropometric data are commonly used to assess the nutritional status of individuals. First, as a measure of child nutritional status, we use the height-for-age Z-score (HAZ) of the child using the World Health Organization (WHO) growth standard reference from 2006 (WHO Multicentre Growth Reference Study Group, 2006), which is an indicator of chronic undernutrition (De Haen et al., 2011). Although the weight-for-age Z-score (WAZ) and weight-for-height Z-score (WHZ) are also common measures of child undernutrition, we focus on the HAZ as it better reflects long term nutritional status and overall social conditions (WHO Working Group, 1986). The other two indicators, particularly the WAZ, are more suitable for analyzing current health status. The HAZ of a child is calculated by subtracting the median value of the reference population from the observed value, divided by the standard

deviation of the reference population. The sample was restricted to observations with values within the plausible range of standard deviations proposed by the WHO, that is not smaller than -6 and not higher than +6. Critical cut-off values for the HAZ are -2 for moderate stunting and -3 for severe stunting. Second, for analyzing nutritional inequality between siblings, the variable used in the analysis captures the difference between the average HAZ of siblings and the child as the observational unit of the following form[3]:

$$Nutrition\ inequality_i = \frac{\sum_{s_i}^{S_i} nutrition_{s_i}}{S_i} - nutrition_i \quad (1)$$

where *nutrition* represents the HAZ, $i = 1, \dots, N$ are the children in the sample, and $s_i = 1_i, \dots, S_i$ is the number of siblings of observation i. Before calculation, HAZ values have been transformed into positive values by an addition of 6, meaning that a HAZ of -6 now corresponds to a transformed HAZ of 0, a HAZ of 0 corresponds to a transformed HAZ of 6 and so on. This is done to avoid the cancelling out of HAZ, where one is in the positives and the other is in the negatives. The interpretation of this measure is straightforward: high values indicate larger nutritional inequality of the child in observation i with respect to her siblings, while low values indicate smaller nutritional inequality.

3.2.3. Measuring women empowerment

The IHDS survey contains detailed questions on gender relations and decision-making within the household. Using this information, we constructed a measure of women empowerment as a weighted index of a number of variables containing information on various aspects of the domestic and social realities a woman is confronted with. Following Malhotra and Schuler (2002), using not only one but a set of different dimensions for analyzing empowerment is useful, since empowerment in one particular dimension or domain does not necessarily imply empowerment in another dimension. Furthermore, including a number of different dimensions of empowerment offers the possibility of disaggregating the empowerment index by the corresponding dimensions. The women empowerment index is disaggregated into four equally weighted sub-categories, which are (i) decision-making, (ii) mobility, (iii) financial resources, and (iv) domestic violence. Decision-making is a commonly used dimension for analyzing a woman's empowerment and is here defined in terms of participation. This means

[3] This measure is a modification by the author of an indicator found in the online appendix of Oskorouchi (2019).

that women who have at least some say with respect to certain decisions are considered 'empowered' within this dimension, which is a definition that is also used in other studies (e.g. Kishor and Gupta, 2004). Mobility is another widely used dimension of women empowerment, as it relates to a woman's ability to make free choices (Malhotra and Schuler, 2002). A woman's mobility may be also an important factor for nutrition when she is allowed to go to local markets or shops by herself. It might also have an influence on the health status of her children, as she would be able to take them to a health care facility in case a child falls sick. Financial resources can strengthen a woman's position by providing means of independence. Furthermore, women with cash in their hands have the ability to directly influence the resources spent for the nutrition and health of their children. Several studies have used relative or absolute measures of woman's control over financial resources as a measure of empowerment (e.g. Haddad and Hoddinott, 1994; Duflo, 2004). The dimension of domestic violence is structurally different from the other three mentioned above in terms of measurement, as female respondents in the IHDS survey were not specifically asked about their own experiences, but rather about common practices within their communities regarding domestic abuse. Kabeer (1997; 1999) defines freedom of domestic violence as direct evidence of women empowerment and presents qualitative evidence that physical violence contributes to increasing a woman's disempowerment, while Malhotra and Schuler (2002) point out that the physical violence or intimidation a person is facing is a critical determinant of one's ability to make strategic life choices. Moreover, Rao (1998) points out that also children suffer from domestic violence towards their mother, as he finds that the caloric consumption of children is positively affected by freedom of domestic violence.

A comprehensive overview of the different indicators and their weights can be found in Table 3.1. The weighting scheme is analogue to the Women Empowerment in Agriculture Index (WEAI) (Alkire et al., 2013), where all of the different dimensions included in the index equally contribute to the aggregate empowerment index. All of the indicators of the empowerment index are dummy variables defined in positive terms, meaning that a dummy variable indicating a certain achievement in empowerment takes the value one and if a certain achievement is not realized it takes the value zero. Defining indicators this way ensures that the empowerment index, ranging from zero to one, increases in empowerment.

Table 3. 1 The four dimensions of empowerment in the women empowerment index

Dimension	Indicator	Description	Weight
Decision-Making		Respondent has at least some say	**1/4**
	Cooking	What to cook on a daily basis	1/20
	Purchases	Whether to buy an expensive item such as TV or fridge	1/20
	Number of children	How many children you have	1/20
	Child health	What to do if a child falls sick	1/20
	Child wedding	To whom her children should be married	1/20
Mobility		Respondent can go without permission/ can go alone to the following places	**1/4**
	Health care center	Permission to local health center	1/20
	Health care center	Go alone to local health center	1/20
	Relatives or Friends home	Permission to the home of relatives or friends [in the village/neighborhood]	1/20
	Relatives or Friends home	Go alone to the home of relatives or friends [in the village/neighborhood]	1/20
	Kirana shop	Permission to the Kirana shop	1/20
Financial resources			**1/4**
	Cash	Respondent has herself any cash in hand to spend on household expenditures	
Domestic violence		Respondent reports it is not usual for husbands to beat their wives in the following situations	**1/4**
	Cooking	If she does not cook food properly	1/20
	Dowry	If her natal family does not give expected money, jewelry or other items	1/20
	Neglect	If she neglects the house or the children	1/20
	Leave without permission	If she goes out without telling him	1/20
	Cheating	If he suspects her of having relations with other men	1/20

3.2.4. Other independent variables

In our analysis we control for a number of individual and household characteristics. Individual characteristics include child age and age squared, sex, birth order, school attendance and whether the child works. Especially the birth order of the child is critical here. There are two main reasons why the birth order of children may affect their nutritional status, also compared to their siblings. First, with more children being born into a household, family

resources have to be distributed amongst a larger number of dependent household members than before, which can have implications especially for later-born children. This is particularly relevant in the Indian context because son preference is a well-documented phenomenon in the Indian society. As Indian families tend to have a preference for boys due to a number of cultural reasons, girls born into families with one or more older sisters are particularly vulnerable to undernourishment (Pande, 2003; Pande, and Astone, 2007). Second, as a biological factor, later-born children are born to older mothers, which could result in a lower weight at birth (Horton, 1988). Furthermore, women giving birth to several children within a short period of time can be physically exhausted, which increases the probability of later-born children being undernourished (Pathak et al., 2004; Basit et al., 2012).

Household variables include the body mass index (BMI) of the mother, mother and father age and age squared, mother and father literacy, whether mother and father work, household wealth measured by an asset index[4], the dependency ratio as a measure of household composition[5], household access to water and sanitary facilities, a rural/urban dummy variable and dummies for Scheduled Castes and Tribes and Muslims. Household wealth can be measured in many different forms. In this article we use an index of a number of household assets, as done in previous studies (Arimond and Ruel, 2004; Hong et al., 2006). The main rationale for using an asset index rather than measures like income or consumption expenditure is that asset indices better reflect long term household wealth, as the ownership of assets usually does not fluctuate as much as other measures of economic status (Filmer and Pritchett, 2001). The nutritional status of a mother is likely to have significant effects on child nutrition and health, as several previous studies suggest (Dharmalingam et al., 2010; Tigga et al., 2018). A mother's pre-pregnancy BMI is not only a crucial indicator of the birth weight of a child, but it has been shown that it also has implications for the growth and subsequent disease risk of children (Yu et al., 2013). As we are not able to measure a woman's pre-pregnancy or pre-birth BMI, we use her actual BMI as a proxy. We use a dummy of scheduled castes and tribes, as well as a dummy for Muslim households, as these groups and communities have been shown to be particularly vulnerable to low socioeconomic and nutritional status in the Indian society (Drèze and Kingdon, 1999; Mohindra et al., 2006).

[4] The asset index counts the number of assets out of a total of 31 different items a household possesses. A detailed list can be viewed in Table A1 of the appendix.

[5] Calculation: $Dependency\ ratio = \frac{Number\ of\ people\ aged\ 0-14\ years + Number\ of\ people\ aged\ 65\ years\ and\ more}{Number\ of\ people\ aged\ between\ 14-65\ years}$

3.2.5. Empirical analysis

To examine the role of women empowerment for the nutritional status of children and nutritional inequality between siblings, we start by estimating a Pooled Ordinary Least Squares (POLS) model of the following structure:

$$y_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 C_{it} + u_{it} \quad (2)$$

where y_{it} is the outcome variable of interest (child nutritional status; nutrition inequality) for child i in time t, β_0 is a constant, β_1 is the estimated coefficient for the key independent variable empowerment x of the mother of child i in time t. For child nutritional status measured by the HAZ, we expect a positive coefficient, hence we hypothesize women empowerment to increase child nutritional status; for nutritional inequality, we expect a negative coefficient, hence we hypothesize women empowerment to reduce nutritional inequality. β_2 is the estimated coefficient of a vector of additional control variables C_{it}, and u is the error term.

To exploit the panel structure of the IHDS data, we make use of the so called Correlated Random Effects model (CRE) originally proposed by Mundlak (1978). The major advantage of the CRE model over the use of Random Effects and Fixed Effects models, as they are commonly used in panel data analyzes, is the ability to include time-invariant variables and separate within-and between-group effects (Schunck, 2013; Schunck and Perales, 2017). This is a critical feature within the scope of this article, as there are several important time-invariant determinants of child nutritional status (for example child sex or birth order) that need to be considered. The estimated CRE model is described by the following specification:

$$y_{it} = \alpha + \beta(x_{it} - \bar{x}_i) + \gamma\bar{x}_i + \delta(C_{it} - \bar{C}_i) + \theta\bar{C}_i + \vartheta T_i + \mu_i + \varepsilon_{it} \quad (3)$$

where y_{it} is the outcome variable of interest (child nutritional status; health inequality) for child i in time t, α is a constant, β is the within-estimator of women empowerment of the mother of child i, γ is the between-estimator of women empowerment of child i. δ and θ represent the within- and between-effects respectively for the time-varying control variables, ϑ estimates the time-invariant control variables T, μ and ε are error terms. Note that the within estimator β accounts for unobserved heterogeneity and estimates the differences within individuals over time, while the between estimator γ does not account for unobserved heterogeneity and estimates the differences between individuals.

3.3. Results

3.3.1. Descriptive statistics

In this section we provide descriptive insights into child nutritional status and nutritional inequality, women empowerment and present the basic sample characteristics. Figure 1 shows the shares of stunted and severely stunted children in the sample, disaggregated by gender and birth order. There is a clear indication that nutritional differences between siblings indeed exist in India. First, girls are generally more likely to be both stunted and severely stunted in comparison to boys. Second, birth order plays a crucial role in child nutritional inequality within households. The prevalence of stunted and severely stunted children is lowest for first born children and increases significantly by birth order. This relationship is especially evident for girls, where the proportion of moderately stunted female children is higher than 40 percent when born as the fourth child or later. Another indication is that, while severe stunting increases significantly by birth order, gender differences decrease by birth order, as the share of severely stunted boys eventually equals the girls' share for children being born as fifth child or later.

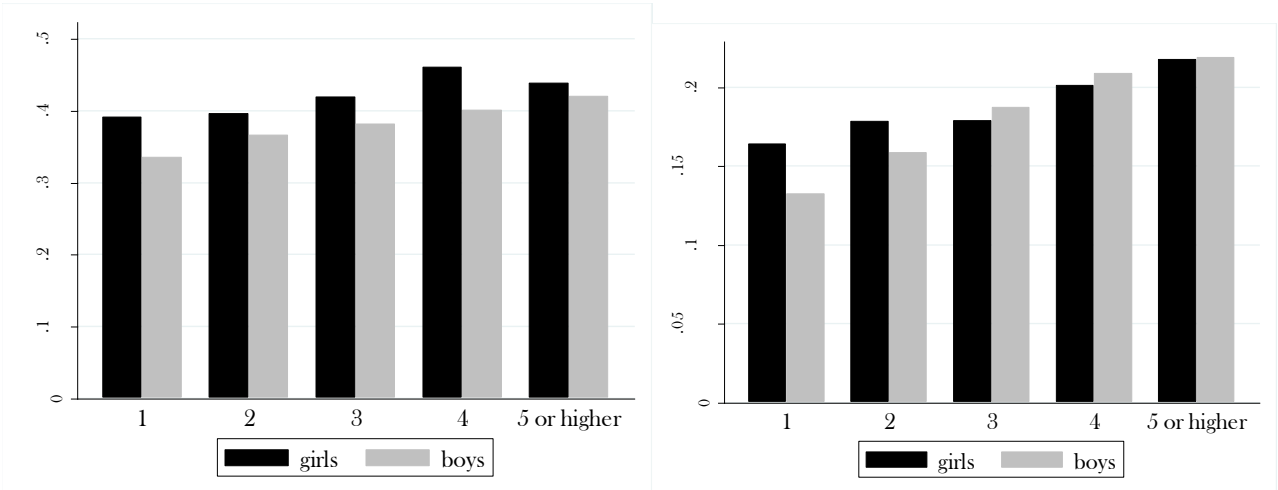

Figure 3. 1: Moderate and severe stunting by birth order and gender

Table 3.2 shows mean values and standard deviations for the HAZ, disaggregated by gender, birth order and survey round, providing additional insights into nutritional inequalities between siblings.

In addition to the evidence provided above, it can be seen that nutritional status in the sample is generally quite low with an average HAZ for girls of -1.87 in round one and -1.54 in round two, compared to an average HAZ of -1.74 in round one and -1.38 in round two for boys. Moreover, nutritional status increases from the first to the second survey round, indicating that nutritional status increases with increasing age of children. Looking at the disaggregation by birth order indicates that with increasing mean age, especially girls with higher birth order have a higher nutritional status than children with a lower birth order, suggesting that nutritional differences between siblings by birth order might reverse over time or at least become less significant and seemingly arbitrary. However, gender differences in nutritional status persist over time.

Table 3. 2: Height-for-age Z-scores by birth order and gender

	Round 1		Round 2	
	Girls	Boys	Girls	Boys
All	-1.871	-1.737	-1.543	-1.375
	(1.862)	(1.973)	(1.277)	(1.353)
Birth order 1	-1.775	-1.561	-1.652	-1.454
	(1.459)	(1.674)	(1.184)	(1.289)
Birth order 2	-1.848	-1.616	-1.516	-1.327
	(1.849)	(1.949)	(1.249)	(1.350)
Birth order 3	-1.783	-1.668	-1.507	-1.356
	(1.967)	(2.060)	(1.318)	(1.370)
Birth order 4	-1.894	-2.002	-1.580	-1.429
	(1.915)	(1.844)	(1.323)	(1.274)
Birth order 5 or higher	-2.044	-1.945	-1.494	-1.351
	(2.026)	(2.179)	(1.311)	(1.434)
Observations	2,190	2,164	2,190	2,164

Note: Standard deviations in parentheses

Table 3.3 provides insights into the women empowerment index with its corresponding dimensions and indicators. First, the aggregate empowerment index is a weighted average of the indicators presented in Table 3.1, ranging from zero to one, where one would indicate

positive outcomes in every single indicator included in the construction of the index, while zero indicates a negative outcome in all of the corresponding indicators.

Table 3. 3: Summary statistics of indicators and dimensions of the women empowerment index

		Round 1 (n=4,354)		Round 2 (n=4,354)	
Dimension	Indicator	Mean	Std. dev.	Mean	Std. dev.
Aggregate Empowerment		0.660	0.175	0.695	0.152
Decision-Making		0.859	0.268	0.890	0.244
	Cooking	0.964	0.186	0.947	0.225
	Purchases	0.767	0.423	0.815	0.389
	Number of children	0.863	0.344	0.907	0.290
	Child health	0.875	0.331	0.899	0.301
	Child wedding	0.824	0.381	0.884	0.321
Mobility		0.391	0.286	0.468	0.291
	Permission: Health care center	0.169	0.375	0.176	0.381
	Go alone: Health care center	0.668	0.471	0.733	0.442
	Permission: Relatives or Friends home	0.148	0.355	0.282	0.450
	Go alone: Relatives or Friends home	0.691	0.462	0.801	0.399
	Permission: Kirana shop	0.279	0.448	0.350	0.477
Financial resources					
	Cash	0.853	0.354	0.945	0.229
Domestic violence		0.537	0.337	0.478	0.321
	Cooking	0.669	0.471	0.661	0.473
	Dowry	0.702	0.457	0.637	0.481
	Neglect	0.635	0.481	0.570	0.495
	Leave without permission	0.570	0.495	0.415	0.493
	Cheating	0.106	0.308	0.107	0.310

Note: n, sample size.

The average value of the empowerment index is 0.66, indicating that mothers in the sample report to have achieved the corresponding positive outcome in an average of 66 percent of the dimensions and indicators. Second, women are significantly more empowered compared to decision-making and cash compared to mobility and domestic violence. While most women are able to at least participate in decision-making regarding basic domains of the household like cooking and raising their children, most of the women in the sample have to ask for

permission in case they want to go to certain community facilities. Furthermore, a substantial proportion of women in the sample states that domestic violence is practiced in their communities in some form. Another indication from these figures is that in general, as women get older, they experience higher degrees of empowerment, indicated by higher values for almost all dimensions and indicators in the second survey round. Only in the dimension of domestic violence, the position of women has been deteriorating over time.

Table 3.4 gives an overview of the sample characteristics and control variables included in the latter analysis. A first indication here is that individual characteristics between boys and girls do not significantly differ. Boys in the sample are marginally younger and just a little more likely of being enrolled in school, which is true for both rounds. Birth order of the average child is for both boys and girls a little over three, while the mean number of siblings is higher for girls than for boys, which could be an indication of son preference. As to the parents, fathers are on average about four years older than mothers and in the first round are twice as likely to be literate as mothers. This differential becomes narrower in the second survey round. About 73 percent of children belong to households living in rural areas. Seventeen percent of children belong to the Muslim community, while about 35 percent of children live in households that belong to a scheduled caste or scheduled tribe.

Table 3. 4: Sample characteristics

	Round 1			Round 2		
	All	Girls	Boys	All	Girls	Boys
Child age	5.758	5.831	5.683	12.36	12.46	12.26
	(3.288)	(3.325)	(3.249)	(3.324)	(3.349)	(3.296)
Child birth order	3.236	3.238	3.234	3.236	3.238	3.234
	(1.975)	(1.944)	(2.007)	(1.975)	(1.944)	(2.007)
Child attends school	0.517	0.509	0.525	0.967	0.959	0.976
	(0.500)	(0.500)	(0.500)	(0.178)	(0.197)	(0.155)
Child works	0.0211	0.0224	0.0199	0.101	0.0904	0.112
	(0.144)	(0.148)	(0.140)	(0.302)	(0.287)	(0.316)
Mother BMI	20.62	20.84	20.40	21.73	21.74	21.71
	(6.068)	(7.735)	(3.680)	(4.365)	(4.494)	(4.231)
Mother age	31.15	31.19	31.11	38.37	38.45	38.30
	(5.457)	(5.381)	(5.534)	(5.695)	(5.572)	(5.818)
Father age	35.93	36.01	35.84	43.20	43.29	43.11
	(6.190)	(6.244)	(6.135)	(6.351)	(6.267)	(6.436)
Mother literacy	0.375	0.374	0.376	0.437	0.433	0.441
	(0.484)	(0.484)	(0.484)	(0.496)	(0.496)	(0.497)
Father literacy	0.653	0.663	0.643	0.659	0.669	0.649
	(0.476)	(0.473)	(0.479)	(0.474)	(0.471)	(0.477)
Mother works	0.626	0.632	0.619	0.553	0.559	0.547
	(0.484)	(0.482)	(0.486)	(0.497)	(0.497)	(0.498)
Father works	0.983	0.984	0.981	0.940	0.935	0.944
	(0.130)	(0.125)	(0.135)	(0.238)	(0.246)	(0.230)
Household wealth (asset index)	9.460	9.443	9.477	13.32	13.26	13.37
	(5.412)	(5.390)	(5.435)	(6.135)	(6.142)	(6.128)
Dependency Ratio	1.596	1.660	1.531	0.963	1.028	0.896
	(0.682)	(0.706)	(0.650)	(0.694)	(0.720)	(0.661)
Household size	6.322	6.453	6.190	6.287	6.500	6.070
	(1.860)	(1.858)	(1.854)	(1.846)	(1.865)	(1.801)
Number of siblings	2.396	2.521	2.269	2.396	2.521	2.269
	(1.235)	(1.271)	(1.184)	(1.235)	(1.271)	(1.184)
Household has access to water	0.938	0.943	0.934	0.929	0.932	0.925
	(0.240)	(0.233)	(0.248)	(0.257)	(0.251)	(0.263)
Household has no toilet	0.737	0.745	0.729	0.588	0.593	0.583
	(0.440)	(0.436)	(0.445)	(0.492)	(0.491)	(0.493)
Rural dummy	0.731	0.725	0.737	0.709	0.703	0.716
	(0.444)	(0.447)	(0.441)	(0.454)	(0.457)	(0.451)
SCST dummy	0.346	0.361	0.331	0.356	0.360	0.353
	(0.476)	(0.480)	(0.471)	(0.479)	(0.480)	(0.478)
Muslim dummy	0.169	0.172	0.167	0.171	0.173	0.169
	(0.375)	(0.377)	(0.373)	(0.376)	(0.378)	(0.375)
Observations	4,354	2,190	2,164	4,354	2,190	2,164

Note: Standard deviations in parentheses.

3.3.2. Estimation results

In the following section, the estimation results of the POLS and CRE regressions for the relationship between women empowerment and child nutritional status as well as nutritional inequality are presented. In addition, we show the regression coefficients of the disaggregated dimensions of the women empowerment index to further identify the relevant pathways. Table 3.5 shows the regression coefficients for children's HAZ as dependent variable. The POLS coefficient estimates in column 1 show that the women empowerment index is highly significant and positively associated with HAZ of children, suggesting that in households, in which women experience a higher degree of women empowerment, children are better nourished in terms of the HAZ. Moving to columns 2-3, the coefficient estimates of the CRE estimation confirm this relationship. Both the between- and the within-estimator are positive and significant, indicating that women empowerment has a positive effect on child nutritional status both between individuals and also over time. Furthermore, women empowerment is not only associated with higher HAZ of children, but especially the significant coefficient of the within-estimator suggests a causal relationship with child nutritional status. The economic significance, however, is comparatively small. As the women empowerment index is a proportion, a one unit increase is equivalent to a 100 percentage point change, which can only happen for values starting at zero. Dividing the coefficient by 10 gives the change by ten percentage points. A ten percentage point increase in women empowerment leads to roughly a 0.04 increase in standard deviations for all three estimators, while the between-estimator has the highest coefficient estimate.

Turning to the other covariates in Table 3.5, child nutritional status significantly decreases in age, as one additional year yields an decrease of 0.28 standard deviations in height-for age Z-scores, and increases slightly once a certain age is reached, indicated by the positive coefficient of child age squared. Being a girl significantly reduces a child's HAZ by about 0.1 standard deviations, and increasing the birth order of a child by one leads to a decrease in HAZ by 0.046 standard deviations. The variable with the highest effect size is school attendance. If a child attends school, the HAZ in all specifications is higher by more than one standard deviation compared to children not going to school. This finding might indicate that the Indian School-Lunch-Program (SLP), launched in 1995, does not only help to increase the number of children in schools, but also significantly contributes to the nourishment of school children.

Table 3. 5: Women empowerment and child nutritional status

VARIABLES	(1) POLS	(2) CRE Within – estimator	(3) CRE Between - estimator	(4) CRE Time - invariant variables
Women empowerment index	0.386***	0.336**	0.433***	
	(0.139)	(0.153)	(0.153)	
Child age	-0.286***	-0.350***	-0.368***	
	(0.0279)	(0.0302)	(0.0348)	
Child age squared	0.00884***	0.00778***	0.0134***	
	(0.00123)	(0.00126)	(0.00181)	
Child sex	0.0984***			0.102***
	(0.0376)			(0.0375)
Child birth order	-0.0460**			-0.0259*
	(0.0181)			(0.0145)
Child attends school	1.096***	1.104***	0.954***	
	(0.0760)	(0.0949)	(0.0961)	
Child works	0.203***	-0.0438	0.392***	
	(0.0626)	(0.112)	(0.116)	
Mother BMI	-0.00564	-0.00949*	-0.00272	
	(0.00602)	(0.00544)	(0.00451)	
Mother age	-0.0690*	-0.162***	-0.00699	
	(0.0400)	(0.0504)	(0.0449)	
Mother age squared	0.00106**	0.00274***	7.90e-05	
	(0.000497)	(0.000619)	(0.000601)	
Father age	0.107***	0.310***	0.0378	
	(0.0319)	(0.0467)	(0.0367)	
Father age squared	-0.00109***	-0.00291***	-0.000304	
	(0.000331)	(0.000483)	(0.000422)	
Mother literacy	-0.0532	0.0406	-0.0486	
	(0.0558)	(0.137)	(0.0492)	
Father literacy	0.0445	-0.0250	0.0721	
	(0.0557)	(0.0961)	(0.0489)	
Mother works	-0.0245	0.00446	-0.0351	
	(0.0481)	(0.0582)	(0.0541)	
Father works	-0.0969	-0.00994	-0.169	
	(0.0964)	(0.131)	(0.130)	
Household wealth (assets)	0.0469***	0.0620***	0.0409***	
	(0.00583)	(0.0101)	(0.00545)	
Dependency ratio	-0.105***	-0.130**	-0.106**	
	(0.0405)	(0.0521)	(0.0479)	
Household has access to water	-0.0541	0.145	-0.181*	
	(0.0907)	(0.103)	(0.0970)	
Household has no toilet	0.0164	0.0570	-0.0253	
	(0.0587)	(0.0780)	(0.0629)	
Rural dummy	0.0659	-0.171	0.0534	
	(0.0617)	(0.239)	(0.0506)	
SCST dummy	0.00738	0.0243	-0.00432	
	(0.0512)	(0.140)	(0.0438)	
Muslim dummy	-0.0123			-0.0292
	(0.0696)			(0.0562)
Constant	-2.181***	-1.138*	-1.138*	-1.138*
	(0.571)	(0.678)	(0.678)	(0.678)
Observations	8,708	8,708	8,708	8,708
Number of clusters		4,354	4,354	4,354
R-squared /Wald $\chi 2$	0.081	836.85***	836.85***	836.85***

Note: POLS, pooled ordinary least squares; CRE, correlated random effects; Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by household in the POLS model.

Furthermore, this finding may also suggest that parents allocate more household resources towards children they send to school, in other words children they are already invest in. Whether the child is currently working also has a positive and significant influence on the HAZ, indicating that parents might allocate resources towards children working to contribute to household income. While the BMI of the mother seems to have little to no influence on the child nutritional status, age and age squared of mother and father are significantly related to child nutritional status. The patterns here, though, differ from each other. While the age of the mother has a U-shaped relationship with child nutritional status, the age of the father has an inverted U-shaped relationship with the HAZ. Household wealth measured by an asset index is positively associated with child nutritional status, and an increasing dependency ratio has a negative effect on children's HAZ.

In Table 3.6 we show the regression results for nutritional inequality between siblings as the dependent variable. In general, the expected negative relationship between women empowerment and nutritional inequality between siblings can be confirmed. The coefficient estimates of both the POLS and the between-estimator of the CRE are negative and statistically significant on the one and five percent level, respectively, suggesting that nutritional differences between siblings are lower in households in which women are more empowered. Only the within-estimator of the CRE model is not statistically significant, implying that in households in which women are more empowered, the nutritional differences between siblings are lower, but women empowerment has no statistical impact on nutritional differences between siblings over time. The magnitudes of the effects of women empowerment on nutritional inequality are in similar ranges compared to the results in Table 3.5: a ten percentage point increase in the women empowerment index leads to a 0.04 decrease in the difference between the average HAZ of siblings and the HAZ of the child as the observational unit.

Looking at the other covariates provides insights into some of the dynamics with respect to nutritional inequalities between siblings. The difference in HAZ between a child and their siblings starts to increase with age up to a certain point and then starts decreasing as children get older, as also indicated from the evidence presented in Table 3.2. This could mean that at early stages in the life of children with older siblings, parents tend to allocate fewer resources to them than towards their older children. But as these children get older, more resources are available to the younger ones.

Table 3. 6: Women empowerment and nutritional inequality between siblings

VARIABLES	(1) POLS	(2) CRE Within - estimator	(3) CRE Between - estimator	(4) CRE Time - invariant variables
Women empowerment index	-0.398***	-0.339	-0.463**	
	(0.139)	(0.229)	(0.222)	
Child age	0.410***	0.508***	0.541***	
	(0.0432)	(0.0452)	(0.0504)	
Child age squared	-0.0121***	-0.0102***	-0.0198***	
	(0.00195)	(0.00189)	(0.00262)	
Child sex	-0.136**			-0.144***
	(0.0545)			(0.0542)
Child birth order	0.0625***			0.0327
	(0.0197)			(0.0210)
Child attends school	-1.580***	-1.617***	-1.358***	
	(0.111)	(0.142)	(0.139)	
Child works	-0.277***	0.0696	-0.540***	
	(0.0885)	(0.167)	(0.168)	
Mother BMI	0.00548	0.00878	0.00256	
	(0.00624)	(0.00814)	(0.00651)	
Mother age	0.0328	0.116	-0.0286	
	(0.0408)	(0.0755)	(0.0650)	
Mother age squared	-0.000726	-0.00253***	0.000324	
	(0.000508)	(0.000927)	(0.000869)	
Father age	-0.107***	-0.348***	-0.0377	
	(0.0317)	(0.0700)	(0.0531)	
Father age squared	0.00108***	0.00318***	0.000299	
	(0.000330)	(0.000723)	(0.000610)	
Mother literacy	0.0680	-0.103	0.0568	
	(0.0561)	(0.205)	(0.0711)	
Father literacy	-0.0269	0.0346	-0.0603	
	(0.0563)	(0.144)	(0.0707)	
Mother works	0.0232	-0.00404	0.0289	
	(0.0485)	(0.0872)	(0.0783)	
Father works	0.114	0.0930	0.150	
	(0.0978)	(0.196)	(0.188)	
Household wealth (assets)	-0.0477***	-0.0758***	-0.0403***	
	(0.00592)	(0.0151)	(0.00789)	
Dependency ratio	0.170***	0.239***	0.157**	
	(0.0434)	(0.0780)	(0.0694)	
Household has access to water	0.0659	-0.140	0.192	
	(0.0908)	(0.154)	(0.140)	
Household has no toilet	-0.0304	-0.0524	0.0150	
	(0.0590)	(0.117)	(0.0910)	
Rural dummy	-0.0819	0.229	-0.0578	
	(0.0623)	(0.357)	(0.0732)	
SCST dummy	-0.0163	-0.0234	0.00139	
	(0.0516)	(0.209)	(0.0633)	
Muslim dummy	-0.0117			0.0114
	(0.0700)			(0.0813)
Constant	-3.728***	-4.938***	-4.938***	-4.938***
	(0.588)	(0.980)	(0.980)	(0.980)
Observations	8,708	8,708	8,708	8,236
Number of clusters		4,354	4,354	4,354
R-squared/Wald $\chi 2$	0.062	646.53***	646.53***	646.53***

Note: POLS, pooled ordinary least squares; CRE, correlated random effects; Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by household in the POLS model.

Moving forward, the sex dummy is negative and highly significant in both models, nutritional inequality between boys and their siblings is significantly lower than between girls and their siblings, suggesting that son preference might play a crucial role for explaining nutritional differences between children within households. The birth order of a child is only significant in the POLS specification, which could be due to the age and age squared variables capturing the effects of the birth order in the dynamic model. Similar to the results presented in Table 3.5, children going to school have a significantly lower difference in nutritional status to their siblings, which might further highlight that parents do not allocate resources equally over their children. Furthermore, nutritional inequality is significantly lower in wealthier households, but expectedly higher in households with more residing dependents.

In Table 3.7 we show the summary of coefficient estimates for the relationship between women empowerment and nutritional inequality of siblings by disaggregating the empowerment index into the four dimensions. A first indication is that by disaggregating the index, it becomes clear that not all of the dimensions are relevant for explaining the nutritional status of children and nutritional inequality. The decision-making dimension, for instance, is insignificant in all of the model specifications. On possible explanation could be that variation within the corresponding indicators is comparatively low, as indicated in Table 3.3. For example, 96 percent of women in the sample report to have at least some say with respect to cooking, and specifically decisions on cooking are expected to be related to nutritional outcomes of children. Moreover, Desai and Johnson (2005) point out that only being able to make a final decision on something qualifies for labelling someone as 'autonomous' in their decisions, and therefore the mere contribution to decisions may not be the best proxy for empowerment. Additionally, also the dimension of domestic violence does not have any statistically significant effect on nutritional inequality between siblings. However, the dimensions mobility and financial resources seem to have effects on nutritional inequality between siblings. The CRE model within-estimator of the mobility dimension is statistically significant at the five percent level, implying that a causal relationship can be established between the level of a mothers' reported mobility and nutritional differences between siblings. Furthermore, this is an indication that women empowerment, measured as the degree of mobility, has the ability to decrease nutritional inequality between siblings over time. A possible interpretation is that using mobility as a proxy of women empowerment may be a more direct measure of actual outcomes for women. Furthermore, as suggested by previous studies, mobility is an indication that a women is able to make free choices

(Malhotra and Schuler, 2005; Mishra and Tripathi, 2017), and more importantly with respect to a child's health and nutritional status, Caldwell (1986) points out that women with the ability to move around independently are more likely to take concrete measures such as seeking medical treatment if a child falls sick, which might be particularly relevant for straightening inequalities between siblings. Restricted mobility of mothers may also affect household food security and availability of nutritious food in case it extends to visiting markets for purchasing food.

Table 3. 7: Dimensions of women empowerment and nutritional inequality between siblings

	POLS	CRE - within	CRE - between
Dimension 1: Decision-making	0.044	0.153	-0.0107
	(0.0830)	(0.137)	(0.145)
Dimension 2: Mobility	-0.167*	-0.320**	-0.0626
	(0.0897)	(0.130)	(0.123)
Dimension 3: Financial resources	-0.286***	-0.181	-0.318***
	(0.086)	(0.121)	(0.123)
Dimension 4: Domestic violence	-0.046	-0.0353	-0.141
	(0.078)	(0.114)	(0.109)
Observations	8,708	8,708	8,708
Number of clusters		4,354	4,354

Note: POLS, pooled ordinary least squares; CRE, correlated random effects; Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Separate models were estimated for each of the women empowerment dimensions. Control variables were estimated, but are not shown. Full models can be viewed in Tables A2.2-A2.5 of the appendix.

3.4. Conclusion

Literature has shown that a strong position of women within their households has significant and positive effects on food security and nutritional status of household members. Women have different preferences with respect to the utilization of household resources, and as primary caregivers for their children, tend to allocate additional resources towards child care, health and nutrition, compared to their male counterparts (Hoddinott and Haddad, 1991; Haddad and Hoddinott, 1994; Duflo, 2004). Previous research on the link between women empowerment and child nutritional status typically uses cross-sectional data for analyzing these underlying effects (Lepine and Strobl, 2013; Sraboni et al., 2014; Malapit et al., 2015; Zereyesus, 2017). In this article, using panel data estimation techniques, we have investigated the causal relationship between women empowerment, measured by an index of four different

dimensions and 16 different indicators related to empowerment, and child nutritional status measured by the HAZ of a child. Furthermore, we have addressed the question of whether women empowerment has also the ability to straighten sibling inequalities within households by introducing a measure of nutritional differences between siblings.

First indications of the sample characteristics suggest that HAZ are relatively low among children in Indian households, but increase from survey round one to survey round two. On average, HAZ of girls are about -1.87 standard deviations lower compared to the reference population in the first survey round, and about -1.54 in the second, while HAZ of boys increased from -1.54 to -1.38 standard deviations. These increases in nutritional status over time are likely to be due to two reasons. First, older children are more likely to be enrolled in school, and the Indian SLP, which guarantees school meals for all school children, could explain the significant effects on the average HAZ. Second, especially around the time of the first survey round, India experienced a sharp increase in the number of undernourished people as a result of spiking global food prices, leading Indian policymakers to withdraw from international rice and wheat markets, which in turn resulted in decreasing undernourishment within the population afterwards (Yu et al., 2015). However, basic sample characteristics also show that there are indeed significant differences between siblings within households. There is clear evidence that boys are better nourished than girls, on average and, especially among younger children, birth order plays a critical role as later born children are worse off than their older siblings in nutritional status.

In our empirical analysis we are able to demonstrate that there is indeed a causal relationship between women empowerment and child nutritional status. Children in households in which women have a comparably high level of empowerment are significantly better nourished in terms of HAZ. This is indicated by highly significant regression coefficients of the aggregate women empowerment index in all of the empirical specifications. These findings also suggest that women empowerment has a continuing positive effect on child nutritional status over time. Moreover, our results show that women empowerment not only has a significant effect on overall child nutritional status, but also has the ability to straighten nutritional inequalities between siblings within households. When using the aggregated women empowerment index as key independent variable, we find a statistically significant negative effect of women empowerment on nutritional inequality between siblings, indicating that in households where women are comparatively more empowered, nutritional differences between siblings are lower. While the within-estimator for the aggregated women empowerment index is

statistically insignificant, by disaggregating the aggregate index into its sub-components, we find that by using the 'mobility' dimension of women empowerment, we are able to establish a causal relationship between women empowerment and nutritional inequality of siblings.

These results lead to a number of conclusions. First, a women's position within her household is clearly linked to the nutritional status of her children. Higher levels of empowerment can increase the ability of mothers to influence the health of their children by deciding on household expenditures and feeding their children more nutritious food, taking them to health care centers in case of illness or for check-ups and sending them to school, where they may have access to a guaranteed meal. Second, higher levels of women empowerment also compensate the food security and nutrition of the worst-off children in the household compared to their siblings, which will decrease the comparative disadvantage for girls and also the disadvantage of being born later, in other words having older siblings. Mothers may have stronger bonds with all of their children compared to fathers, leading mothers to value the achievements of their children more equally amongst them and more crucially in India, have a lower preference for sons. Third, analyzing the effects of women empowerment on nutrition is very sensitive to the dimensions and indicators used. While the inclusion of a women's questionnaire in the IHDS surveys made this research possible, future research should put more emphasis on the conceptualization of women empowerment before data collection[6].

[6] One example is the recently developed WEAI (Alkire et al., 2013), though limited to households engaged in agriculture.

3.5. Appendix A3

Table A3. 1: List of assets included in the asset index

Pucca Roof	Any vehicle	Electric fan	Air cooler
Pucca wall	Motor vehicle	Washing machine	Air conditioner
Pucca floor	Black/white TV	Pressure cooker	Table or chair
Electricity	Color TV	Microwave oven	Mixer/grinder
Generator set	Cable TV	Laptop	Cot
Kitchen	Telephone	Computer	Clothes
Liquefied petroleum gas	Sewing machine	Mobile phone	Credit card
Indoor piped water	Flush toilet	Refrigerator	

Table A3. 2: Decision-making and nutritional inequality between siblings

VARIABLES	(1) POLS	(2) CRE Within - estimator	(3) CRE Between - estimator	(4) CRE Time-invariant variables
Dimension 1: Decision-making	0.0443	0.153	-0.0107	
	(0.0830)	(0.137)	(0.145)	
Child age	0.409***	0.508***	0.541***	
	(0.0433)	(0.0452)	(0.0505)	
Child age squared	-0.0121***	-0.0102***	-0.0198***	
	(0.00195)	(0.00189)	(0.00262)	
Child sex	-0.137**			-0.145***
	(0.0545)			(0.0542)
Child birth order	0.0642***			0.0341
	(0.0198)			(0.0210)
Child attends school	-1.582***	-1.619***	-1.361***	
	(0.111)	(0.142)	(0.139)	
Child works	-0.278***	0.0603	-0.530***	
	(0.0887)	(0.167)	(0.168)	
Mother BMI	0.00527	0.00850	0.00233	
	(0.00619)	(0.00814)	(0.00652)	
Mother age	0.0307	0.106	-0.0281	
	(0.0409)	(0.0756)	(0.0650)	
Mother age squared	-0.000717	-0.00245***	0.000302	
	(0.000509)	(0.000928)	(0.000870)	
Father age	-0.106***	-0.342***	-0.0381	
	(0.0319)	(0.0700)	(0.0532)	
Father age squared	0.00108***	0.00313***	0.000315	
	(0.000332)	(0.000723)	(0.000610)	
Mother literacy	0.0541	-0.107	0.0439	
	(0.0559)	(0.205)	(0.0713)	
Father literacy	-0.0239	0.0413	-0.0569	
	(0.0564)	(0.144)	(0.0708)	
Mother works	0.0203	-0.00949	0.0253	
	(0.0485)	(0.0872)	(0.0784)	
Father works	0.104	0.0682	0.147	
	(0.0982)	(0.196)	(0.188)	
Household wealth (assets)	-0.0488***	-0.0775***	-0.0417***	
	(0.00590)	(0.0151)	(0.00787)	
Dependency ratio	0.174***	0.237***	0.166**	
	(0.0434)	(0.0780)	(0.0693)	
Household has access to water	0.0577	-0.144	0.178	
	(0.0910)	(0.154)	(0.140)	
Household has no toilet	-0.0316	-0.0450	0.0102	
	(0.0590)	(0.117)	(0.0911)	
Rural dummy	-0.0725	0.212	-0.0455	
	(0.0623)	(0.357)	(0.0730)	
SCST dummy	-0.0188	-0.0263	-0.00190	
	(0.0517)	(0.209)	(0.0633)	
Muslim dummy	-0.00353			0.0185
	(0.0700)			(0.0813)
Constant	-3.987***	-5.244***	-5.244***	-5.244***
	(0.587)	(0.974)	(0.974)	(0.974)
Observations	8,708	8,708	8,708	8,236
Number of clusters		4,354	4,354	4,354
R-squared/Wald $\chi 2$	0.061	640.80	640.80	640.80

Note: POLS, pooled ordinary least squares; CRE, correlated random effects; Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by household in the POLS model.

Table A3. 3: Mobility and nutritional inequality between siblings

VARIABLES	(1) POLS	(2) CRE Within - estimator	(3) CRE Between - estimator	(4) CRE Time-invariant variables
Dimension 1: Decision-making	-0.167*	-0.320**	-0.0626	
	(0.0897)	(0.130)	(0.123)	
Child age	0.410***	0.508***	0.541***	
	(0.0303)	(0.0452)	(0.0505)	
Child age squared	-0.0121***	-0.0101***	-0.0198***	
	(0.00144)	(0.00189)	(0.00262)	
Child sex	-0.136***			-0.145***
	(0.0517)			(0.0542)
Child birth order	0.0634***			0.0340
	(0.0193)			(0.0210)
Child attends school	-1.579***	-1.611***	-1.359***	
	(0.0982)	(0.142)	(0.139)	
Child works	-0.278**	0.0806	-0.533***	
	(0.120)	(0.167)	(0.168)	
Mother BMI	0.00539	0.00894	0.00235	
	(0.00506)	(0.00814)	(0.00651)	
Mother age	0.0307	0.115	-0.0288	
	(0.0479)	(0.0754)	(0.0650)	
Mother age squared	-0.000709	-0.00250***	0.000312	
	(0.000627)	(0.000926)	(0.000870)	
Father age	-0.104**	-0.347***	-0.0370	
	(0.0407)	(0.0699)	(0.0532)	
Father age squared	0.00106**	0.00316***	0.000301	
	(0.000456)	(0.000722)	(0.000611)	
Mother literacy	0.0665	-0.104	0.0472	
	(0.0645)	(0.205)	(0.0713)	
Father literacy	-0.0274	0.0409	-0.0588	
	(0.0617)	(0.144)	(0.0708)	
Mother works	0.0234	-0.00474	0.0268	
	(0.0582)	(0.0871)	(0.0784)	
Father works	0.108	0.0943	0.147	
	(0.136)	(0.195)	(0.188)	
Household wealth (assets)	-0.0488***	-0.0775***	-0.0417***	
	(0.00657)	(0.0150)	(0.00787)	
Dependency ratio	0.171***	0.247***	0.164**	
	(0.0513)	(0.0780)	(0.0694)	
Household has access to water	0.0576	-0.141	0.178	
	(0.104)	(0.154)	(0.140)	
Household has no toilet	-0.0326	-0.0494	0.00956	
	(0.0713)	(0.117)	(0.0911)	
Rural dummy	-0.0789	0.192	-0.0479	
	(0.0672)	(0.357)	(0.0732)	
SCST dummy	-0.0155	-0.0287	-0.000383	
	(0.0585)	(0.209)	(0.0633)	
Muslim dummy	-0.00497			0.0189
	(0.0764)			(0.0812)
Constant	-3.927***	-5.228***	-5.228***	-5.228***
	(0.666)	(0.970)	(0.970)	(0.970)
Observations	8,708	8,708	8,708	8,236
Number of clusters		4,354	4,354	4,354
R-squared/Wald $\chi 2$	0.062	646.20	646.20	646.20

Note: POLS, pooled ordinary least squares; CRE, correlated random effects; Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by household in the POLS model.

Table A3. 4: Financial resources and nutritional inequality between siblings

VARIABLES	(1) POLS	(2) CRE Within - estimator	(3) CRE Between - estimator	(4) CRE Time-invariant variables
Dimension 1: Decision-making	-0.286***	-0.181	-0.318***	
	(0.0764)	(0.121)	(0.123)	
Child age	0.411***	0.507***	0.542***	
	(0.0432)	(0.0452)	(0.0504)	
Child age squared	-0.0121***	-0.0102***	-0.0198***	
	(0.00195)	(0.00189)	(0.00262)	
Child sex	-0.137**			-0.145***
	(0.0545)			(0.0542)
Child birth order	0.0664***			0.0368*
	(0.0198)			(0.0210)
Child attends school	-1.577***	-1.613***	-1.359***	
	(0.110)	(0.142)	(0.139)	
Child works	-0.282***	0.0655	-0.544***	
	(0.0882)	(0.167)	(0.168)	
Mother BMI	0.00532	0.00859	0.00246	
	(0.00624)	(0.00814)	(0.00651)	
Mother age	0.0309	0.113	-0.0315	
	(0.0408)	(0.0754)	(0.0650)	
Mother age squared	-0.000699	-0.00250***	0.000367	
	(0.000507)	(0.000926)	(0.000870)	
Father age	-0.109***	-0.345***	-0.0416	
	(0.0316)	(0.0699)	(0.0531)	
Father age squared	0.00110***	0.00316***	0.000331	
	(0.000328)	(0.000723)	(0.000610)	
Mother literacy	0.0583	-0.104	0.0456	
	(0.0558)	(0.205)	(0.0708)	
Father literacy	-0.0272	0.0361	-0.0587	
	(0.0563)	(0.144)	(0.0707)	
Mother works	0.0180	-0.00800	0.0243	
	(0.0485)	(0.0872)	(0.0783)	
Father works	0.109	0.0831	0.147	
	(0.0978)	(0.195)	(0.188)	
Household wealth (assets)	-0.0471***	-0.0754***	-0.0398***	
	(0.00592)	(0.0151)	(0.00790)	
Dependency ratio	0.172***	0.236***	0.165**	
	(0.0434)	(0.0780)	(0.0692)	
Household has access to water	0.0813	-0.130	0.209	
	(0.0909)	(0.154)	(0.141)	
Household has no toilet	-0.0275	-0.0568	0.0234	
	(0.0590)	(0.117)	(0.0911)	
Rural dummy	-0.0775	0.217	-0.0545	
	(0.0622)	(0.357)	(0.0730)	
SCST dummy	-0.0176	-0.0183	-0.00195	
	(0.0515)	(0.209)	(0.0632)	
Muslim dummy	-0.00999			0.0142
	(0.0698)			(0.0812)
Constant	-3.693***	-4.887***	-4.887***	-4.887***
	(0.588)	(0.979)	(0.979)	(0.979)
Observations	8,708	8,708	8,708	8,236
Number of clusters		4,354	4,354	4,354
R-squared/Wald $\chi 2$	0.063	649.17	649.17	649.17

Note: POLS, pooled ordinary least squares; CRE, correlated random effects; Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by household in the POLS model.

Table A3. 5: Domestic violence and nutritional inequality between siblings

VARIABLES	(1) POLS	(2) CRE Within - estimator	(3) CRE Between - estimator	(4) CRE Time-invariant variables
Dimension 1: Decision-making	-0.0457	-0.0353	-0.141	
	(0.0629)	(0.114)	(0.109)	
Child age	0.409***	0.507***	0.540***	
	(0.0433)	(0.0452)	(0.0505)	
Child age squared	-0.0121***	-0.0102***	-0.0198***	
	(0.00195)	(0.00189)	(0.00262)	
Child sex	-0.137**			-0.144***
	(0.0545)			(0.0542)
Child birth order	0.0633***			0.0318
	(0.0198)			(0.0210)
Child attends school	-1.582***	-1.620***	-1.356***	
	(0.111)	(0.142)	(0.139)	
Child works	-0.277***	0.0605	-0.530***	
	(0.0887)	(0.167)	(0.168)	
Mother BMI	0.00532	0.00860	0.00236	
	(0.00616)	(0.00814)	(0.00651)	
Mother age	0.0316	0.111	-0.0278	
	(0.0409)	(0.0754)	(0.0650)	
Mother age squared	-0.000725	-0.00251***	0.000309	
	(0.000508)	(0.000927)	(0.000870)	
Father age	-0.107***	-0.345***	-0.0382	
	(0.0319)	(0.0700)	(0.0531)	
Father age squared	0.00109***	0.00316***	0.000309	
	(0.000332)	(0.000723)	(0.000610)	
Mother literacy	0.0563	-0.107	0.0429	
	(0.0559)	(0.205)	(0.0709)	
Father literacy	-0.0238	0.0397	-0.0580	
	(0.0564)	(0.144)	(0.0707)	
Mother works	0.0211	-0.00550	0.0270	
	(0.0484)	(0.0872)	(0.0783)	
Father works	0.106	0.0780	0.147	
	(0.0981)	(0.196)	(0.188)	
Household wealth (assets)	-0.0486***	-0.0766***	-0.0407***	
	(0.00592)	(0.0151)	(0.00791)	
Dependency ratio	0.173***	0.237***	0.163**	
	(0.0434)	(0.0780)	(0.0693)	
Household has access to water	0.0576	-0.143	0.181	
	(0.0911)	(0.154)	(0.140)	
Household has no toilet	-0.0314	-0.0473	0.0102	
	(0.0590)	(0.117)	(0.0910)	
Rural dummy	-0.0743	0.227	-0.0512	
	(0.0623)	(0.358)	(0.0731)	
SCST dummy	-0.0187	-0.0261	-0.000316	
	(0.0517)	(0.209)	(0.0633)	
Muslim dummy	-0.00582			0.0146
	(0.0700)			(0.0813)
Constant	-3.932***	-5.172***	-5.172***	-5.172***
	(0.583)	(0.971)	(0.971)	(0.971)
Observations	8,708	8,708	8,708	8,236
Number of clusters		4,354	4,354	4,354
R-squared/Wald $\chi 2$	0.061	641.37	641.37	641.37

Note: POLS, pooled ordinary least squares; CRE, correlated random effects; Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by household in the POLS model.

4. General conclusion

Despite considerable efforts and substantial improvements over the past few decades, promoting women and ultimately achieving gender equity remains one of the central objectives in development research and policy-making. Women empowerment is not only a fundamental right, it is also one of the crucial preconditions for achieving essentially all development goals, including the eradication of poverty and hunger and eliminating all forms of malnutrition. The position of women is particularly important for food security, nutrition and health, as mothers are usually the primary caregivers of their children and especially in developing countries are typically responsible for tasks like food preparation and cooking. However, the influence of women on the well-being of their peers can extend far beyond their roles in the domestic sphere. This dissertation contributes to the literature by analyzing the linkages between the position of women within their households and communities, and the food security and nutrition of household members. We particularly examined the role of women in various aspects of their social and productive life, and identify areas in which women are most disadvantaged and vulnerable. We further investigate patterns of food security, nutrition and health and examine the relevant pathways in which women empowerment plays a role in intra-household allocation of resources and in contributing to the improvement of nutritional outcomes.

In the first essay of this dissertation (Chapter 2), we used the methodology of the WEAI developed by Alkire et al. (2013) to analyze the relationship between women empowerment and nutrition, based on household and individual level data from Tunisian farm households. We also examined the level of women empowerment by using a set of ten indicators within five domains of empowerment, and investigated the dietary composition of households in general and of women in particular. More specifically, we calculated dietary indicators from seven-day-food-recalls at the household level, and from 24-hour food-recalls at the individual level and empirically analyzed the associations between women empowerment and these two indicators.

The results show that, although food insecurity is not of a particular concern in Tunisia, dietary patterns could be more diverse in terms of micronutrients, especially considering the increasing occurrence of the double burden of malnutrition in Tunisia, and particularly iron-deficiency anemia in women of reproductive age. Furthermore, we found that more than 30 percent of women in the sample can be classified as ‘disempowered’, following the definition

of the WEAI. Most importantly, we presented evidence that the level of women empowerment is significantly associated with both household food security and dietary diversity of women. Apart from the aggregate index of empowerment, increasing women's control over and decisions on income and credit can significantly contribute to higher dietary diversity both at the household and the individual level.

In the second essay of this dissertation, we used a nationally representative panel dataset from India to develop a measure of women empowerment and analyze the linkages between women empowerment, child nutritional status and nutritional inequality within households. As a measure of child nutritional status, we used the child's HAZ, and as a measure of nutritional inequality, we developed an indicator capturing the difference between the nutritional status of a child measured by the HAZ and the average HAZ of the other siblings in that same household. For that purpose we have narrowed our sample to children with at least one sibling.

Our analysis shows that differences in nutritional status between siblings predominantly occur by birth order and gender. Later born children have significantly lower HAZ and are more likely to be stunted. Analogically, girls have a significant disadvantage in nutritional status compared to their male siblings. Furthermore, our results indicate a strong and causal relationship between women empowerment and child nutritional status. Moreover, in empirical literature examining intra-household differences with regards to nutrition and health typically dummy variables or interaction effects are used for analyzing effects for different subgroups in a sample. However, by introducing a direct measure of nutritional inequality within households, we were able to analyze the dynamics of inequality within households in more detail. Our results show that women empowerment does not only have a positive influence on the nutritional status of children on average, but it has also the ability to straighten nutritional inequalities between siblings within households. Increasing our measures of women empowerment significantly decreases differences in HAZ between siblings, emphasizing the role of women for nutrition in general, but especially pointing to the role of women in compensating the nutrition security of the most vulnerable children in the household.

This dissertation points to the importance of gender equality not only as a desirable outcome for women, but also because it has strong implications for the well-being of others. Both essays show that improving the position of a woman within a household is potentially

increasing household food security, nutrition and health of other household members in general and children in particular.

However, few limitations of this dissertation have to be acknowledged. One limitation is the identification strategy of the first paper. Usually with cross-sectional data, one would try to find suitable instruments in order to address possible endogeneity and to establish a causal relationship between explanatory and dependent variables. However, we were not able to find a variable that fits the criteria of a valid instrument, which is why the estimation results are interpreted as associations rather than causation. Several studies have succeeded in finding valid instruments for analyzing the relationship between women empowerment and nutrition in other contexts. Lepine and Strobl (2013) and Sraboni et al. (2014) for example show that OLS regressions tend to underestimate the effects of women empowerment on dietary diversity scores compared to IV estimation techniques, but apart from this confirm the OLS estimates.

Moreover, to measure women empowerment, we have used two different, but in principle similar indices of women empowerment. Both of these indicators may be problematic to some extent. First of all, we include a rather broad number of sub-indicators and dimensions in those indices, all of them carrying the same weight in the indices. Not all of those sub-indicators may be fully appropriate to depict women empowerment, and some of them might be oversimplified. Furthermore, weighing different dimensions and indicators equally over one index may be considered arbitrary. Some of the dimensions are likely to play a more important role in real life than others, which in turn would lead to a misrepresentation of actual empowerment when referring to the aggregate index. Disaggregating these indices into their sub-components can help to address these issues to some extent. However, since questions on gender relations and power are very sensitive in nature, and also highly dependent on each respondent's own perception and interpretation of power, these types of indicators can never be fully objective and unbiased.

In conclusion, this dissertation contributes to understanding the role of women in terms of intra-household allocation of resources in general and food security and nutrition in particular. We could show that women in Tunisia and India are significantly disempowered in certain areas, while they are more empowered in others. We contribute to the literature by empirically validating the hypothesis that the relative position of a woman within a household matters for understanding patterns of food intake and health. To make women empowerment more comparable across countries, we propose that researchers take into account matters of female

autonomy and women empowerment, particularly when designing and implementing new household surveys. Especially research on food security and nutrition should acknowledge the role women play within this particular area of development, even if it may not be the primary focus of the research.

Policies targeting to strengthen the position of women may not only result in more equitable societies, but might ultimately bring about improvements in many other areas of life. Such policies could be initiatives aiming at increasing social participation of women, like improving education explicitly targeting girls and women, creating job opportunities for women outside their homes or encouraging women to participate in local leadership within their communities.

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General appendix

Household survey in Tunisia (2016): Questionnaire (shortened version)

Household Survey October – December 2016

Approaches of Agricultural Technology Diffusion – Evaluation of Extension Service Approaches

International Center for Agricultural Research in the Dry Areas (ICARDA), Institut National de Recherche Agronomique de Tunis (INRAT) and Office de l'Elevage et des Pâturages (OEP), and Georg-August University of Goettingen, Germany, are conducting a survey in order to provide more understanding about farmers' production and marketing decisions. We are particularly interested in finding the mechanisms through which farmers can effectively adopt agricultural technologies that may improve their economic status and well-being. We are currently conducting the first round of the survey and will follow-up in 2017 and 2018. Your participation in answering these questions is very much appreciated.

We will ask you and some members of your household detailed questions on various topics related to agriculture, social networks, and household well-being, including aspects of gender and nutrition. The interview will take around two hours in total. Your responses will be treated with utmost confidentiality and the data will be used for research purposes only. **We cannot promise that you and your community will benefit directly from this study, but the information that we are collecting will help to improve agricultural research and development activities in your region, country, and beyond.**

Do you have any questions that we need to clarify? [Make clarifications in case there are questions] If No, do you agree to take part in this survey?

MODULE 0 – HOUSEHOLD ID

1	Household ID		8	Village	
2	Date of Interview		9	Douar	
3	Full Name of HH Head		10	Result: 1=Interview completed 2= Interview partly completed 3= Specify	
4	Cell Phone Number		11	Enumerator-ID	
5	The Respondent is the Head of Household		12	Enumerator Name	
6	Governorate		13	Questionnaire Number	
7	Delegation				

MODULE A: HOUSEHOLD DEMOGRAPHIC DATA *(reference period: the last 12 months)*

Household composition: Please, list all household members (All those who are under the care of the household head in terms of food and shelter provision, and those who normally live and eat their meals together), starting with the household head. *(Ask about everybody who is considered a HH member, even if currently (temporarily) not present.)*

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Member ID	First name of the household member	Sex M=1 F=0	Relationship with HH head **Code A**	Age in years	Years of formal education	Highest level of education attained **Code B**	Is member currently enrolled in school? Yes=1 No=0	Marital Status **Code C**	How many months in the last 12 months has [NAME] been away from home?	Main Occupation based on time spent **Code D**	Household farm labor contribution (for those > 16 years) **Code E**	How many years of farming experience does the person have (for those > 16 years)?	Does [NAME] have off-farm income/ work? Yes=1 No=0
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

Code A
1= Head
2=Spouse
3=Son/daughter
4=Father/mother
6=Grandchild
7=Grandfather/-mother
8=Step child
9=Step father/mother
11 =Sister/brother-in-law
12 = House girl
13 =Farm laborer
14 = Other relative

Code B
1=illiterate
2=Kottab
3=primary
4=high school
5=college
6=university

Code C
1=married
2=single
3=divorced
4=widow(er)

Code D
0= None
1= Farming (crop + livestock)
2= Casual labor on-other farm
3= Casual labor off-farm
5= Salaried employment
6=Student/school
77=Other (Specify _____)

Code E
1= Part time
2= Fulltime
3=Doesn't work on farm

MODULE B: CHARACTERISTICS OF MAIN HOUSE *(Instructions: please, observe or ask about the following)*

1	2	3	4	5	6	7	8	9	10
Observe				**Ask**					
Roofing material *1=bricks* *2=iron sheet* *3=tiles* *4=other, specify _____)*	Wall material *1=mud* *2=iron sheet* *3=wood* *4=plastered* *5=bricks* *6=stones* *7=other (specify _____)*	Floor material *1=earth* *2=cement* *3=wood* *4=tiles* *5=ceramic* *6= other (specify _____)*	Type of toilet *1=bush* *2=pit latrine* *3=flush toilet* *4= other (specify _____)*	Mode of ownership *1=owned* *2=rented* *3=owned by relative* *4= other (specify _____)*	Main source of water **Code A**	Distance of the main source of water from the main house in minutes by foot	Mode of treating drinking water *1=do nothing* *2=boil it* *3=use water guard/filter/tablets* *4= other (specify _____)*	Main cooking fuel *1=firewood* *2=charcoal* *3=paraffin* *4=gas/biogas* *5=electricity* *6=solar power* *7=other (specify _____)*	Main source of lighting *1=tin lamp* *2=lantern* *3=pressure lamp* *4=electricity* *5=solar power* *6= other (specify _____)*

Code A

1=piped into compound
2=piped outside compound
3=stream/river
4=well
5=unprotected spring
6=protected spring
7=Borehole protected (private)
8=Borehole unprotected (private)
9= Borehole protected (shared)
10= Borehole unprotected (shared)
11=roof catchments
12=water tankers
13=other, (specify _____)

MODULE C: HOUSEHOLD ASSETS

Enumerator: To estimate the value ask the respondent how much they would be willing to buy the item in its current state if it were being sold to them

As of September 2016, how many of the following items did the household own that are in usable/repairable condition?

	Asset	Total Quantity		Asset	Total Quantity
1	Tractor		2	Slasher	
3	Car/Van		4	Axe	
5	Pickup		6	Hoes	
7	Motorcycle		8	Spades/shovel	
9	Bicycle		10	Chemical spray pump	
11	Television		12	Treadle pump	
13	Radio		14	Powered water pump	
15	Cell Phone		16	Greenhouse	
17	Refrigerator		18	Water tank	
19	Solar panels		20	Store for farm produce	
21	Generator		22	Lanterns	
23	Chaff cutter		24	Main house	
25	Ploughs for tractor		26	Wheelbarrow	
27	Reaper		28	Computer/laptop	
29	Cart		30	Combine Harvester	
31	Livestock stable		32	Cupboard	
33	Washing machine		34	Grain storage structures	
35	Oven		36	Hydraulic equipment	
37	Straw-press		38	Milk cans	
39	Milking machine		40	Other(specify_____)	

MODULE D: LAND HOLDING IN HECTARES *(reference period: last 12 months)*

D.1 How much land do you or anyone else in the household own in hectares? _____ ha

D.2 Do you or anyone else in the household have a title deed for your land? *Circle the applicable.*
1=Yes, all land 2=Yes, partly 0=No, no land

D.3	Land category	Land (in ha)
1	Total agricultural land	
2	Total area cultivated	
3	Land under homestead	
4	Own land	
5	Rented in	
6	Rented out	
7	Total irrigated land	
8	Land under pasture	
9	Access of the HH to communal (pasture) land	
10	Propriete SMVDA	
11	Lot technician Metayage	
12	Location Gerance	

D.4	How much money spent on one ha (Tunisian dinar / year)?			
1	Irrigated land	1.1	Well water	
		1.2	Public Water	
2	Rainfed land for pasture			
3	Rainfed land for trees			
4	Rainfed land for cereal production			
5	Rainfed land for Cacti			

MODULE E: NON-LABOUR PURCHASED INPUT USE *(reference period: last 12 months)*

1	2	3	4	5a)	5b)	5c)	6a)	6b)	6c)	7	8	9a)	9b)	9c)
Plot Code (Use alphabets in Capital letters)	Plot name	Crop Grown **Code A**	Land under crop (# in ha)	Seed used			Fertilizer (planting) *(Fill once for intercrops)*			Horses/Mules/Camels/Donkeys and Tractor hire cost (machinery costs)* (TND)	Use of Farm manure 0=No 1=Yes own 2=yes, purchased	Pesticides/herbicides		
				Qty.	Unit **Code C**	Price/Unit (TND)	Qty.	Unit **Code C**	Price/Unit (TND)			Qty.	Unit **Code C**	Price/ Unit (TND)
Perennial Crops														

Codes A
1=Barley
2= Hard wheat
3= Soft wheat
4= Oat
5= Chickpea
6= Faba bean
6=Lentil
7= Almonds
8= Nuts
9=Vegetables (Specify _____)
10= Olives
11= Fruit trees (Specify _____)
12= Cactus

Codes C
1= Kilogram
2=Gaiba
3=Quintal
4=Ton

Codes D
1=Farm gate
2=Village market
3=Main market
4=Other farmer
5=Collection Center
6=Traders and distribution
77=Other (specify _____

Codes E
1=male household head
2= female household head
3=female spouse
4=male spouse
5=joint decision
77=Others (specify _____)

*Includes for Harvesting, Threshing, Ploughing

MODULE F: CROP UTILIZATION *(reference period: last 12 months, refers to Crops and Codes from Module 3)*

1	2a)	2b)	3	4	5	6	7	8	9	10
Crop **Code A** (Aggregated crop)	Unit **Code C**	Total Grain Output (Enter total crop output per ha)	Consumption in own HH for family	Consumption in own HH for animal production	Saved as seed	Gift, donations, paid as wages	Quantity sold	Price received (in TND)	Point of most sales **Code D**	Who mostly decides over revenue use? **Code E**

F.2		1	2	4	
	Residue type	Output from production	% used for feeding animals	Amount sold (if sold)	Price per unit
1	Straw				
2	Hay				

F.3 Market Access Constraints

	1	2	3	4	5	6	7	8	9	10	11	12
	Poor infrastructure	Distant markets	Poor market prices for produce	High market prices for inputs	Cheating on quality standards/weighing scales	Lack of contracts or reliable buyers	Lack of contracts or reliable sellers	Exploitative middle men	Lack of information	Lack of demand for produce	Lack of input supply	Other, (specify _____)
On a scale from 1 to 10, […] constrains me…												

F.4 What is the distance to the farm to the closest paved road (in km)? _____

MODULE G: LABOUR INPUTS CROP PRODUCTION *(reference period: last 12 months)*

1	2.1		2.2		3.1		3.2		4.1		4.2		5.1		5.2		6.1		6.2		7
Crop **Code A**	Ploughing & Harrowing, Planting (plus, for trees: Grafting and Pruning)				Fertilizer, Pesticide, Herbicide Application				Weeding				Harvesting /Threshing				Bagging				Work done by mainly F=0 mainly M=1 Both equally =3
	Family		Hired		Family		Hired		Family		Hired		Family		Hired		Family		Hired		
	a) Total labor days	b) # of hours/day	c)Total labor days	d) # of hours/day	a)Total labor days	b)# of hours/day	c) Tot. labor days	d) # of hours/day	a) Total labor days	b) # of hours/day	c) Total labor days	d) # of hours/day	a) Total labor days	b) # of hours/day	c) Tot. labor days	d) # of hours/day	a) Total labor days	b) # of hours/day	c) Tot. labor days	d) # of hours/day	

Codes A 1=Barley 2= Hard wheat 3= Soft wheat 4= Oat 5= Chickpeas 6= Faba bean 6=Lentil 7= Almonds 8= Nuts 9=Vegetables 10= Olives 11= Fruit trees 12= Cactus

G.1		1	2
	If you paid someone for the following tasks, how much would it be?	Men:_____ TDN/day	Women:_____ TDN /day
1	Planting (for trees also Grafting and Pruning)		
2	Fertilizer, Pesticide application		
3	Weeding		
4	Harvesting /Threshing		
5	Bagging		

MODULE H: LIVESTOCK PRODUCTION AND MARKETING *(reference period: last 12 months)*

	Livestock	# owned	Race 0=local 1=improve 2=cross bred 3=both breeds)	Sales					# of animals consumed as meat in the own household	Wool		Milk production (liter/year)	
				# of heads	Average price for liveweight (TND/kg)	Average weight per animal sold (kg)	Purpose **Code A**	Month **Code C**		Production	Price per unit	Production	Price per unit
1	**Cattle**												
2	Milk cows												
3	Non-milk cows												
4	**Camel**												
5	**Sheep**												
6	Adult ewe												
7	Rams												
8	Male lambs												
9	Female lambs												
10	**Goats**												
11	**Bee hives**												
12	**Others(specify)**												

Code A 1=To meet planned household expenses 2=To meet emergency household expenses 3= Livestock trading as a business 4= Culling because not productive 5= Culling because sick 6=To achieve a high market price 77 = Other (Specify _____)

Code B 1= Replacement of old or culled animal 2 = Improvement of mutton production n 3 = Improvement of meat production 4= To sell later 5 = As a way of storing money I had available at the time 6 = To guard against food shortage because the animal can be sold 7 = To guard against food shortage because the animal can be slaughtered 8 = Increase social prestige 9 = Replace animal that died 10 = Other , (Specify _____)

Code C 1=Jan, 2= Feb, 3= Mar, 4= Apr, 5= May, 6= Jun, 7=Jul, 8= Aug, 9= Sep, 10= Oct, 11=Nov, 12= Dec

MODULE I: LIVESTOCK PRODUCTION AND MARKETING - CONTINUED

		# of animals gifted	# of animals received as gift	Birth			Purchase			Treatment (sick animals, not vaccination)		Dead from disease/accident?
				# Born	Main Month of birth **Code C**	# Born dead	# Purchased	Average price per unit (TND)	Reasons **Code B**	# treated	Average cost/animal	
1	**Cattle**											
2	Milk cows											
3	Non-milk cows											
4	**Camel**											
5	**Sheep**											
6	Adult ewe											
7	Rams											
8	Male lambs											
9	Female lambs											
10	**Goats**											
11	**Bee hives**											
12	**Others(specify)**											

I.1 a) Are any animals used for transportation or land preparation? *Circe the applicable*. *If No to this Question, skip to Question 6.4* 1=Yes 0=No

I.1 b) If animals are used for transportation or land preparation how many of which species? *Use Code A to Answer the Question.* _____

Code A 1=Horse 2=Cow 3=Donkey 4=Camel 5=Mule

I.2 If you or anyone else in the household were to sell all of your sheep today, how much money would you receive? _____ TND

I.3 What is the age at first parturition of the sheep? ____ months

MODULE M: OTHER SOURCES OF INCOME AND TRANSFER

M.1 Do you or other members in the household have any other off-farm employment? (Please prompt the codes to make sure nothing is forgotten.)

1	2	3	4	5a)	5b)
Member ID	Type of Occupation **Code A**	Average Number of days worked per month in the last 12 months	Average Number of months worked in the last 12 months	Earning per unit	
				TND	Unit **Code B**

Code A 1=Agricultural labor (casual+permanent) 2=Casual labor (non-agricultural) 3=Salary (Permanent non-agricultural employment) 4=Trader/Merchant

Code B 1=Day, 2=Month, 3=Year, 4=Lump sum, payment, 77=Other (Specify _____)

	M2	1	2	3a)	3b)	3c)	3d)	3e)
	Type of income source	Amount /value received in the last 12 months/ for small businesses ask for profit (+) losses (-) (in TND)						
	Member ID							
1	Remittances/Gifts/Transfers/ Pension/ Dividends (e.g. government transfers)							
2	Sales of Fruits							
3	Sales of Crop residues (e.g. straw)							
4	Hiring out machinery land or services to other farmers/animals for ploughing or transport							

M.3 Does the household have any other sources of income*? 1=Yes, (Specify _____) 0=No*

MODULE N: NON-FOOD EXPENDITURE

Consider the last 12 months, how much has your household generally spent on the items listed in the last month (see specification indicated for each item)?

	Read out: Please exclude Business Expenditures *Enter 77 if respondent does not know.*	How much did your household spend on [ITEM/SERVICE] during the last year (TDN)?
1	Rent (housing)	
2	Personal care supplies	
3	Clothes, shoes and bags, accessories	
4	Detergent/washing powder	
5	Electricity	
6	Other non-food	
7	Fuel, maintenance, insurance, and tax for motorbike/car	
8	Public transport	
9	Telephone expenditures/Airtime	
10	Other transportation, communication	
11	School transport (bus, taxi …)	
12	School fees	
13	School books	
14	Student's dress/uniform	
15	Tuition and rental fee	
16	Other costs of schooling	
17	Medicine, doctor fees	
18	Other health cost	
19	Celebration	
20	Recreation and entertainment	
21	Tobacco	
22	Insurance (e.g. car, life, health)	
23	Remittances transferred to other HH	
24	Other social cost	

MODULE O: ACCESS TO SOCIOECONOMIC INFRASTRUCTURE

		1	2
	Social facilities	Distance to the nearest (km) […]	Most frequently used means of transportation to the facility **Code A**
2	Village market		
3	Main Agricultural input market		
4	Crop production		
5	Animal Production		
6	Main agricultural product market		
7	Crop production		
8	Animal Production		
9	Health Centre		
10	School		
11	Agric. extension agent		

Code A 1=Own Bicycle 2=Minibus 3=Hired truck 4=Donkey/Horse 5=Walking 6= Own truck 7= Taxi 8= Motorbike 9= Tractor 10= Pick-up 77=Other (specify _____)

MODULE P: SELF ASSESSMENT OF RISK

How would you describe yourself? Are you generally willing to take risks, or do you try to avoid taking risks? Please choose a number on the scale between 0 and 5, where the value 0 means "always trying to avoid risks" and the value 5 means "fully prepared to take risks". *Circle the applicable.*

		[…] always trying to avoid risks					[…] fully prepared to take risks
1	In terms of trying out new agricultural production technology, I am […]	0	1	2	3	4	5
2	In terms of moving from my place to another place outside of the country, I am […]	0	1	2	3	4	5

MODULE S1: 7 DAY FOOD RECALL

Enumerator: Ask this section to the female head/spouse or member with the most knowledge on food preparation

Food recall: *READ:* Now I would like to ask you about foods that the members of your household consumed at home. Could you please tell me how many days in the past week your household has eaten the following food items, prepared and/or consumed at home and what the source of the food was?	Item	1 Quantity of the item eaten in previous 7 days: If 0 >> Next item **Code A (for Unit)**	2 Price per Unit (in TND)	3 Amount of money spent on the item in the last 7 days (in TND)	4 What was the main source of this food in the last 7 days? **Code B**
Wheat flour (bread, noodles, couscous)	1				
Rice	2				
Cereals (maize, barley)	3				
Vegetables	4				
Onions	5				
Bell peppers	6				
Carrots	7				
Chickpeas	8				
Tomatoes	9				
Capers	10				
Celery	11				
Turnips	12				
Potatoes	13				
Chili Peppers	14				
Cucumbers	15				
Eggplants	16				
Beans, lentils, peas, nuts	17				
Eggs	18				
Fruits	19				
Lemon	20				
Oranges	21				
Figs	22				
Dates	23				
Apricots	24				

Pomegranates	25				
Quince	26				
Olives	27				
Dairy products	28				
Milk	29				
Cheese	30				
Yoghurt	31				
Cream	32				
Meat	33				
Goat	34				
Beef	35				
Lamb	36				
Veal	37				
Camel	38				
Chicken	39				
Sheep	40				
Mutton	41				
Fish	42				
Tuna	43				
Squid	44				
Octopus	45				
Anchovies	46				
Sardines	47				
Mackarel	48				
Eel	49				
Oil//fats (butter, veg oil, olive oil)	50				
Sugar, Honey	51				
Condiments (spices, harissa,)	52				
Nuts and seeds (hazelnuts, almonds, chestnuts, pine nuts, peanuts)	53				

Codes A
1=Kilogram 2=Galba
3=Quintal 4=Liter
5=piece/number 77= other (specify:_____)

Codes B
1=Own production 2=Hunting/gathering/fishing 7=Received as payment
3=Bought using cash 4=Bought on credit
%=Borrowed 6=Gifts (friends/relatives)

MODULE S2: 24 HOUR FOOD FREQUENCY

Food frequency: S2.1 Did you consume any of the following food items during the last 24 hours? *1=Yes 0=NO*		1	2	3
		M Respondent	**F** Respondent	Child > 2 years
HH Member ID				
Cereals (corn, maize, rice, etc. or any other grains/foods made from these like bread, noodles, porridge, etc.)	1			
White roots and tubers (white potatoes or any other foods made from roots)	2			
Vitamin A rich Vegetables and Tubers (pumpkin, carrot, squash or sweet potato + other local vegetables like red sweet pepper)	3			
Dark green leafy vegetables (including wild forms + local vegetables like spinach, kale, amaranth)	4			
Other vegetables (like tomato, onion, eggplant and other local vegetables)	5			
Vitamin A rich fruits (ripe mango, cantaloupe apricot, ripe papaya, dries peach and 100% fruit juice made from these + local fruits)	6			
Other fruits (including wild fruits and 100% fruit juice made from these)	7			
Organ meat (liver, kidney, heart, or other organ meats or blood-based foods)	8			
Flesh meats (beef, pork, lamb, goat, sheep, rabbit, chicken, duck, other birds)	9			
Eggs (from chicken, duck or any other egg)	10			
Fish and Seafood (fresh or dried fish or shellfish)	11			
Legumes, Nuts and Seeds (dried beans, dried peas, lentils, nuts, seeds or foods made from these, e.g. hummus)	12			
Milk and milk products (milk, cheese, yoghurt or other milk products)	13			
Oils and fats (oil, fats or butter added to food or used for cooking)	14			
Sweets (sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cake)	15			
Spices, condiments, beverages (black pepper, salt, soy sauce, hot sauce, harissa, coffee, tea)	16			
S2.2 Did you eat anything (meal or snack) outside the home yesterday*? 1=Yes 0=No*				

Individual Questionnaire

Enumerator: This questionnaire should be administered separately to individuals identified in the household roster (Section B) of the household level questionnaire as the primary and secondary respondents. You should complete this coversheet for each individual identified in the "selection section" even if the individual is not available to be interviewed for reporting purposes.

MODULE A. INDIVIDUAL IDENTIFICATION

Household Identification	**Code**	**Household Identification**	**Code**
A01. Household Identification (from Module 0):		**A05.** Outcome of interview (**Code 1**):	
A02. Name of respondent currently being interviewed (code from roster in Section B of HH questionnaire) **Surname:.....**		**A06.** Ability to be interviewed alone (**Code 2**):	
A03. Sex of respondent**:** 1=Male 2=Female			
A04. Type of household 1=Male and female adult, 2= Female adult only 3=Male adult only			

Code 1

1=Completed 2=Incomplete

3=Absent 4=Refused

5=Could not locate

Code 2

1=Alone 2=With adult females present

3=With adult males present 4=With adults mixed sex present

5=With children present 6=With adults mixed sex and children present

A.07 Are your parents still alive? *Circle the applicable.* 1=Yes 0=No

A.08 How many years of formal education have your parents completed? _____

A.09 Can/Could your parents read a bill? *Circle the applicable.* 1=Yes 0=No

A.10 How many brothers and sisters do you have? _____

A.11 What is the highest year of education among all your brothers and sisters? _____

MODULE B: Role in household decision-making around production and income generation *Enumerator: The purpose of this module is to get an idea about men's and women's relative roles in decision making around income-generating activities.*

Activity		Did you (singular) participate in [ACTIVITY] in the past 12 months? 1=Yes ... 1 2=No .... 2, if No skip to next activity	How much input did you have in making decisions about [ACTIVITY]? **Code 1**	How much input did you have in decisions on the use of income generated from [ACTIVITY]? **Code 1**
Activity Code	Activity Description	**B01**	**B02**	**B03**
1	Food crop farming: crops that are grown primarily for household food consumption			
2	Cash crop farming: crops that are grown primary for sale in the market			
3	Livestock raising a) Sheep/Goat			
4	Livestock raising b) Cattle			
5	Livestock raising c) Camel			
6	Non-farm economic activities: Small business, self-employment, buy-and-sell wage and salary employment in kind of monetary work both agriculture or wage work			

Code 1
1=No input
2= Input into very few decisions
3= Input into some decisions
4= Input into most decisions
5= Input into all decisions
6= No decision made

MODULE C: Access to productive capital

Enumerator: The purpose of this module is to get an idea about men's and women's access to capital or assets and their ability to control use of the resource.

Productive Capital		Does anyone in your household currently have any [ITEM]? 1=Yes 1 2=No...2 if No, skip to next Item	Who would you say owns most of the [ITEM]? **Code 1**	Who would you say can decide whether to sell [ITEM] most of the time? **Code 1**	Who would you say can decide whether to give away [ITEM] most of the time? **Code 1**	Who would you say can decide to mortgage or rent out [ITEM] most of the time? **Code 1**	Who contributes most to decisions regarding a new purchase of [ITEM]? **Code 1**
	Productive Capital	**C01**	**C02**	**C03**	**C04**	**C05**	**C06**
1	Agricultural land (pieces/plots)						
2	Small livestock (goats, sheep)						
3	Large Livestock (Cattle, …)						
4	Farm equipment (non-mechanized)						
5	Farm equipment (mechanized)						
6	House (and other structures)						
7	Large consumer durables (fridge, TV, sofa)						
8	Small consumer durables (radio, cookware)						
9	Cell phone						
10	Means of transportation (bicycle, motorcycle, car)						

Code 1
1=Self
2=Partner/Spouse
3=Self and partner/spouse jointly
4=Other household member
5= Self and other household member(s)
6= Partner/Spouse and other household member(s)
7= Someone (or group of people) outside the household
8= Self and other outside people
9= Partner/Spouse and other outside people
10= Self, partner/spouse and other outside people

MODULE C: Access to Credit

Lending sources		Has anyone in your household taken any loans or borrowed cash/in-kind from [SOURCE] in the past 12 months? 1=Yes, cash 2=Yes, in-kind 3=Yes, cash and in-kind 4=No 5=Don't know, if No or Don't know, skip to C13B	If yes C10 a) how much did you receive in TDN?	Who made the decision to borrow from [SOURCE]? **CODE 1**	Who makes the decision about what to do with the money/ item borrow from [SOURCE]? >> Next source **CODE 1**	If more credit for agricultural purposes had been available from this source, would you have used it? Yes ....1, if Yes, skip to next source No……..2	Why would you not have borrowed more from [SOURCE]? >> Next source **CODE 2**	Did you want to borrow or get a loan or agricultural purposes from [SOURCE] in the last 12 months but did not? 1=Yes 2=No >> Next source	Why were you not able to borrow from [SOURCE]? **CODE 2**
Lending source names		**C10a)**	**C10b)**	**C11**	**C12**	**C13**	**C13A**	**C13B**	**C13C**
A	Non-governmental organization								
B	Informal lender								
C	Formal lender (bank/financial institution)								
D	Friends or relatives								
E	Group based micro-finance or lending								
F	Marketers and distributors								

Code 1:
1=Self
2=Partner/Spouse
3=Self and partner/spouse jointly
4=Other household member
5= Self and other household member(s)
6= Partner/Spouse and other household member(s)
7= Someone (or group of people) outside the household
8= Self and other outside people
9= Partner/Spouse and other outside people
10= Self, partner/spouse and other outside people

Code 2:
1=Have enough money
2=Afraid of losing collateral
3= Do not have enough collateral/did not qualify for the loan
4=Afraid cannot pay back the money
5=Interest rate/other costs too high
6= Not allowed to borrow/family dispute in borrowing decision
7= Place of lender is too far
8= Other (specify _____

MODULE E: Individual leadership and influence in the community

Enumerator: The purpose of this module is to get an idea about men's and women's potential for leadership and influence in the communities where they live.

QNo.	Question	Response	Response options/Instructions
E02A	Do you feel comfortable speaking up in public to help decide on infrastructure (like small wells, roads, water supplies) to be built in your community?		1=No, not at all comfortable 2=Yes, but with a great deal of difficulty 3=Yes, but with a little difficulty 4=Yes, fairly comfortable 5=Yes, very comfortable
E02B	Do you feel comfortable speaking up in public to ensure proper payment of wages for public works or other similar programs? Do you feel comfortable speaking up in public to protest the misbehavior of authorities or elected officials?		

Group membership		Is there a [GROUP] in your community? 1=Yes 2=No, If No, Skip to next group	Is this group Women and men……..1 Men only or mostly ....2 Women only/mostly ...3	Are you an active member of this [GROUP]? 1=Yes 2=No If No, Skip to E09A	How much input do you have in making decisions in this [GROUP]? (>> next group) **Code 1**	Why are you not a member of this [GROUP]? **Code 2**	Code 1 1=No input 2=Input into very few decisions 3=Input into some decisions 4=Input into most decisions 5=Input into all decisions
	Group Categories	**E06A**		**E06**	**E09**	**E09A**	
A	Agricultural / livestock/ fisheries producer's group (including marketing groups)						Code 2 1=Not interested 2=No time 3=Unable to raise entrance fees 4=Unable to raise reoccurring fees 5=Group meeting location not convenient 6=Family dispute/unable to join 7=Not allowed because of sex 8=Not allowed because of other reason9=Other, specify
B	Credit or microfinance or savings group						
C	Mutual help or insurance group						
D	Political party or similar						
E	Local government						
F	Other women's group (only if it does not fit into one of the other categories, e.g. NGO)						
G	Sports group, Cultural group						
H	Neighborhood/Village committee						
I	Other, (Specify _____)						
K	Other, (Specify _____)						

MODULE G: Decision making, Enumerator: The purpose of this module is to get additional information about decision making within households.

ENUMERATOR: Ask G01 for all categories of activities before asking G02. If household does not engage in that particular activity, enter code for "Decision not made" and proceed to next activity.		When decisions are made regarding the following aspects of household life, who is it that normally takes the decision? If 1 and respondent is male OR If 2 and respondent is female (>> **next domain)** Otherwise >>G02 CODE 1	To what extent do you feel you can make your own personal decisions regarding these aspects of household life if you want(ed) to? CODE 2
		G01	**G02**
A	Agricultural production?		
B	What inputs to buy for agricultural production?		
C	What types of crops to grow for agricultural production?/animal feeding?		
D	Livestock raising?		
E	When or who would take animals to the market?		
F	If a new farm technology will be adopted or not?		
K	Your own (singular) wage or salary employment?		
H1	Major household expenditures? (such as a large appliance for the house like refrigerator)		
H2	Minor household expenditures? (such food for daily consumption or other household needs)		
L	What kind of tasks you will do on a particular day?		

Code 1

1=Main male or husband
2=Main female or wife
3=Husband and wife jointly
4=Someone else in the household
5=Jointly with someone else inside the household
6=Jointly with someone else outside the household
7=Someone outside the household/other
8=Decision not made

Code 2:

1=Not at all
2=Small extent
3=Medium extent
4=To a high extent

MODULE G: Decision making, CONTINUED

ENUMERATOR: This set of questions is very important. I am going to give you some reasons why you act as you do in the activities I just mentioned. You might have several reasons for doing what you do and there is no right or wrong answer. Please tell me how true it would be to say: If household does not engage in that particular activity, enter code for "Decision not made" and proceed to next activity.		My actions in [DOMAIN] are determined by the situation. I don't really have an option. CODE 1	My actions in [DOMAIN] are partly because I will get in trouble with someone if I act differently. CODE 1	Regarding [DOMAIN] I do what I do so others don't think poorly of me. CODE 1	Regarding [DOMAIN] I do what I do because I personally think it is the right thing to do. CODE 1
		G03A	**G03**	**G04**	**G05**
A	Agricultural production				
B	Getting inputs for agricultural production				
C	The types of crops to grow for agricultural production				
D	Livestock raising?				
E	When or who would take animals to the market?				
F	If a new farm technology will be adopted or not?				
K	Your own (singular) wage or salary employment				
H1	Major household expenditures (such as a large appliance for the house like refrigerator)				
H2	Minor household expenditures (such food for daily consumption or other household needs)				
L	What kind of tasks you will do on a particular day?				

Code 1:

1=Never true
2=Not very
3=Somewhat true
4=Always true
5=Decision not made

MODULE F (Dimension 5): Time allocation, CONTINUED

	Question	Response	Response options/Instructions
F01	Was yesterday a holiday or nonworking day?		1=Yes 0=No
F02	How much time did you spend the last day on farming activities?		In hours
F03	How much time did you spend the last day on housework activities (cooking, washing, cleaning,		In hours
F04	How much time did you spend the last day on leisure activities like visiting neighbors, watching TV, listening to the radio, seeing movies or doing sport?		In hours
F05	How satisfied are you with your available time for leisure activities like visiting neighbors, watching TV, listening to the radio, seeing movies or doing sports?		READ: Please give your opinion on a scale of 1 to 10. 1 means you are not satisfied and 10 means you are very satisfied. If you are neither satisfied or dissatisfied this would be in the middle or 5 on the scale.
F06	During the last four weeks, how many days of your primary daily activities did you miss because of poor health?		Enter number of days [1-28]
F07	Do you suffer from a chronic disability?		1=Yes 0=No