

Women Empowerment in Agriculture: What Role for Food Security in Bangladesh?¹

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14.1 Introduction

While Bangladesh has experienced steady advances in food production through the adoption of agricultural technologies, chronic food insecurity remains a challenge. Similar to other countries in South Asia, there is a strong gender dimension to food insecurity and malnutrition in Bangladesh. In South Asia, the low status of women and gender gaps in health and education contribute to chronic child malnutrition (Smith et al. 2003) and food insecurity (von Grebmer et al. 2009), even as other determinants of food security, such as per capita incomes, have improved. Renewed interest in agriculture as an engine of inclusive growth and specifically in women's empowerment has highlighted the need to develop indicators for measuring women's empowerment, to examine its relationship to various food security outcomes, and to monitor the impact of interventions to empower women.

This chapter presents how the recently developed Women's Empowerment in Agriculture Index (WEAI) (Alkire et al. 2013) can be used to assess the extent of women's empowerment in agriculture, diagnose areas where gaps in empowerment exist, and examine the extent to which improvements in the underlying indicators in these areas can improve food security in rural Bangladesh. The WEAI is a new survey-based index that uses individual-level data collected from primary male and female respondents within the same households, and is similar in construction to the Alkire and Foster (2011) group of multidimensional poverty indices.

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Although it was initially developed as a monitoring and evaluation tool for the US Government's Feed the Future programs, the WEAI has broader applicability as a diagnostic tool for policymakers, development organizations, and academics seeking to inform efforts to increase women's empowerment. The WEAI was developed and tested between 2011 and 2012 using three country pilots in Bangladesh, Guatemala, and Uganda (Alkire et al. 2013); this chapter presents the results using a nationally representative survey.

Using nationally representative data from the 2012 Bangladesh Integrated Household Survey (BIHS) conducted by the International Food Policy Research Institute (IFPRI), this chapter examines the relationship between women's empowerment in agriculture and three measures of food security in rural Bangladesh: per capita calorie availability, household dietary diversity, and adult body-mass index (BMI). We use six measures of women's empowerment—the aggregate women's empowerment score, based on five domains of empowerment in agriculture (5DE)—as well as four individual indicators derived by decomposing the 5DE to identify in which of the five domains disempowerment is most acute, and using the specific indicators that comprise those domains. Our sixth measure, women's empowerment relative to men, is reflected by another component of the WEAI, the gender parity gap. Because empowerment itself is endogenous, we use instrumental variables regression to examine the relationship between various measures of women's empowerment and measures of household food security.

Increases in women's empowerment scores are found to increase both calorie availability and household dietary diversity. Empowerment gaps for women in rural Bangladesh are found to be greatest in terms of leadership in the community and control and access to resources. Analyzing these two domains further in terms of their component indicators, we find that the number of groups in which women actively participate and women's greater control of assets are positively associated with both food security outcomes. Narrowing the gap in empowerment between men and women within households is also positively associated with calorie availability and household dietary diversity, consistent with the growing literature arguing that reducing intra-household gender inequality contributes positively to household welfare. Most of the indicators for women's empowerment do not have any significant impact on adult BMI, suggesting that other factors, such as household wealth, education and occupation, are more important determinants of adult male and female nutritional status. However, women's group membership and decision-making concerning credit are negatively

and significantly associated with adult male BMI, suggesting possible trade-offs within the household. The impacts of women's empowerment appear to vary by household wealth, as proxied by the size of owned land. Our results suggest that the positive effect of different dimensions of female empowerment on food security outcomes is greater for smaller landowners, that is, for less well-off households, pointing to the potential positive redistributive effect of focusing women's empowerment efforts on poorer households.

14.2 Background

14.2.1 Agriculture, Women's Empowerment and Food Security

Agriculture is closely linked to food security, by providing a source of food and nutrients, a broad-based source of income, and by directly influencing food prices (Arimond et al. 2010). Women account for 43 percent of the agricultural labor force in developing countries (FAO 2011a); yet considerable gender bias exists in the agriculture sector, both in terms of quantities of assets, agricultural inputs and resources that women control (see, Agarwal 1994 on land in South Asia; Deere, Oduro, Swaminathan, and Doss 2013 on assets; and Peterman, Behrman, and Quisumbing, 2010 on non-land inputs), as well as returns to those inputs (Kilic, Palacios-Lopez, and Goldstein 2013). Similar to the recognition of women's contribution to agriculture worldwide, women's role in Bangladeshi agriculture tends to be underappreciated, owing to the commonly held view that women are not involved in agricultural production, especially outside the homestead, because of cultural norms that value female seclusion and undervalue female labor (Kabeer 1994; Rahman 2000). Nevertheless, participation of women in the agriculture sector has increased over time (Asaduzzaman 2010 citing Bangladesh Bureau of Statistics, various years). Between 1999-2000 and 2005-2006, the number of employed persons in agriculture increased from 19.99 to 22.93 million—by about 15 percent. For male labor, there has been an absolute decrease of about 6 percent, while for females the number has increased from 3.76 to 7.71 million—that is, by more than 100 percent. As a result of such changes, the proportion of women in the agricultural labor force has increased from less than 20 percent to 33.6 percent of the total. This is indeed a phenomenal change, although it is not yet clear how much of this change resulted from a true secular increase as opposed to better measurement of women's participation.

Women in poor households, who are at greater risk of being food-insecure, are more likely to be involved in the agriculture sector, particularly

as wage laborers, because women's earnings are important to their families' subsistence. Zaman (1995) provides evidence that the gender division of labor in agriculture is not as strictly demarcated as assumed, with women being involved in agricultural work both inside and outside the household. Rahman (2010) shows that female agricultural labor contributes significantly to productivity as well as technical efficiency, but finds, similar to Zaman (1995), that gender bias exists in the agricultural labor market. Remunerative employment of labor remains skewed in favor of men, since female labor is engaged only when the male labor supply is exhausted.

Women's ability to generate income in the agriculture sector is severely constrained by their limited use, ownership, and control of productive physical and human capital. Bangladeshi women are disadvantaged relative to men with respect to assets brought to marriage (Quisumbing and Maluccio 2003), current productive assets (including land, livestock, and agricultural machinery) (Quisumbing et al. 2013), and human capital. Women lag behind in terms of education in Bangladesh—with more than one in three women having no schooling, compared to one in four men. A recent analysis also shows that lack of education in adult women in Bangladesh is a strong correlate of being "ultra-poor": 80 percent of adult women with no education live below half a dollar a day (Ahmed et al. 2007).

The rationale for paying attention to gender inequality in agriculture is rooted in a body of empirical evidence that demonstrates the ways in which women are essential to improvements in household agricultural productivity, food security and nutrition security. Considerable evidence exists that households do not act in a unitary manner when making decisions or allocating resources (Alderman et al. 1995; Haddad, Hoddinott, and Alderman 1997). This means that men and women within households do not *always* have the same preferences nor pool their resources. The non-pooling of agricultural resources within the household creates a gender gap in control of agricultural inputs, which has important implications for productivity. Several empirical studies have found that redistributing inputs between men and women in the household has the potential for increasing productivity (Udry, Hoddinott, Alderman, and Haddad 1995; Peterman, Behrman, and Quisumbing 2010; Kilic, Palacios-Lopez and Goldstein 2013). A growing body of empirical evidence suggests that increasing women's control over resources has positive effects on a number of important development outcomes. For Côte d'Ivoire, Hoddinott and Haddad (1995) and Duflo and Udry (2004) find that increasing women's share of cash income significantly increases the share of household budget allocated to food. Doss (2006) shows that, in Ghana, women's share

of assets, particularly farmland, significantly increases budget shares on food expenditure.

Considerable evidence also suggests that mothers' greater control over resources improves child outcomes—in particular, nutrition and education (Hallman 2003; Quisumbing 2003; Quisumbing, and Maluccio 2003; Skoufias 2005). Although much of the above-mentioned evidence has emerged from observational studies, a systematic review of programs targeting transfers to women (Yoong, Rabinovich, and Diepeveen 2012) has found that these improve children's well-being, especially in the form of investments in children's health and education.

The linkages between women's *empowerment* and food security have been more difficult to quantify owing to the difficulty of measuring empowerment. Despite these difficulties, there is evidence that *disempowerment* in one of its most extreme forms—being a victim of intimate partner violence (IPV)—is associated with poor nutritional outcomes both for children and their mothers. Ziaei, Naved, and Ekström (2012), using data from the 2007 Bangladesh Demographic and Health Survey (BDHS), investigate the association between women's exposure to IPV and their children's nutritional status. Of 2,042 women in the BDHS survey with at least one child under five years of age, 49.4 percent report lifetime experience of physical partner violence, while 18.4 percent report experience of sexual partner violence. They find that women are more likely to have a stunted child if they had lifetime experience of physical IPV or had been exposed to sexual IPV. A study based on a longitudinal dataset following up three sites in Bangladesh where agricultural technologies have been introduced finds that experience of domestic abuse (particularly verbal abuse) has a significant negative impact on women's current BMI and on improvements in BMI over time (Quisumbing, Bhagowalia, Menon, and Soundararajan 2009).

Current efforts to define and measure empowerment have drawn heavily on Kabeer's (1999) definition of empowerment as expanding people's ability to make strategic life choices, particularly in contexts in which this ability has been denied to them. In Kabeer's definition, the ability to exercise choice encompasses three dimensions: resources, agency, and achievements (well-being outcomes). The WEAI focuses on the "agency" aspect, which is far less studied than resources such as income, or achievements such as educational levels. Moreover, while nationally representative surveys such as some demographic and health surveys (DHS) include a range of questions about decision making within the household, these are typically confined to the domestic sphere and do not encompass decisions in the productive and

economic spheres, nor do the surveys have identical questions for men and women (Alkire et al. 2013). The WEAI also departs from previous measures of women's empowerment in that it captures control over resources or agency within the agriculture sector, something which existing indices have not done.

14.2.2 Measuring Women's Empowerment using WEAI

The WEAI is an aggregate index, reported at the country or regional level, which is based on individual-level data on men and women within the same households. The WEAI is a weighted average of two sub-indexes: (i) five domains of women's empowerment (5DE) and (ii) gender parity (Gender Parity Index, GPI).² The 5DE sub-index shows how empowered women are, capturing the roles and extent of women's engagement in the agriculture sector in five domains: (1) decisions over agricultural production, (2) access to and decision-making power over productive resources, (3) control over use of income, (4) leadership in the community, and (5) time use. Table 14.1 describes the five domains and their corresponding ten indicators. The 5DE assesses the degree to which women are empowered in these domains, and for those who are not empowered, the percentage of domains in which they are empowered. 'Empowerment' within a domain means that the person has adequate achievements or has "achieved adequacy" for that domain (specific thresholds used to determine whether a person has adequate achievements will be discussed subsequently). Because the survey method goes beyond the traditional practice of interviewing only a household "head" (often a male) to interview both a principal male and principal female, 5DE measures can be computed for both the principal male and the principal female in a dual adult household, although the 5DE component of the WEAI only includes women's 5DE. Computation of men's 5DE scores and their comparison to women's 5DE enables the comparison of the agricultural empowerment of men and women living in the same household. This comparison is embodied in the GPI (gender parity index), a relative inequality measure that reflects the inequality in 5DE profiles between the primary adult male and female in each household. The aggregate WEAI uses the mean GPI value of dual-adult households. GPI combines two key pieces of information: (1) the percentage of women who lack gender parity relative to their male-household counterparts and (2) the extent of the inequality in empowerment between those women who lack parity and the men with whom they live (see Alkire et al. 2013 for details).

² This description draws from Alkire et al. (2013).

Table 14.1: Five Domains of Empowerment in WEAI

Domain	Indicator	Definition of indicator	Weight
Production	Input in productive decisions	Sole or joint decision-making over food and cash-crop farming, livestock, and fisheries	1/10
	Autonomy in production	Autonomy in agricultural production (e.g., what inputs to buy, crops to grow, what livestock to raise, etc.). Reflects the extent to which the respondent's motivation for decision-making reflects his/her values rather than a desire to please others or avoid harm.	1/10
Resources	Ownership of assets	Sole or joint ownership of major household assets	1/15
	Purchase, sale, or transfer of assets	Whether respondent participates in decision to buy, sell, or transfer his/her owned assets	1/15
	Access to and decisions on credit	Access to and participation in decision-making concerning credit	1/15
Income	Control over use of income	Sole or joint control over income and expenditures	1/5
Leadership	Group member	Whether respondent is an active member in at least one economic or social group (e.g., agricultural marketing, credit, water users' groups)	1/10
	Speaking in public	Whether the respondent is comfortable speaking in public concerning various issues such as intervening in a family dispute, ensure proper payment of wages for public work programs, etc.	1/10
Time	Workload	Allocation of time to productive and domestic tasks	1/10
	Leisure	Satisfaction with the available time for leisure activities	1/10

Source: Alkire et al. 2013.

Both measures, taken together, make up the WEAI.³ The aggregate index therefore shows the degree to which women are empowered in their households and communities (5DE) and the degree of inequality between women and men in their households (GPI). Details regarding the construction and

³ The WEAI is a weighted sum of the 5DE and GPI with weights 0.9 and 0.1, respectively.

validation of the index can be found in Alkire et al. (2013). In this chapter, we use individual measures of (women's) 5DE and its component indicators to investigate the relationship between women's empowerment in agriculture and food security; additionally, we examine the relationship between inequality in empowerment and food security in dual adult households using the gender parity gap, a component of the GPI.

14.3 Data, Empirical Specifications and Variables

14.3.1 Data

The Bangladesh Integrated Household Survey (BIHS) was conducted from December 2011 to March 2012. The BIHS sample is nationally representative of rural Bangladesh and representative of rural areas of each of the seven administrative divisions of the country. To estimate the total sample size of 5,503 households in 275 primary sampling units (PSUs), BIHS followed a stratified sampling design in two stages—selection of PSUs and selection of households within each PSU—using the sampling frame developed from the community series of the 2001 population census. In the first stage, a total sample of 275 PSUs were allocated among the seven strata (seven divisions) with probability proportional to the number of households in each stratum. Sampling weights were adjusted using the sampling frame of the 2011 population census.

The BIHS questionnaires include several modules that provide an integrated data platform to answer a variety of research questions, as well as separate questionnaires for self-identified primary male and female decision-makers in sampled households. Our study relied primarily on information concerning household demographics, educational attainment, occupation and employment, food and nonfood consumption and expenditures, household-level agricultural production and livestock holding, household assets, housing and amenities, community infrastructure and facilities, individual anthropometric measurements, and a detailed module on the WEAI.

The BIHS sample consists of 1,608 nonfarm and 3,895 farm households; since WEAI aims to measure agency in the agriculture sector, we restrict our analysis to farm households, including households relying on agricultural wage labor. The WEAI relies on information collected from both primary male and female adults in the household, and thus, our estimation samples depend on valid responses from these household members. For the household-level analysis using women's 5DE alone, we use data from the self-identified primary female adults. Of this data, 424 observations were

dropped, because the primary female respondent was either unavailable on the day of the interview or did not respond to all of WEAI survey questions. In addition, 192 observations were dropped because a female other than the primary female was interviewed, and six additional cases were dropped because of possible data entry errors in the demographic data. Our final estimation sample consists of 3,273 households. For the analysis that examines women's relative empowerment within the household, we restrict the analyses to households where both the primary male and female decision makers have been interviewed, reducing our sample size to 3,213 households.

For the individual-level analysis using women's 5DE, BMI values were obtained for 3,150 primary adult males and 3,263 primary adult females from farm households. For the analysis examining women's relative empowerment using the gender parity gap, the sample sizes for men and women are reduced to 3,094 and 3,203, respectively.

14.3.2 Empirical Specifications

To examine the relationship between women's empowerment in agriculture and household food security, we estimate the following equation:

$$\mathbf{f} = \beta_0 + \beta_1 \text{empowerment} + \beta_2 \mathbf{x} + \beta_3 \mathbf{h} + \beta_4 \mathbf{c} + \varepsilon, \quad (14.1)$$

where \mathbf{f} is a vector of food security outcomes, β_i are coefficients to be estimated, \mathbf{x} is a vector of individual-level characteristics, \mathbf{h} is a vector of household-level characteristics, \mathbf{c} is a vector of community or village characteristics, and ε is an error term.

In addition to the base regression described in equation (14.1), we also examine how the relationship between women's empowerment in agriculture and household food security varies by the size of cultivable land owned by the household. We therefore estimate the augmented equation:

$$\begin{aligned} \mathbf{f} = & \beta_0 + \beta_1 \text{empowerment} + \beta_2 \ln(\text{land area} + 1) \\ & + \beta_3 [\text{empowerment} \times \ln(\text{land area} + 1)] \\ & + \beta_4 \mathbf{x} + \beta_5 \mathbf{h}_{\text{aug}} + \beta_6 \mathbf{c} + \nu, \end{aligned} \quad (14.2)$$

where β_3 represents the interaction effect of empowerment and land area, \mathbf{h}_{aug} is a vector of household-level characteristics excluding land, and ν is an error term.⁴

We use two measures of women's empowerment in alternative specifications. In the first main specification, estimated for the full estimation sample, our

⁴ We add the integer 1 to the land area variable to avoid losing observations for households that do not own land but are involved in agriculture, such as cultivators who rent in land or agricultural wage laborers.

measure of empowerment is the women's 5DE score; in the second main specification, estimated for a subsample of households in which we have both men's and women's empowerment scores, our measure of empowerment consists of the gender parity gap, computed by taking the difference between the men's and women's 5DE scores for households that do not have gender parity.⁵ Because it is likely that women's empowerment within the household might be affected by the same factors affecting the availability of food and dietary diversity, we apply standard instrumental variables techniques to correct for potential endogeneity bias, using the *ivreg2* procedure in Stata12 (Baum, Schaffer, and Stillman 2010; StataCorp 2011).

14.3.3 Outcome Variables

Per capita calorie availability: A commonly-used indicator for food security at the household level is calorie availability, constructed by converting quantities of food consumed into corresponding energy units. Food consumption data, covering around 300 food items, was collected at the household level. The data capture quantities consumed from market purchases, home production, and from other sources outside the house, e.g., relatives, government/nongovernment aid or food received in exchange for labor. Agricultural seasonality is of concern when working with food consumption data, since lack of labor market activities during the lean season might affect household income, food expenditure, and consequently food consumption. The survey period, however, does not coincide with any of the two lean seasons prevalent in Bangladesh, thus allaying concerns about seasonality. The seven-day data were converted to daily calorie equivalents and the resulting calorie values were divided by the household size to obtain per capita calorie availability values (Ahmed and Shams 1994).⁶

Household dietary diversity: One of the criticisms of the use of calorie availability indicators is that they do not reflect the quality of foods available to households (Ruel 2003). This is particularly relevant to developing countries where diets are heavily dependent on starchy staples, contain little animal products, and may be high in fats and sugars (Carletto, Zezza,

⁵ As discussed below, the gender parity gap is equal to zero if the women's score is equal to or exceeds the man's 5DE score.

⁶ Alternatively, calorie availability can be expressed in terms of per adult equivalents. Results for both per capita and per adult equivalent calorie availability are qualitatively similar, hence we focus our discussion on the per capita indicator. Results for per adult equivalent calorie availability are in the Appendix, and available upon request.

and Banerjee 2013). In recent years, household dietary diversity measures have gained importance as measures of household food security, especially as several studies have demonstrated a strong association between dietary diversity and household per capita consumption and daily caloric availability (Hoddinott and Yohannes 2002; Hatløy, Hallund, Diarra, and Oshaug 2000). Household dietary diversity is defined as the count of food groups consumed using the seven-day recall household food consumption data. Food was grouped into 12 categories: cereals, white tubers and roots, vegetables, fruits, meat, eggs, fish and other seafood, legumes and nuts, milk and milk products, oils and fats, sweets, and spices, condiments, and beverages (FAO 2011b); this measure has been validated as a measure of household food security and is being increasingly used.

Adult BMI: Per capita calorie availability only measures what is available at the household level, given household size, but not its intrahousehold distribution or utilization by individuals. It is not a sufficient indicator of food energy deficiency, which requires comparing calorie availability against the energy requirement of households, which, in turn, depends on the age and sex composition of households, and their individual height, weight, and activity levels (Carletto, Zezza, and Banerjee 2013). Moreover, measures of short-term nutritional status, such as BMI, also reflect current energy expenditure, health status, and access to health services and sanitation (UNICEF 1990). Gender disparities in BMI can be affected by the intrahousehold distribution of food, work effort, and health inputs; for women, BMI is also affected by pregnancy and lactation status. In the absence of data on activity levels, we use BMI values to indicate food energy deficiency. BMI values were calculated for the primary adult male and female decision makers and analysed separately for men and women.

14.3.4 Key Independent Variables

Women's Empowerment in Agriculture Index: To measure women's empowerment in agriculture, we use the WEAI, computed using individual-level data collected from primary male and female respondents within the same households.

Table 14.1 presents the five domains, which comprise ten indicators. Each domain is weighted equally, as are each of the indicators within a domain. The 5DE sub-index is a measure of empowerment that shows the number of domains in which women are empowered. A woman is defined as empowered in 5DE if she has adequate achievements in four of the five domains or is empowered in some combination of the weighted indicators

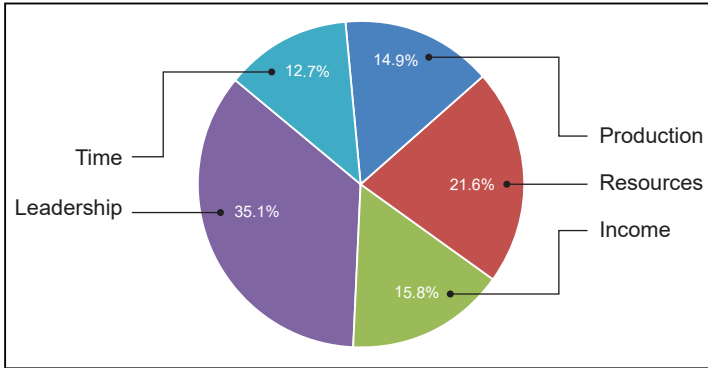
that reflect 80 percent total adequacy. The five domains of empowerment are defined as follows:

- *Production*: This domain concerns decisions over agricultural production, and refers to sole or joint decision making over food and cash-crop farming, livestock, and fisheries, as well as autonomy in agricultural production.
- *Resources*: This domain concerns ownership, access to, and decision-making power over productive resources such as land, livestock, agricultural equipment, consumer durables, and credit.
- *Income*: This domain concerns sole or joint control over the use of income and expenditures
- *Leadership*: This domain concerns leadership in the community, here measured by membership in economic or social groups and comfort in speaking in public.
- *Time*: This domain concerns the allocation of time to productive and domestic tasks and satisfaction with the available time for leisure activities.

A key innovation of the Index is that it identifies the domains in which women are disempowered as well as the relative degree of disempowerment. We use the diagnostic results on the WEAI, which describes the overall pattern of women's disempowerment across the five domains in rural Bangladesh, to guide our choice of empowerment indicators. We first identify the key domains that contribute the most to disempowerment, and then within each key domain, identify the indicators that contribute the most to disempowerment. We then construct a continuous measure of empowerment that draws on the individual-level data for the identified indicators.

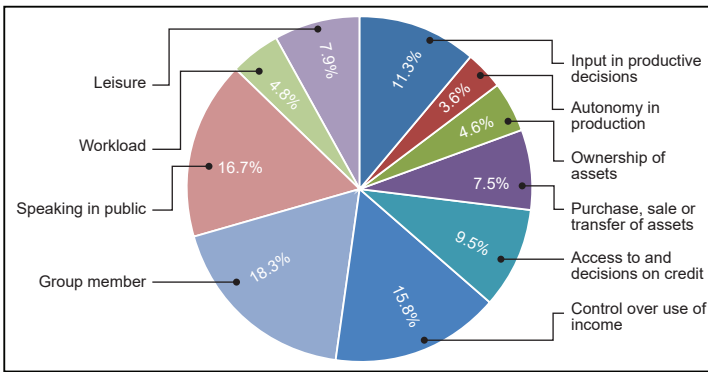
Figure 14.1 shows that the leadership and *resources* domains contribute the most to women's disempowerment in rural Bangladesh, while Figure 14.2 shows the contribution of each domain indicator. *Group membership* emerges as the indicator that contributes most to disempowerment in the leadership domain and *access to and decisions on credit* as the most critical indicator for the resources domain. The credit indicator, however, may be problematic, since it is not clear whether non-borrowers are truly credit constrained (they may not avail of credit because they have sufficient liquidity). In light of this issue, we also analyze the two other indicators for the resources domain, namely, *asset ownership* and *rights over assets*. Based on this information, we use the following alternative measures of empowerment.

Figure 14.1: Contribution of Each of the 5 Domains to the Disempowerment of Women



Source: Sraboni, Quisumbing, and Ahmed (2013).

Figure 14.2: Contribution of Each of the 10 Domain Indicators to Disempowerment of Women



Source: Sraboni, Quisumbing, and Ahmed (2013).

Model 1: Aggregate empowerment score of primary female respondent is the 5DE empowerment score of the female respondent in the household, which is the weighted average of her achievements in the ten indicators that comprise the five domains of empowerment in agriculture. This measure is increasing in empowerment, and ranges from zero to one.

Model 2: (Leadership domain, group membership indicator) Number of groups in which woman is an active member is the total number of groups in which the female respondent reports being an active member.

Model 3: (Resources domain, access to and decisions on credit indicator) Average number of decisions, concerning credit, taken by female is the number of credit decisions that the female respondent has made solely or jointly, averaged over the lending sources used. For each of the five possible lending sources (NGOs, informal, formal, friends/family, and ROSCAs), the survey asks who made the decision to borrow and who made the decision on how to use the money/item borrowed.

Model 4: (Resources domain, asset ownership indicator) Number of assets woman has sole/joint ownership is the total number of asset types for which the female respondent reports sole or joint ownership.

Model 5: (Resources domain, rights over assets indicator) Number of sole/joint decisions, concerning purchase/sale/transfer of assets, taken by woman is the total number of decisions made solely or jointly by the female respondent, summed over all asset types. For each asset type, the survey asks who can decide whether to sell, give away, mortgage/rent, and purchase the asset.

Considerable evidence exists in support of the need to pay attention to intra-household gender inequality for attaining development objectives (Alderman et al. 1995; Haddad, Hoddinott, and Alderman 1997; Quisumbing 2003). Therefore, it is interesting to examine whether women's *relative* empowerment within the household is associated with household food security. The Gender Parity Index (GPI) is a composite index that reflects the percentage of women who have gender parity as well as the empowerment gap between men and women in households not having gender parity. Because we are interested in examining how differences between empowerment levels of men and women affect household food security outcomes, we use the gender parity gap component of the GPI as our measure of empowerment. Since we need both male and female scores to compute the gender parity gap, we use the smaller estimation sample of 3,213 households where both the primary male and female decision makers have been interviewed.

Model 6: (Gender parity gap) According to Alkire et al. (2013), a household enjoys parity if woman is empowered or her empowerment score is greater than or equal to that of the male in her household. Thus, the gender parity gap is zero if the household enjoys gender parity. Otherwise, the gap equals the difference in male and female aggregate empowerment scores.

14.3.5 Instruments

We use the difference in ages between the primary male and female decision makers and number of types of informal credit sources in the village as instruments for all empowerment indicators. The survey collected information on whether the following types of informal credit sources are present in the community—moneylender within/outside village, shopkeepers who offer credit, agricultural input dealers who sell on credit, and large farmers/traders who buy crops at a fixed forward price. We do not include formal credit sources, because obtaining credit from these sources typically require collateral (which could be correlated with household wealth and could directly affect the outcomes being considered), nor NGOs, because obtaining credit from NGOs is membership-based. The existence of a large number of informal credit sources could be indicative of both greater social capital within the community, which could influence a woman's decision to actively participate in a group, as well as the size of the informal credit market. The availability of a large pool of funds could thus facilitate decision making concerning credit, and accumulation of assets by the borrowers. The differences in ages can reflect differences in human capital between the primary female and her spouse, and therefore reflect relative bargaining strengths (Quisumbing and Hallman 2005).⁷

We also instrument empowerment scores, gender parity gap as well as group membership using information on the number of community activities woman participated during the previous year; a woman who is more active in the community is more likely to be an active participant in groups. The survey collected information on whether woman has contributed money or time to the following community activities—building/maintenance of small wells or irrigation facilities, roads, development projects, local mosque or other religious structure, helping out other families with childcare, agricultural labor, or care of a patient—during the last year. The difference in recall period implies that the decision to participate in the mentioned activities was already given (exogenous) prior to current decision to join (or maintain membership in) a group.

An additional variable—whether the homestead land has been inherited by woman, is used to instrument for both ownership of and rights over assets. Inherited assets have been previously used as a bargaining measure in the literature (Quisumbing 1994; Quisumbing and Maluccio 2003). While

⁷ For households where information on the woman's spouse was not available (in female-headed households—where the male spouse is a migrant, or the female is widowed/separated), we considered the age difference to be zero.

inherited land is arguably endogenous, inherited homestead land is much less likely to be correlated with the error term.

14.3.6 Other Independent Variables

Our analysis controls for a number of household and community characteristics, as well as individual characteristics for the BMI regressions. Household characteristics include age, age-squared and years of schooling of the household head,⁸ household size, and proportion of males and females in various age groups (with males aged 60 and above as the excluded category). The occupation of the household head is accounted for using dummy variables for two types of primary occupation: farming and trading. We also include the price of rice as a control variable, since rice is the staple food in Bangladesh, accounting for a fifth of all spending of an average rural household, 35 percent of food expenditure, and 71 percent of total calorie intake (Ahmed et al. 2013). The number of dairy cows owned by a household is expected to affect food security outcomes through the pathway of production and consumption of milk and milk products, as well as household wealth. Three other variables are used as indicators of the socioeconomic status of the household: amount, in decimals, of cultivable land owned by the household, a dummy for whether the household has access to electricity, and a dummy for whether it owns at least one tube well.⁹ Taken together these socioeconomic characteristics represent the most important assets owned by rural households in Bangladesh. We also include diversity in food crop production (that is, total number of food crops produced by the household) as a regressor; if households consume some of the food that they produce, then more diverse agricultural production is expected to increase dietary diversity at the household level. A change in total number of food crops produced may also alter calorie availability of producer households through explicit or implicit changes in household income. A household's crop production decisions may be affected by the same factors that influence its calorie availability and dietary diversity, which could lead to endogeneity bias in our analysis. We use the following instruments at the farm level to identify food crop production diversity: (i) whether or not the soil type is clay-loam, (ii) whether or not the soil type is sandy-loam, and (iii) percentage of cropped land that is irrigated. Division dummies are included to control for location-specific

⁸ The household head is the self-identified primary decisionmaker (in most cases, male) in the sample household.

⁹ 100 decimals = 1 acre.

effects. For the regressions with adult male and female BMI as dependent variables, we include age and years of education of the primary male and female. For the primary female, we add two dummy variables indicating whether she is pregnant or lactating. Summary statistics of all the variables used are presented in Table 14.2.

Table 14.2: Summary Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Dependent variables					
Per capita calorie availability	3,273	2,487	688	979	7,115
Per adult equivalent calorie availability	3,273	3,185	813	1,186	9,530
Household dietary diversity	3,273	9.54	1.58	4	12
Body Mass Index (BMI) of primary male respondent	3,150	20.13	2.74	12.65	32.79
Body Mass Index (BMI) of primary female respondent	3,263	20.75	3.36	12.94	34.69
Empowerment variables					
Empowerment score of women	3,273	0.67	0.23	0.07	1
Number of groups woman is an active member of	3,273	0.33	0.49	0	3
Average number of decisions over credit	3,273	0.96	0.98	0	2
Number of assets woman has self/joint ownership of	3,273	1.96	1.50	0	10
Number of self/joint decisions over purchase, sale or transfer of assets made by women	3,273	11.90	9.76	0	48
Gender parity gap	3,213	0.17	0.20	0	0.89
Other controls					
Age (in years) of household head	3,273	45.26	13.39	20	95
Age-squared of household head	3,273	2,228	1,303	400	9,025
Years of education of household head	3,273	2.97	3.82	0	16
Age (in years) of primary male respondent	3,150	45.27	13.42	20	95
Age-squared of primary male respondent	3,150	2,230	1,307	400	9,025
Years of education of primary male respondent	3,150	2.99	3.84	0	16
Age (in years) of primary female respondent	3,263	37.21	11.70	18	80
Age-squared of primary female respondent	3,263	1,522	949	324	6,400
Years of education of primary female respondent	3,263	2.93	3.42	0	16
Female respondent is pregnant (=1, 0 otherwise)	3,263	0.04	0.18	0	1
Female respondent is lactating (=1, 0 otherwise)	3,263	0.18	0.39	0	1

Continued

Continued from Table 14.2

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Household head is farmer (=1, 0 otherwise)	3,273	0.31	0.46	0	1
Household head is trader (=1, 0 otherwise)	3,273	0.08	0.27	0	1
Household size	3,273	4.36	1.57	2	17
Proportion of males 0-4 years old	3,273	0.05	0.10	0	0.6
Proportion of males 5-10 years old	3,273	0.07	0.12	0	0.6
Proportion of males 11-18 years old	3,273	0.07	0.12	0	0.67
Proportion of males 19-59 years old	3,273	0.25	0.14	0	0.75
Proportion of females 0-4 years old	3,273	0.05	0.10	0	0.6
Proportion of females 5-10 years old	3,273	0.07	0.12	0	0.5
Proportion of females 11-18 years old	3,273	0.07	0.12	0	0.6
Proportion of females 19-59 years old	3,273	0.28	0.12	0	0.75
Proportion of females 60 years and older	3,273	0.04	0.10	0	0.67
Number of food crops produced by household	3,273	1.27	1.42	0	11
Number of dairy cows owned	3,273	0.74	1.20	0	9
Price of rice (in taka)	3,273	29.90	3.38	20	50
Ln (owned cultivable land+1)	3,273	0.70	1.55	0	6.98
Access to electricity (=1, 0 otherwise)	3,273	0.44	0.50	0	1
Owens hand tube well (=1, 0 otherwise)	3,273	0.25	0.43	0	1
Division dummy 1	3,273	0.06	0.23	0	1
Division dummy 2	3,273	0.10	0.29	0	1
Division dummy 3	3,273	0.29	0.45	0	1
Division dummy 4	3,273	0.14	0.35	0	1
Division dummy 5	3,273	0.20	0.40	0	1
Division dummy 6	3,273	0.16	0.37	0	1
Instruments					
Age difference (male-female)	3,273	8.08	4.60	-15	40
Types of informal credit sources in village	3,273	2.36	1.50	0	5
Whether female has participated in any community activity during last 1 year (=1, 0 if otherwise)	3,273	0.46	0.50	0	1
Number of community activities woman has participated in last year	3,273	0.86	1.18	0	7
Whether homestead land has been inherited by woman (=1, 0 if otherwise)	3,273	0.03	0.18	0	1
Clay-loam soil (=1, 0 if otherwise)	3,273	0.28	0.45	0	1
Sandy-loam soil (=1, 0 if otherwise)	3,273	0.18	0.38	0	1
Percent of land irrigated by household	3,273	46.26	42.29	0	100

Source: IFPRI Bangladesh Integrated Household Survey, 2011-2012.

14.4 Results

14.4.1 Women's Empowerment and Food Security

Tables 14.3-14.8 present the OLS and IV regression results for the determinants of household food security. IV diagnostics are presented at the end of each table. First-stage results are available upon request. We first discuss results on calorie availability and dietary diversity, and then discuss results on adult BMI.

For the regressions involving per capita calorie availability and household dietary diversity (columns 1-4), the Anderson-Rubin and endogeneity test results imply that the endogenous variables are relevant and, in fact, endogenous. The over-identification and under-identification test results confirm that the instruments are valid and the models identified. The Kleibergen-Paap F-statistics show that the null hypothesis for weak instruments is rejected at the 5-percent (Tables 14.3, 14.6, 14.7, and 14.8) and 10-percent-level thresholds (Table 14.4). However, the F-statistic in Table 14.5 fails to exceed the critical value of 4.79, which is associated with a bias relative to OLS of less than 30 percent (Stock and Yogo 2005). This suggests that the instruments used for women's decisions on credit may be weak.

Columns 1 and 3 of Table 14.3 present the OLS coefficient estimates of the determinants of per capita calorie availability and household dietary diversity, respectively. These estimates show that the female empowerment score is highly significant and positively correlated with both these food security indicators at the household level. In columns 2 and 4, after instrumenting for both potentially endogenous variables (empowerment and food crop production), the estimates show a similar pattern, with the IV estimates being larger than the OLS estimates. These results, together with the good performance of the instruments in general, suggest that household diet diversity and per capita calorie availability increase if the primary female decision maker is more empowered; the larger IV coefficients suggest that neglecting endogeneity of empowerment may underestimate the impact of increasing women's empowerment on these food security outcomes.

Moving on to the individual indicators in Table 14.4, we find that women's group membership is positively and significantly correlated with the calorie availability measures and dietary diversity. This implies that increasing the number of groups in which women actively participate has a positive impact on household food security outcomes. In Table 14.5, the

OLS coefficient estimates (columns 1 and 3) for women's decision making concerning credit are insignificant, but IV estimates emerge as positive and significant, suggesting that women's decision making concerning credit is significant and positively correlated with food security outcomes (columns 2 and 4). Since the weak-identification test results suggest that the instruments used for this particular model are weak, we take these results with caution. An underlying problem with using decisions on credit as an indicator of empowerment in this context is that wealthier people may not need to avail of credit (because they can self-finance) and that many microfinance activities are targeted to poorer women in Bangladesh.

The OLS and IV coefficient estimates of women's ownership of assets (presented in Table 14.6) and rights over assets (Table 14.7) are significantly positive, implying that female ownership of and control over major household assets has a role to play in improving household food security. Previous work in Bangladesh has demonstrated that greater resource control by women is associated with improved child health (Hallman 2003); evaluations of the long-term impact of agricultural interventions have similarly showed that interventions targeted to women's groups have increased women's assets and improved nutritional status of women and girls (Kumar and Quisumbing 2010).

Table 14.8 presents the regression results for the gender parity gap and food security outcomes. The OLS and IV coefficient estimates of the gender parity gap are significant and negative, implying that a reduction in the gap is associated with an increase in calorie availability and household dietary diversity. Reducing the gender gap in empowerment or improving women's relative empowerment is associated with greater food security at the household level, consistent with the existing literature on female bargaining power within the household and household welfare outcomes.

In most IV models, the effect of number of food crops produced by household on calorie availability at the household level is insignificant, but a strong and significant positive association between crop diversity and dietary diversity is evident; the more food crops the households produce, the higher their dietary diversity. The number of dairy cows owned has a significant positive impact on both household food energy availability and household dietary diversity in all models. Rice price is not significantly associated with household level food energy availability, but is strongly and positively associated with the household-level dietary diversity. The latter

finding is similar to that of Rashid, Smith, and Rahman (2011), who argue that households may respond to an increase in rice price by partially shifting consumption away from rice to other food items, which results in an increase in dietary diversity. Owned cultivable land is strongly associated with both household food energy availability and household dietary diversity in all models; larger areas of cultivable land may increase household-level calorie availability and dietary diversity both through an income or wealth effect, as well as by making available a larger stock of productive assets. However, other two income-related variables—ownership of hand tube well and access to electricity—appear to significantly influence household-level food energy availability and dietary diversity only in certain models.

Consistent with the existing literature on human capital and household food security, education of the household head has a positive and significant relationship with both calorie availability and dietary diversity. Having a household head whose primary occupation is farming significantly increases both calorie availability and dietary diversity in most of the regression models. The positive relationship between farming as the main occupation with both calorie availability and dietary diversity is consistent with our other result that diversity in agricultural production increases dietary diversity at the household level. Having a household head who is primarily involved in trade improves only dietary diversity, not calorie availability.

Household size has a significant negative impact on per capita calorie availability in all regressions, but has a positive and significant correlation with diet diversity. Since a household member may have access to food from a variety of sources (home production, purchased outside the house, received in exchange for labor, etc.), a larger household size may simply be a reflection of the greater variety in food consumption patterns as a result of having more people living in the household. Coefficients on demographic categories indicate that household demographic composition significantly affects calorie availability across different specifications of the empowerment variable, but only a few demographic categories significantly affect dietary diversity. In the (preferred) IV specification, households with a larger proportion of females between 19-59 years of age have more diverse diets; these coefficients are weakly significant in the specifications using the overall empowerment score and asset-based empowerment indicators.

Table 14.3: Model 1: Women's Empowerment Score and Household Food Security Outcomes

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Empowerment score of women	235.364*** (47.705)	891.858*** (172.793)	0.493*** (0.120)	1.938*** (0.411)	-0.119 (0.212)	-0.447 (0.775)	-0.256 (0.264)	0.021 (0.885)
Age (in years) of household head	14.282** (6.178)	9.929 (6.644)	-0.010 (0.015)	-0.023 (0.016)				
Age-squared of household head	-0.110 (0.067)	-0.067 (0.072)	0.000 (0.000)	0.000 (0.000)				
Years of education of household head	8.639*** (3.284)	8.514** (3.347)	0.074*** (0.007)	0.072*** (0.008)				
Age (in years) of member					0.059** (0.030)	0.061** (0.031)	0.238*** (0.035)	0.239*** (0.036)
Age-squared of member					-0.001** (0.000)	-0.001** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)
Years of education of member					0.118*** (0.015)	0.118*** (0.015)	0.119*** (0.021)	0.119*** (0.021)
Pregnant (=1, 0 otherwise)							1.105*** (0.286)	1.123*** (0.286)
Lactating (=1, 0 otherwise)							-0.861*** (0.184)	-0.850*** (0.185)

Continued

Continued from Table 14.3

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Household head is farmer (=1, 0 otherwise)	79.132*** (26.165)	95.092*** (34.737)	0.220*** (0.064)	0.174** (0.081)	0.137 (0.122)	0.123 (0.148)	-0.040 (0.143)	0.077 (0.180)
Household head is trader (=1, 0 otherwise)	39.311 (38.856)	15.330 (40.629)	0.547*** (0.097)	0.514*** (0.100)	0.977*** (0.213)	0.992*** (0.214)	0.452* (0.246)	0.419* (0.247)
Household size	-75.922*** (8.606)	-71.063*** (9.149)	0.078*** (0.020)	0.081*** (0.022)	0.073* (0.040)	0.069* (0.042)	0.035 (0.047)	0.046 (0.048)
Proportion of males 0-4 years old	-1,533.389*** (199.816)	-1,564.817*** (208.895)	0.396 (0.473)	0.400 (0.489)	0.020 (0.868)	0.045 (0.871)	0.181 (1.002)	0.056 (1.016)
Proportion of males 5-10 years old	-960.172*** (187.744)	-1,021.892*** (195.191)	0.379 (0.421)	0.284 (0.436)	0.605 (0.806)	0.636 (0.808)	1.050 (0.921)	0.971 (0.929)
Proportion of males 11-18 years old	-301.962 (185.377)	-363.127* (192.144)	-0.151 (0.414)	-0.275 (0.428)	0.215 (0.792)	0.244 (0.791)	1.518* (0.895)	1.486* (0.898)
Proportion of males 19-59 years old	165.236 (153.994)	163.044 (158.439)	0.542* (0.314)	0.534 (0.326)	1.220* (0.659)	1.216* (0.656)	1.854*** (0.676)	1.860*** (0.674)
Proportion of females 0-4 years old	-1,604.705*** (198.528)	-1,596.603*** (206.674)	0.495 (0.474)	0.599 (0.490)	0.137 (0.864)	0.141 (0.868)	0.705 (1.015)	0.579 (1.018)
Proportion of females 5-10 years old	-813.647*** (192.091)	-892.625*** (198.954)	0.573 (0.424)	0.425 (0.438)	0.964 (0.833)	1.005 (0.837)	0.610 (0.925)	0.546 (0.936)

Continued

Continued from Table 14.3

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Proportion of females 11-18 years old	-153.315 (199.495)	-260.023 (205.349)	0.498 (0.432)	0.267 (0.450)	0.273 (0.822)	0.328 (0.823)	1.637* (0.948)	1.590* (0.961)
Proportion of females 19-59 years old	30.101 (226.492)	-22.283 (232.903)	0.944* (0.501)	0.855* (0.519)	1.121 (1.012)	1.140 (1.011)	1.787 (1.098)	1.747 (1.095)
Proportion of females 60 years and older	-319.497 (250.737)	-357.407 (257.477)	0.300 (0.519)	0.254 (0.539)	1.040 (1.095)	1.055 (1.096)	2.269* (1.228)	2.210* (1.228)
Number of food crops produced by household	36.259*** (9.009)	24.510 (23.556)	0.075*** (0.020)	0.142** (0.057)	-0.086** (0.038)	-0.071 (0.102)	0.040 (0.047)	-0.087 (0.126)
Number of dairy cows owned	49.536*** (10.399)	44.001*** (11.409)	0.126*** (0.024)	0.095*** (0.026)	0.078* (0.044)	0.080* (0.048)	0.035 (0.057)	0.058 (0.060)
Price of rice (in taka)	-4.194 (3.952)	-1.502 (4.083)	0.021** (0.009)	0.027*** (0.010)	0.059*** (0.018)	0.057*** (0.018)	0.043** (0.022)	0.044** (0.022)
Ln (owned cultivable land+1)	28.398*** (8.488)	29.720*** (8.678)	0.038** (0.017)	0.042** (0.018)	0.154*** (0.039)	0.153*** (0.039)	0.132*** (0.044)	0.132*** (0.044)
Owens hand tube well (=1, 0 otherwise)	100.024*** (26.863)	45.094 (29.281)	0.286*** (0.063)	0.143** (0.070)	0.044 (0.122)	0.068 (0.135)	0.089 (0.146)	0.095 (0.160)
Access to electricity (=1, 0 otherwise)	10.708 (22.838)	-14.117 (24.523)	0.411*** (0.056)	0.355*** (0.060)	0.512*** (0.105)	0.525*** (0.108)	0.626*** (0.127)	0.620*** (0.129)
Division level fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Continued

Continued from Table 14.3

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Constant	2,691.208*** (219.368)	2,339.944*** (243.215)	7.291*** (0.530)	6.537*** (0.587)	15.248*** (1.015)	15.434*** (1.097)	11.971*** (1.179)	11.822*** (1.213)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	41.928	38.481	26.628	25.084	12.722	12.404	15.078	15.007
Adjusted R ²	0.275	0.230	0.175	0.130	0.113	0.112	0.106	0.103
Hansen J p, Ho: instruments valid		0.470		0.640		0.311		0.192
Under ID test p, Ho: underidentified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		41.798		41.798		39.627		40.325
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.456		0.352
A-R Wald Chi2 test, p-value		0.000		0.000		0.449		0.345
Endogeneity test p, Ho: exogenous		0.000		0.000		0.925		0.582
First stage Adjusted R ² (Empowerment score of women)		0.180		0.180		0.181		0.183
First stage Adjusted R ² (Number of food crops produced by household)		0.314		0.314		0.310		0.313

Note: Estimates from base regression without interaction with land. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

Table 14.4: Model 2: Women's Group Membership and Household Food Security Outcomes

Variable	Per capita calorie availability		Household dietary diversity			Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)	
Number of groups woman is an active member of	39.109* (22.939)	813.559*** (186.928)	0.109* (0.057)	1.673*** (0.424)	-0.264** (0.103)	-0.134 (0.664)	0.032 (0.125)	0.501 (0.753)	
Age (in years) of household head	15.426** (6.125)	6.450 (7.423)	-0.008 (0.015)	-0.029* (0.017)					
Age-squared of household head	-0.120* (0.066)	-0.016 (0.081)	0.000 (0.000)	0.000* (0.000)					
Years of education of household head	8.837*** (3.304)	11.529*** (3.922)	0.074*** (0.007)	0.078*** (0.009)					
Age (in years) of member			0.062** (0.030)		0.062** (0.030)	0.060* (0.031)	0.235*** (0.035)	0.231*** (0.037)	
Age-squared of member			-0.001** (0.000)		-0.001** (0.000)	-0.001** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)	
Years of education of member			0.117*** (0.015)		0.117*** (0.015)	0.117*** (0.015)	0.118*** (0.021)	0.119*** (0.021)	
Pregnant (=1, 0 otherwise)							1.105*** (0.285)	1.123*** (0.284)	
Lactating (=1, 0 otherwise)							-0.856*** (0.184)	-0.853*** (0.184)	

Continued

Continued from Table 14.4

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Household head is farmer (=1, 0 otherwise)	80.475*** (26.353)	201.120*** (51.229)	0.226*** (0.064)	0.387*** (0.114)	0.102 (0.122)	0.113 (0.193)	-0.030 (0.144)	0.166 (0.234)
Household head is trader (=1, 0 otherwise)	45.881 (39.175)	10.528 (50.801)	0.559*** (0.097)	0.509*** (0.115)	0.983*** (0.212)	0.980*** (0.214)	0.442* (0.246)	0.395 (0.249)
Household size	-77.840*** (8.671)	-82.949*** (10.772)	0.073*** (0.020)	0.056** (0.023)	0.075* (0.040)	0.074* (0.041)	0.037 (0.047)	0.046 (0.047)
Proportion of males 0-4 years old	-1,528.809*** (199.730)	-1,643.825*** (234.459)	0.402 (0.473)	0.245 (0.531)	0.053 (0.865)	0.042 (0.874)	0.137 (1.002)	-0.098 (1.043)
Proportion of males 5-10 years old	-943.952*** (187.720)	-1,051.360*** (220.073)	0.410 (0.421)	0.234 (0.477)	0.633 (0.802)	0.619 (0.809)	1.007 (0.921)	0.839 (0.950)
Proportion of males 11-18 years old	-289.250 (185.171)	-469.103** (215.354)	-0.131 (0.414)	-0.483 (0.468)	0.274 (0.789)	0.243 (0.806)	1.479* (0.895)	1.332 (0.932)
Proportion of males 19-59 years old	164.890 (153.762)	141.817 (171.874)	0.540* (0.314)	0.491 (0.354)	1.227* (0.655)	1.226* (0.655)	1.839*** (0.676)	1.792*** (0.685)
Proportion of females 0-4 years old	-1,606.313*** (198.999)	-1,560.295*** (234.269)	0.494 (0.474)	0.674 (0.525)	0.124 (0.860)	0.141 (0.864)	0.685 (1.015)	0.521 (1.024)
Proportion of females 5-10 years old	-791.767*** (191.789)	-913.201*** (220.747)	0.615 (0.424)	0.396 (0.475)	0.992 (0.830)	0.976 (0.836)	0.563 (0.924)	0.415 (0.953)
Proportion of females 11-18 years old	-129.198 (199.970)	-408.405* (232.738)	0.539 (0.432)	-0.021 (0.505)	0.355 (0.820)	0.307 (0.846)	1.572* (0.948)	1.364 (1.018)

Continued

Continued from Table 14.4

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Proportion of females 19-59 years old	45.373 (226.539)	-17.950 (255.454)	0.974* (0.500)	0.873 (0.549)	1.134 (1.009)	1.129 (1.008)	1.760 (1.097)	1.666 (1.104)
Proportion of females 60 years and older	-310.409 (250.924)	-390.661 (283.066)	0.316 (0.518)	0.193 (0.575)	1.074 (1.092)	1.061 (1.099)	2.240* (1.228)	2.095* (1.251)
Number of food crops produced by household	38.339*** (9.092)	18.129 (27.980)	0.079*** (0.020)	0.133** (0.064)	-0.086** (0.038)	-0.078 (0.104)	0.037 (0.047)	-0.109 (0.128)
Number of dairy cows owned	52.596*** (10.426)	69.454*** (14.079)	0.132*** (0.024)	0.147*** (0.031)	0.072* (0.044)	0.073 (0.050)	0.034 (0.057)	0.071 (0.064)
Price of rice (in taka)	-4.851 (3.975)	1.351 (4.827)	0.020** (0.010)	0.033*** (0.011)	0.057*** (0.018)	0.058*** (0.019)	0.045** (0.022)	0.048** (0.022)
Ln (owned cultivable land+1)	28.612*** (8.513)	42.641*** (10.334)	0.038** (0.017)	0.069*** (0.021)	0.149*** (0.039)	0.152*** (0.040)	0.134*** (0.044)	0.142*** (0.047)
Owens hand tube well (=1, 0 otherwise)	115.792*** (26.784)	32.833 (35.942)	0.316*** (0.063)	0.126 (0.080)	0.064 (0.120)	0.047 (0.137)	0.064 (0.147)	0.046 (0.160)
Access to electricity (=1, 0 otherwise)	18.498 (22.946)	-3.726 (27.953)	0.427*** (0.056)	0.381*** (0.065)	0.517*** (0.104)	0.512*** (0.107)	0.617*** (0.127)	0.607*** (0.128)
Division level fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2,818.102*** (220.021)	2,841.667*** (256.485)	7.558*** (0.529)	7.625*** (0.592)	15.178*** (1.004)	15.180*** (1.000)	11.868*** (1.180)	11.926*** (1.188)

Continued

Continued from Table 14.4

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	40.377	29.168	25.837	21.037	13.151	12.488	15.092	14.952
Adjusted R ²	0.270	-0.017	0.171	-0.052	0.115	0.114	0.105	0.098
Hansen J p, Ho: instruments valid		0.247		0.914		0.151		0.137
Under ID test p, Ho: underidentified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		9.545		9.545		9.059		9.782
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.296		0.255
A-R Wald Chi2 test, p-value		0.000		0.000		0.289		0.249
Endogeneity test p, Ho: exogenous		0.000		0.000		0.900		0.524
First stage Adjusted R ² (Number of groups woman is an active member of)		0.106		0.106		0.108		0.106
First stage Adjusted R ² (Number of food crops produced by household)		0.321		0.321		0.317		0.320

Note: Estimates from base regression without interaction with land. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

Table 14.5: Model 3: Women's Decisions on Credit and Household Food Security Outcomes

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Average number of decisions over credit	-0.127 (11.102)	806.335** (313.472)	-0.020 (0.028)	0.940* (0.543)	-0.135*** (0.051)	-0.580 (0.771)	-0.059 (0.061)	-0.882 (0.991)
Age (in years) of household head	15.914*** (6.135)	-17.073 (16.396)	-0.006 (0.015)	-0.049* (0.028)				
Age-squared of household head	-0.126* (0.066)	0.224 (0.175)	0.000 (0.000)	0.001* (0.000)				
Years of education of household head	8.713*** (3.304)	17.340*** (6.538)	0.073*** (0.007)	0.082*** (0.011)				
Age (in years) of member					0.064** (0.030)	0.082* (0.045)	0.238*** (0.035)	0.280*** (0.060)
Age-squared of member					-0.001** (0.000)	-0.001** (0.000)	-0.003*** (0.000)	-0.004*** (0.001)
Years of education of member					0.116*** (0.015)	0.111*** (0.017)	0.117*** (0.021)	0.115*** (0.022)
Pregnant (=1, 0 otherwise)							1.099*** (0.286)	1.017*** (0.328)
Lactating (=1, 0 otherwise)							-0.853*** (0.184)	-0.814*** (0.194)
Household head is farmer (=1, 0 otherwise)	75.134*** (26.390)	307.092*** (112.967)	0.207*** (0.064)	0.380* (0.195)	0.108 (0.122)	-0.042 (0.287)	-0.048 (0.143)	-0.209 (0.371)

Continued

Continued from Table 14.5

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Household head is trader (=1, 0 otherwise)	47.475 (39.196)	15.810 (68.466)	0.564*** (0.098)	0.552*** (0.116)	0.974*** (0.212)	0.994*** (0.214)	0.445* (0.246)	0.455* (0.257)
Household size	-77.518*** (8.636)	-58.839*** (16.989)	0.074*** (0.020)	0.087*** (0.028)	0.070* (0.040)	0.055 (0.049)	0.036 (0.046)	0.020 (0.057)
Proportion of males 0-4 years old	-1,523.630*** (199.666)	-2,048.095*** (390.761)	0.428 (0.474)	-0.103 (0.666)	0.095 (0.870)	0.415 (1.029)	0.186 (1.001)	0.729 (1.297)
Proportion of males 5-10 years old	-938.865*** (187.610)	-1,282.772*** (329.839)	0.432 (0.422)	0.074 (0.553)	0.646 (0.806)	0.846 (0.882)	1.048 (0.920)	1.494 (1.127)
Proportion of males 11-18 years old	-280.204 (185.283)	-735.363** (339.529)	-0.095 (0.415)	-0.622 (0.579)	0.291 (0.793)	0.588 (0.940)	1.528* (0.894)	2.076* (1.135)
Proportion of males 19-59 years old	166.093 (153.762)	99.133 (230.437)	0.545* (0.314)	0.462 (0.376)	1.228* (0.658)	1.254* (0.663)	1.859*** (0.676)	2.085*** (0.744)
Proportion of females 0-4 years old	-1,609.422*** (198.590)	-1,903.357*** (348.876)	0.491 (0.474)	0.250 (0.612)	0.178 (0.864)	0.366 (0.924)	0.712 (1.013)	1.026 (1.178)
Proportion of females 5-10 years old	-785.832*** (191.973)	-1,086.839*** (332.238)	0.639 (0.426)	0.313 (0.553)	1.003 (0.834)	1.197 (0.895)	0.600 (0.924)	0.997 (1.081)
Proportion of females 11-18 years old	-115.074 (199.732)	-477.554 (336.649)	0.588 (0.432)	0.160 (0.568)	0.317 (0.825)	0.535 (0.900)	1.620* (0.945)	2.092* (1.134)

Continued

Continued from Table 14.5

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Proportion of females 19-59 years old	48.339 (226.709)	-76.428 (354.347)	0.985** (0.501)	0.870 (0.592)	1.134 (1.011)	1.217 (1.027)	1.781 (1.098)	1.997* (1.176)
Proportion of females 60 years and older	-306.680 (251.198)	-560.668 (391.181)	0.332 (0.519)	0.078 (0.643)	1.088 (1.095)	1.291 (1.155)	2.277* (1.227)	2.694* (1.405)
Number of food crops produced by household	38.471*** (9.088)	-37.308 (54.556)	0.080*** (0.020)	0.108 (0.094)	-0.085** (0.038)	-0.021 (0.133)	0.038 (0.047)	0.022 (0.173)
Number of dairy cows owned	51.920*** (10.443)	91.177*** (24.800)	0.130*** (0.024)	0.153*** (0.043)	0.072* (0.044)	0.045 (0.064)	0.031 (0.057)	0.010 (0.083)
Price of rice (in taka)	-5.169 (3.988)	6.870 (7.605)	0.019** (0.009)	0.033** (0.014)	0.057*** (0.018)	0.051** (0.021)	0.043** (0.022)	0.031 (0.026)
Ln (owned cultivable land+1)	27.889*** (8.524)	18.896 (13.731)	0.037** (0.017)	0.028 (0.022)	0.156*** (0.039)	0.161*** (0.040)	0.134*** (0.044)	0.138*** (0.045)
Owens hand tube well (=1, 0 otherwise)	120.209*** (26.698)	30.360 (53.824)	0.331*** (0.063)	0.196** (0.090)	0.054 (0.121)	0.105 (0.158)	0.075 (0.146)	0.185 (0.183)
Access to electricity (=1, 0 otherwise)	19.639 (22.978)	-37.329 (44.644)	0.431*** (0.056)	0.362*** (0.078)	0.520*** (0.104)	0.561*** (0.128)	0.622*** (0.127)	0.679*** (0.146)
Division level fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2,816.747*** (220.321)	2,679.870*** (354.557)	7.557*** (0.529)	7.419*** (0.627)	15.210*** (1.006)	15.309*** (1.035)	11.863*** (1.181)	11.880*** (1.232)

Continued

Continued from Table 14.5

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	40.253	14.729	25.562	17.980	12.860	11.896	15.076	14.149
Adjusted R ²	0.269	-1.001	0.170	-0.168	0.115	0.090	0.106	0.051
Hansen J p, Ho: instruments valid		0.592		0.397		0.244		0.263
Under ID test p, Ho: underidentified		0.031		0.031		0.012		0.032
Weak ID test stat (Kleibergen-Paaprk Wald F)		2.134		2.134		2.594		2.125
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.356		0.314
A-R Wald Chi2 test, p-value		0.000		0.000		0.349		0.307
Endogeneity test p, Ho: exogenous		0.000		0.001		0.848		0.320
First stage Adjusted R ² (Average number of decisions over credit)		0.059		0.059		0.063		0.057
First stage Adjusted R ² (Number of food crops produced by household)		0.320		0.320		0.317		0.319

Note: Estimates from base regression without interaction with land. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

Table 14.6: Model 4: Women's Ownership of Assets and Household Food Security Outcomes

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Number of assets woman has self/joint ownership of	33.263*** (8.323)	146.085*** (33.343)	0.104*** (0.019)	0.178** (0.078)	0.032 (0.036)	-0.069 (0.148)	0.051 (0.043)	-0.137 (0.173)
Age (in years) of household head	14.621** (6.161)	10.146 (6.614)	-0.011 (0.014)	-0.018 (0.015)				
Age-squared of household head	-0.113* (0.067)	-0.068 (0.072)	0.000 (0.000)	0.000 (0.000)				
Years of education of household head	7.654** (3.257)	4.012 (3.452)	0.070*** (0.007)	0.066*** (0.008)				
Age (in years) of member					0.057* (0.030)	0.060** (0.030)	0.232*** (0.035)	0.248*** (0.037)
Age-squared of member					-0.001** (0.000)	-0.001** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)
Years of education of member					0.117*** (0.015)	0.120*** (0.016)	0.114*** (0.021)	0.128*** (0.024)
Pregnant (=1, 0 otherwise)							1.103*** (0.286)	1.126*** (0.287)
Lactating (=1, 0 otherwise)							-0.849*** (0.184)	-0.870*** (0.186)

Continued

Continued from Table 14.6

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Household head is farmer (=1, 0 otherwise)	76.609** (26.218)	78.643** (34.327)	0.216*** (0.064)	0.115 (0.078)	0.139 (0.122)	0.136 (0.144)	-0.031 (0.143)	0.052 (0.175)
Household head is trader (=1, 0 otherwise)	39.113 (38.802)	11.481 (41.059)	0.538*** (0.097)	0.545*** (0.099)	0.962*** (0.213)	0.995*** (0.220)	0.433* (0.246)	0.451* (0.249)
Household size	-75.261*** (8.512)	-67.855*** (9.154)	0.081*** (0.020)	0.078*** (0.021)	0.076* (0.040)	0.069 (0.043)	0.041 (0.046)	0.036 (0.050)
Proportion of males 0-4 years old	-1,519.595*** (199.323)	-1,503.062*** (208.246)	0.429 (0.473)	0.532 (0.479)	0.025 (0.868)	-0.005 (0.873)	0.121 (1.003)	0.138 (1.011)
Proportion of males 5-10 years old	-950.629*** (187.730)	-988.932*** (196.402)	0.387 (0.422)	0.413 (0.430)	0.595 (0.804)	0.599 (0.807)	0.982 (0.921)	1.067 (0.931)
Proportion of males 11-18 years old	-306.015* (185.826)	-392.922** (195.517)	-0.187 (0.414)	-0.230 (0.425)	0.191 (0.790)	0.239 (0.794)	1.440 (0.896)	1.620* (0.910)
Proportion of males 19-59 years old	162.392 (153.699)	149.777 (158.473)	0.532* (0.314)	0.520 (0.320)	1.228* (0.659)	1.211* (0.658)	1.825*** (0.675)	1.907*** (0.679)
Proportion of females 0-4 years old	-1,621.661*** (198.185)	-1,660.018*** (207.263)	0.447 (0.474)	0.530 (0.482)	0.137 (0.863)	0.152 (0.869)	0.641 (1.016)	0.719 (1.039)
Proportion of females 5-10 years old	-802.075*** (192.398)	-856.122*** (200.614)	0.581 (0.425)	0.577 (0.433)	0.945 (0.831)	0.966 (0.836)	0.536 (0.925)	0.648 (0.935)
Proportion of females 11-18 years old	-158.353 (200.579)	-304.838 (210.733)	0.443 (0.432)	0.351 (0.451)	0.224 (0.820)	0.317 (0.827)	1.511 (0.949)	1.795* (0.981)

Continued

Continued from Table 14.6

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Proportion of females 19-59 years old	18.455 (227.380)	-81.933 (239.440)	0.889* (0.502)	0.856* (0.519)	1.108 (1.010)	1.135 (1.013)	1.712 (1.100)	1.892* (1.113)
Proportion of females 60 years and older	-343.769 (250.994)	-468.114* (261.353)	0.211 (0.520)	0.176 (0.539)	1.025 (1.094)	1.066 (1.098)	2.182* (1.231)	2.389* (1.256)
Number of food crops produced by household	35.492*** (9.097)	28.672 (23.999)	0.070*** (0.020)	0.183*** (0.056)	-0.090** (0.038)	-0.076 (0.102)	0.033 (0.047)	-0.058 (0.123)
Number of dairy cows owned	48.602*** (10.464)	36.671*** (12.087)	0.120*** (0.024)	0.089*** (0.026)	0.073* (0.044)	0.084* (0.049)	0.028 (0.057)	0.068 (0.061)
Price of rice (in taka)	-4.833 (3.957)	-3.687 (4.061)	0.020** (0.009)	0.021** (0.010)	0.060*** (0.018)	0.058*** (0.018)	0.045** (0.022)	0.042** (0.021)
Ln (owned cultivable land+1)	27.584*** (8.533)	26.615*** (8.890)	0.035** (0.017)	0.037** (0.017)	0.154*** (0.039)	0.154*** (0.039)	0.133*** (0.044)	0.132*** (0.044)
Owens hand tube well (=1, 0 otherwise)	110.866*** (26.577)	78.456*** (28.379)	0.299*** (0.062)	0.250*** (0.064)	0.025 (0.121)	0.052 (0.127)	0.053 (0.146)	0.131 (0.155)
Access to electricity (=1, 0 otherwise)	12.291 (22.890)	-12.634 (25.116)	0.407*** (0.056)	0.389*** (0.059)	0.502*** (0.105)	0.520*** (0.108)	0.609*** (0.127)	0.644*** (0.130)
Division level fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2,799.797*** (218.773)	2,743.056*** (226.553)	7.501*** (0.528)	7.488*** (0.535)	15.147*** (1.006)	15.254*** (1.017)	11.872*** (1.180)	11.805*** (1.177)

Continued

Continued from Table 14.6

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	41.121	37.357	27.427	24.975	12.792	12.437	15.119	14.884
Adjusted R ²	0.274	0.218	0.179	0.166	0.113	0.110	0.106	0.098
Hansen J p. Ho: instruments valid		0.574		0.518		0.277		0.343
Under ID test p. Ho: under-identified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		32.199		32.199		32.288		30.094
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.415		0.425
A-R Wald Chi2 test, p-value		0.000		0.000		0.407		0.418
Endogeneity test p. Ho: exogenous		0.001		0.013		0.755		0.206
First stage Adjusted R ² (Number of assets woman has self/joint ownership of)		0.128		0.128		0.132		0.135
First stage Adjusted R ² (Number of food crops produced by household)		0.320		0.320		0.316		0.319

Note: Estimates from base regression without interaction with land. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

Table 14.7: Model 5: Women's Rights over Assets and Household Food Security Outcomes

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Number of self/joint decisions over purchase, sale or transfer of assets made by woman	5.737*** (1.243)	19.637*** (5.135)	0.018*** (0.003)	0.016 (0.013)	-0.005 (0.006)	0.002 (0.023)	0.006 (0.007)	0.002 (0.028)
Age (in years) of household head	13.646** (6.124)	8.675 (6.473)	-0.014 (0.015)	-0.017 (0.015)				
Age-squared of household head	-0.104 (0.066)	-0.056 (0.070)	0.000 (0.000)	0.000 (0.000)				
Years of education of household head	7.625** (3.255)	5.217 (3.368)	0.070*** (0.007)	0.069*** (0.008)				
Age (in years) of member					0.060** (0.030)	0.058* (0.031)	0.232*** (0.035)	0.238*** (0.038)
Age-squared of member					-0.001** (0.000)	-0.001** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)
Years of education of member					0.119*** (0.015)	0.117*** (0.015)	0.115*** (0.021)	0.118*** (0.023)
Pregnant (=1, 0 otherwise)							1.109*** (0.285)	1.125*** (0.286)
Lactating (=1, 0 otherwise)							-0.850*** (0.184)	-0.848*** (0.187)

Continued

Continued from Table 14.7

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Household head is farmer (=1, 0 otherwise)	71.321*** (26.184)	75.632** (34.346)	0.200*** (0.064)	0.102 (0.078)	0.144 (0.121)	0.146 (0.145)	-0.038 (0.142)	0.082 (0.175)
Household head is trader (=1, 0 otherwise)	34.877 (39.204)	0.964 (43.539)	0.525*** (0.096)	0.554*** (0.101)	0.985*** (0.214)	0.966*** (0.225)	0.431* (0.247)	0.413 (0.254)
Household size	-74.161*** (8.566)	-64.884*** (9.564)	0.084*** (0.020)	0.075*** (0.022)	0.070* (0.040)	0.075* (0.045)	0.041 (0.046)	0.048 (0.051)
Proportion of males 0-4 years old	-1,546.846*** (199.041)	-1,615.209*** (206.383)	0.346 (0.471)	0.441 (0.479)	0.031 (0.868)	-0.001 (0.878)	0.102 (1.002)	0.037 (1.036)
Proportion of males 5-10 years old	-971.520*** (187.126)	-1,057.285*** (194.103)	0.324 (0.419)	0.382 (0.430)	0.618 (0.806)	0.583 (0.818)	0.974 (0.921)	0.955 (0.942)
Proportion of males 11-18 years old	-325.653* (185.415)	-437.470** (194.681)	-0.245 (0.412)	-0.219 (0.428)	0.239 (0.792)	0.194 (0.806)	1.437 (0.895)	1.469 (0.922)
Proportion of males 19-59 years old	166.953 (153.243)	169.525 (154.577)	0.546* (0.313)	0.542* (0.315)	1.214* (0.660)	1.224* (0.655)	1.839*** (0.675)	1.860*** (0.673)
Proportion of females 0-4 years old	-1,630.065*** (197.888)	-1,694.354*** (205.187)	0.422 (0.473)	0.532 (0.483)	0.153 (0.864)	0.125 (0.873)	0.650 (1.014)	0.560 (1.038)
Proportion of females 5-10 years old	-821.326*** (191.731)	-911.444*** (197.929)	0.523 (0.422)	0.564 (0.435)	0.978 (0.833)	0.939 (0.842)	0.530 (0.922)	0.532 (0.944)
Proportion of females 11-18 years old	-155.518 (199.050)	-253.923 (203.938)	0.455 (0.429)	0.470 (0.443)	0.281 (0.821)	0.244 (0.825)	1.542 (0.946)	1.578 (0.962)

Continued

Continued from Table 14.7

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Proportion of females 19-59 years old	16.339 (226.667)	-65.496 (234.410)	0.885* (0.498)	0.925* (0.512)	1.129 (1.013)	1.108 (1.011)	1.729 (1.097)	1.734 (1.104)
Proportion of females 60 years and older	-340.188 (250.662)	-427.584* (257.228)	0.224 (0.518)	0.279 (0.530)	1.052 (1.096)	1.026 (1.098)	2.203* (1.227)	2.193* (1.245)
Number of food crops produced by household	34.134*** (9.093)	8.077 (27.137)	0.066*** (0.020)	0.181*** (0.063)	-0.083** (0.038)	-0.098 (0.116)	0.033 (0.048)	-0.096 (0.140)
Number of dairy cows owned	47.587*** (10.465)	40.221*** (11.727)	0.117*** (0.024)	0.096*** (0.026)	0.081* (0.044)	0.078 (0.048)	0.028 (0.057)	0.058 (0.061)
Price of rice (in taka)	-4.737 (3.969)	-3.757 (4.057)	0.020** (0.009)	0.021** (0.010)	0.059*** (0.018)	0.060*** (0.018)	0.045** (0.022)	0.044** (0.021)
Ln (owned cultivable land+1)	26.100*** (8.498)	21.487** (8.830)	0.031* (0.017)	0.034* (0.018)	0.155*** (0.039)	0.153*** (0.039)	0.132*** (0.044)	0.131*** (0.045)
Owens hand tube well (=1, 0 otherwise)	117.479*** (26.503)	114.594*** (27.182)	0.320*** (0.062)	0.294*** (0.063)	0.036 (0.121)	0.036 (0.122)	0.065 (0.146)	0.097 (0.149)
Access to electricity (=1, 0 otherwise)	12.156 (22.890)	-5.785 (24.534)	0.407*** (0.056)	0.408*** (0.059)	0.514*** (0.104)	0.506*** (0.108)	0.611*** (0.127)	0.618*** (0.129)
Division level fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2,822.341*** (219.334)	2,832.715*** (222.547)	7.571*** (0.528)	7.593*** (0.530)	15,188*** (1,007)	15,178*** (0,999)	11,890*** (1,179)	11,841*** (1,178)

Continued

Continued from Table 14.7

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	41.058	37.590	28.025	25.513	12.761	12.490	15.086	15.011
Adjusted R ²	0.275	0.240	0.181	0.172	0.113	0.112	0.106	0.103
Hansen J p, Ho: instruments valid		0.061		0.131		0.251		0.259
Under ID test p, Ho: underidentified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		23.334		23.334		23.340		21.822
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.415		0.425
A-R Wald Chi2 test, p-value		0.000		0.000		0.407		0.418
Endogeneity test p, Ho: exogenous		0.012		0.070		0.941		0.386
First stage Adjusted R ² (Number of self/joint decisions over purchase, sale or transfer of assets made by woman)		0.181		0.181		0.190		0.188
First stage Adjusted R ² (Number of food crops produced by household)		0.320		0.320		0.316		0.319

Note: Estimates from base regression without interaction with land. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

Table 14.8: Model 6: Gender Parity Gap and Household Food Security Outcomes

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Gender parity gap (=0 if woman enjoys gender parity, 'gap' if not)	-163.834*** (52.646)	-1,282.089*** (256.600)	-0.401*** (0.133)	-2.583*** (0.601)	0.220 (0.241)	0.785 (1.110)	0.318 (0.301)	0.252 (1.242)
Age (in years) of household head	15.976** (6.217)	9.845 (7.016)	-0.009 (0.015)	-0.025 (0.016)				
Age-squared of household head	-0.126* (0.067)	-0.066 (0.076)	0.000 (0.000)	0.000 (0.000)				
Years of education of household head	9.238*** (3.330)	10.081*** (3.523)	0.074*** (0.007)	0.074*** (0.008)				
Age (in years) of member			0.056* (0.030)		0.056* (0.030)	0.059* (0.031)	0.238*** (0.036)	0.240*** (0.037)
Age-squared of member			-0.001** (0.000)		-0.001** (0.000)	-0.001** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)
Years of education of member			0.119*** (0.015)		0.119*** (0.015)	0.118*** (0.015)	0.116*** (0.021)	0.117*** (0.021)
Pregnant (=1, 0 otherwise)							1.159*** (0.294)	1.178*** (0.295)
Lactating (=1, 0 otherwise)							-0.890*** (0.184)	-0.884*** (0.184)
Household head is farmer (=1, 0 otherwise)	74.163*** (26.352)	84.660** (35.405)	0.223*** (0.064)	0.151* (0.082)	0.130 (0.122)	0.110 (0.146)	-0.038 (0.144)	0.056 (0.177)

Continued

Continued from Table 14.8

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Household head is trader (=1, 0 otherwise)	43.092 (39.325)	4.451 (42.673)	0.556*** (0.099)	0.505*** (0.103)	0.940*** (0.213)	0.967*** (0.216)	0.488* (0.251)	0.464* (0.253)
Household size	-76.559*** (8.692)	-68.532*** (9.552)	0.073*** (0.020)	0.080*** (0.023)	0.063 (0.041)	0.057 (0.043)	0.038 (0.047)	0.047 (0.050)
Proportion of males 0-4 years old	-1,544.764*** (204.887)	-1,594.009*** (224.046)	0.474 (0.477)	0.468 (0.506)	-0.168 (0.877)	-0.123 (0.883)	0.146 (1.017)	0.059 (1.030)
Proportion of males 5-10 years old	-967.151*** (191.741)	-1,043.160*** (206.927)	0.439 (0.422)	0.343 (0.452)	0.488 (0.812)	0.531 (0.815)	1.195 (0.935)	1.147 (0.943)
Proportion of males 11-18 years old	-328.485* (190.186)	-425.453** (205.314)	-0.121 (0.418)	-0.292 (0.443)	0.011 (0.802)	0.057 (0.804)	1.566* (0.909)	1.553* (0.915)
Proportion of males 19-59 years old	142.865 (157.756)	135.830 (168.143)	0.590* (0.316)	0.579* (0.336)	1.176* (0.666)	1.171* (0.665)	1.886*** (0.688)	1.893*** (0.686)
Proportion of females 0-4 years old	-1,613.382*** (203.070)	-1,597.564*** (220.178)	0.525 (0.479)	0.662 (0.506)	0.013 (0.874)	0.026 (0.880)	0.617 (1.027)	0.517 (1.029)
Proportion of females 5-10 years old	-839.164*** (197.619)	-969.284*** (213.360)	0.582 (0.429)	0.363 (0.459)	0.869 (0.843)	0.935 (0.851)	0.697 (0.947)	0.663 (0.959)
Proportion of females 11-18 years old	-149.120 (204.730)	-289.433 (217.506)	0.553 (0.436)	0.291 (0.467)	0.237 (0.831)	0.304 (0.833)	1.522 (0.962)	1.511 (0.977)
Proportion of females 19-59 years old	8.155 (231.876)	-80.391 (248.583)	0.983* (0.506)	0.846 (0.541)	0.928 (1.017)	0.964 (1.017)	1.823 (1.112)	1.797 (1.111)

Continued

Continued from Table 14.8

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Proportion of females 60 years and older	-357.547 (256.315)	-435.890 (273.060)	0.310 (0.523)	0.206 (0.561)	0.781 (1.099)	0.814 (1.100)	2.409* (1.244)	2.367* (1.248)
Number of food crops produced by household	36.659*** (9.105)	40.145* (23.874)	0.080*** (0.020)	0.195*** (0.057)	-0.080** (0.038)	-0.062 (0.100)	0.040 (0.048)	-0.067 (0.122)
Number of dairy cows owned	50.519*** (10.434)	44.513*** (11.663)	0.128*** (0.024)	0.095*** (0.026)	0.073* (0.044)	0.073 (0.048)	0.039 (0.058)	0.060 (0.060)
Price of rice (in taka)	-3.700 (3.868)	-0.469 (4.191)	0.021** (0.009)	0.028*** (0.010)	0.059*** (0.018)	0.057*** (0.018)	0.044** (0.022)	0.044** (0.022)
Ln (owned cultivable land+1)	29.223*** (8.609)	35.044*** (9.058)	0.038** (0.017)	0.051*** (0.019)	0.154*** (0.039)	0.151*** (0.039)	0.134*** (0.045)	0.133*** (0.045)
Owens hand tube well (=1, 0 otherwise)	110.282*** (26.994)	46.695 (30.367)	0.307*** (0.063)	0.157** (0.071)	0.046 (0.122)	0.073 (0.134)	0.062 (0.147)	0.083 (0.159)
Access to electricity (=1, 0 otherwise)	12.421 (23.142)	-13.203 (25.453)	0.408*** (0.057)	0.357*** (0.061)	0.519*** (0.105)	0.532*** (0.108)	0.632*** (0.127)	0.632*** (0.129)
Division level fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2,821.997*** (222.972)	3,085.689*** (245.743)	7.585*** (0.535)	8.115*** (0.585)	15.336*** (1.016)	15.220*** (1.036)	11.699*** (1.212)	11.699*** (1.269)
Observations	3,213	3,213	3,213	3,213	3,094	3,094	3,203	3,203
F	40.077	34.102	26.200	23.094	12.467	12.048	15.215	15.136

Continued

Continued from Table 14.8

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Adjusted R ²	0.270	0.170	0.173	0.091	0.111	0.110	0.107	0.106
Hansen J p, Ho: instruments valid		0.553		0.423		0.425		0.255
Under ID test p, Ho: underidentified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		27.216		27.216		25.550		25.764
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.566		0.446
A-R Wald Chi2 test, p-value		0.000		0.000		0.559		0.439
Endogeneity test p, Ho: exogenous		0.000		0.000		0.860		0.646
First stage Adjusted R ² (Gender parity gap)		0.121		0.121		0.118		0.121
First stage Adjusted R ² (Number of food crops produced by household)		0.314		0.314		0.310		0.313

Note: Estimates from base regression without interaction with land. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

For regressions involving male and female BMI, we fail to reject the exogeneity of women's empowerment and household crop production in the adult male and female BMI equations (columns 6 and 8); hence the OLS results (columns 5 and 7) are our preferred estimates for this sample.

Most indicators for women's empowerment do not have any significant impact on adult male (column 5 of Tables 14.3, 14.6, 14.7, and 14.8) and adult female BMI (column 7 of Tables 14.3, 14.4, 14.5, 14.6, 14.7, and 14.8), suggesting that other factors, such as household wealth, education, and occupation (discussed below), are more important determinants of adult male and female nutritional status. However, women's group membership and decision-making concerning credit are negatively and significantly associated with adult male BMI (column 5 of Tables 14.4 and 14.5). Taken together with our findings on calorie availability and dietary diversity, these results suggest that adults in households where the primary female has larger social networks and greater access to credit may have increased energy requirements beyond that which is provided by the increased access to food. The insignificant impacts on females and significant and negative impact on males may result from higher demands on male labor, resulting in higher activity levels and therefore greater energy deficiencies for men. Our findings on credit may also be reflecting poverty, given that credit is typically targeted to women in poor households. These hypotheses deserve further investigation in future work. We find that the number of food crops produced by the household has a strongly significant negative association with adult male BMI in all models, possibly because growing more crops increases the intensity of labor inputs in the field, which is primarily a male domain. Rice price is strongly and positively associated with male and female BMI in all models, possibly working through two pathways. First, an increase in the rice price would increase the income of net sellers of rice (who would typically be farming households), hence BMI of household members is expected to improve. Second, an increase in the rice price may also induce a shift towards higher quality diets, possibly from staple- to protein-based diets.

Household wealth indicators such as owned cultivable land and access to electricity are strongly and positively associated with both male and female BMI in all models; however, the number of dairy cows has a positive and significant impact on adult male BMI only. Dairying is very intensive in female labor (Quisumbing et al. 2013), although we do not find any significant impact on female BMI of dairy cow ownership.

The education of primary male and female also has significant and positive impact on their BMIs. Primary males and females also have higher

BMI in households where the primary male (household head) is engaged in trading, possibly because trading is less physically strenuous than farming. Household size is significantly and positively associated with male BMI in most models. Pregnancy and lactation status significantly affect women's BMI, with pregnant women having significantly higher BMI, but with lactating women having significantly *lower* BMIs. The latter finding highlights the biological demands of lactation, and indicates that lactating women are a nutritionally vulnerable group in the Bangladeshi context.

14.4.2 Household Wealth and Impact of Women's Empowerment on Food Security

There is suggestive evidence from India (Eswaran, Ramaswami, and Wadhwa 2013) that the relationship between women's empowerment and status (as determined by caste and wealth) may not be positive. Using time allocation data, Eswaran, Ramaswami, and Wadhwa (2013) show that women's market work relative to males is lower in the higher castes, suggesting that greater family status may result in lower autonomy for women. Because land is the most important asset for rural Bangladeshi households, we examine how the relationship between women's empowerment in agriculture and household food security varies by the size of owned cultivable land. As shown in equation 14.2 (section 14.3.2), we estimate the interaction effect of empowerment and land area, with selected regression results presented in Table 14.9. The IV diagnostics for the regressions involving calorie availability and dietary diversity (Models 1, 2, 4 and 6) show that while the results of the Anderson Rubin, over-identification, and under-identification tests deteriorate to some extent, endogenous variables are still relevant, null hypotheses of exogeneity can be rejected, instruments remain valid, and models are identified. However, for Models 3 and 5, we fail to reject the null that the model is under-identified; the weak-identification test results for Models 3, 4, and 5 suggest that our instruments are weak. For the regressions involving male and female BMI, we fail to reject the exogeneity of women's empowerment and household crop production in the adult male and female BMI equations; hence the OLS results (columns 5 and 7) are taken to be valid for this sample. Given the weak performance of the 2SLS estimates in Models 3, 4, and 5 in the regressions with interactions (compared to base regression), we treat the results of the augmented regressions with appropriate caveats, and focus on the discussion of the interaction terms rather than the main effects, for which the impacts are qualitatively similar to base regressions.

Table 14.9: Estimates from Household Food Security Outcome Regressions with Land Interactions

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Model 1: Women's empowerment score								
Empowerment score of woman	236.420*** (50.699)	878.890*** (184.769)	0.575*** (0.131)	2.244*** (0.460)	-0.222 (0.225)	-0.432 (0.841)	-0.253 (0.282)	-0.577 (0.948)
Ln (owned cultivable land+1)	29.371 (23.518)	-3.467 (75.926)	0.113** (0.050)	0.181 (0.150)	0.059 (0.104)	-0.082 (0.312)	0.136 (0.131)	-0.494 (0.385)
Empowerment score of woman× Ln (owned cultivable land+1)	-1.438 (31.270)	49.081 (112.493)	-0.112 (0.068)	-0.206 (0.219)	0.140 (0.141)	0.349 (0.460)	-0.005 (0.180)	0.926 (0.564)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	40.566	37.049	25.761	24.237	12.348	12.153	14.587	14.472
Adjusted R ²	0.274	0.225	0.176	0.122	0.113	0.112	0.105	0.093
Hansen J p, Ho: instruments valid		0.231		0.446		0.526		0.630
Under ID test p, Ho: underidentified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		20.703		20.703		19.911		19.682
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.643		0.562
A-R Wald Chi2 test, p-value		0.000		0.000		0.633		0.551
Endogeneity test p, Ho: exogenous		0.000		0.000		0.962		0.192

Continued

Continued from Table 14.9

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Model 2: Women's group membership								
Number of groups woman is an active member of	48.466** (24.499)	692.446*** (170.405)	0.162*** (0.063)	1.719*** (0.433)	-0.301*** (0.109)	-0.320 (0.645)	0.173 (0.132)	-0.262 (0.758)
Ln (owned cultivable land+1)	32.219*** (9.388)	32.722 (27.536)	0.059*** (0.018)	0.092* (0.053)	0.135*** (0.044)	0.111 (0.104)	0.189*** (0.049)	-0.042 (0.127)
Number of groups woman is an active member of × Ln (owned cultivable land+1)	-15.431 (18.423)	34.626 (119.194)	-0.088** (0.038)	-0.101 (0.214)	0.061 (0.077)	0.165 (0.407)	-0.232** (0.091)	0.756 (0.519)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	39.023	30.405	25.014	20.564	12.741	12.188	14.875	13.992
Adjusted R ²	0.270	0.050	0.173	-0.045	0.115	0.114	0.107	0.063
Hansen J p, Ho: instruments valid		0.108		0.368		0.313		0.473
Under ID test p, Ho: underidentified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		5.229		5.229		4.380		5.327
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.497		0.407
A-R Wald Chi2 test, p-value		0.000		0.000		0.485		0.394
Endogeneity test p, Ho: exogenous		0.000		0.000		0.992		0.117

Continued

Continued from Table 14.9

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Model 3: Women's decisions on credit								
Average number of decisions over credit	4.529 (11.728)	705.155*** (253.810)	-0.006 (0.031)	0.659 (0.462)	-0.112** (0.053)	-0.655 (0.718)	0.005 (0.066)	-1.139 (0.945)
Ln (owned cultivable land+1)	33.918*** (12.219)	152.357* (88.380)	0.056** (0.023)	0.155 (0.132)	0.185*** (0.052)	0.289 (0.376)	0.217*** (0.062)	-0.003 (0.400)
Average number of decisions over credit \times Ln (owned cultivable land+1)	-6.854 (8.167)	-149.154 (97.669)	-0.022 (0.016)	-0.139 (0.147)	-0.034 (0.037)	-0.143 (0.411)	-0.094** (0.043)	0.160 (0.445)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	39.136	18.759	24.735	21.297	12.426	10.937	14.740	13.267
Adjusted R ²	0.269	-0.539	0.171	0.030	0.115	0.065	0.107	0.019
Hansen J p. Ho: instruments valid		0.334		0.032		0.415		0.533
Under ID test p. Ho: underidentified		0.269		0.269		0.452		0.190
Weak ID test stat (Kleibergen-Paaprk Wald F)		1.000		1.000		0.794		1.135
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.516		0.501
A-R Wald Chi2 test, p-value		0.000		0.000		0.506		0.490
Endogeneity test p. Ho: exogenous		0.000		0.029		0.878		0.279

Continued

Continued from Table 14.9

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Model 4: Women's ownership of assets								
Number of assets woman has self/joint ownership of	38.631*** (9.214)	174.917*** (35.279)	0.118*** (0.021)	0.231*** (0.083)	0.042 (0.039)	-0.012 (0.154)	0.066 (0.047)	-0.141 (0.183)
Ln (owned cultivable land+1)	42.827*** (13.099)	156.687*** (76.327)	0.074*** (0.029)	0.164 (0.112)	0.181*** (0.065)	0.311 (0.254)	0.175** (0.073)	-0.037 (0.333)
Number of assets woman has self/joint ownership of × Ln (owned cultivable land+1)	-6.962 (4.683)	-59.385* (33.890)	-0.018* (0.010)	-0.058 (0.050)	-0.013 (0.024)	-0.075 (0.118)	-0.019 (0.028)	0.078 (0.150)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	39.678	34.728	26.469	24.045	12.349	11.876	14.717	14.383
Adjusted R ²	0.274	0.201	0.180	0.164	0.113	0.107	0.106	0.096
Hansen J p, Ho: instruments valid		0.703		0.243		0.465		0.580
Under ID test p, Ho: underidentified		0.010		0.010		0.008		0.013
Weak ID test stat (Kleibergen-Paaprk Wald F)		2.085		2.085		2.261		2.052
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.001		0.623		0.656
A-R Wald Chi2 test, p-value		0.000		0.001		0.612		0.646
Endogeneity test p, Ho: exogenous		0.000		0.059		0.899		0.274

Continued

Continued from Table 14.9

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model 5: Women's rights over assets								
Number of self/joint decisions over purchase, sale or transfer of assets made by woman	6.045*** (1.337)	23.091*** (5.225)	0.019*** (0.003)	0.027** (0.013)	-0.007 (0.006)	0.012 (0.023)	0.004 (0.007)	0.009 (0.028)
Ln (owned cultivable land+1)	30.912** (12.666)	126.288 (78.503)	0.061** (0.027)	0.334* (0.184)	0.128** (0.060)	0.481* (0.284)	0.088 (0.068)	0.226 (0.405)
Number of self/joint decisions over purchase, sale or transfer of assets made by woman×Ln (owned cultivable land+1)	-0.351 (0.789)	-7.580 (5.522)	-0.002 (0.001)	-0.022* (0.013)	0.002 (0.004)	-0.024 (0.020)	0.003 (0.004)	-0.007 (0.029)
Observations	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263
F	39.768	35.436	27.011	22.323	12.319	11.515	14.612	14.541
Adjusted R ²	0.275	0.223	0.181	0.131	0.113	0.088	0.106	0.100
Hansen J p, Ho: instruments valid		0.165		0.316		0.583		0.474
Under ID test p, Ho: underidentified		0.238		0.238		0.134		0.234
Weak ID test stat (Kleibergen-Paaprk Wald F)		1.156		1.156		1.376		1.164
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.001		0.623		0.656
A-R Wald Chi2 test, p-value		0.000		0.001		0.612		0.646
Endogeneity test p, Ho: exogenous		0.006		0.086		0.633		0.553

Continued

Continued from Table 14.9

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
Model 6: Women's gender parity gap								
Gender parity gap (=0 if woman enjoys gender parity, gap if not)	-161.629*** (54.641)	-1,335.018*** (281.034)	-0.380*** (0.145)	-2.855*** (0.694)	0.342 (0.258)	0.876 (1.227)	0.268 (0.321)	1.200 (1.361)
Ln (owned cultivable land+1)	29.784*** (10.399)	37.863 (28.102)	0.044** (0.022)	0.040 (0.054)	0.186*** (0.050)	0.252** (0.114)	0.121** (0.058)	0.366*** (0.136)
Gender parity (=0 if woman enjoys gender parity, 'gap' if not) × Ln (owned cultivable land+1)	-3.094 (37.327)	-14.139 (144.634)	-0.030 (0.076)	0.068 (0.296)	-0.174 (0.154)	-0.541 (0.576)	0.071 (0.211)	-1.285* (0.718)
Observations	3,213	3,213	3,213	3,213	3,094	3,094	3,203	3,203
F	38.725	32.434	25.290	22.113	12.065	11.746	14.718	14.468
Adjusted R ²	0.270	0.158	0.173	0.077	0.111	0.109	0.107	0.090
Hansen J p, Ho: instruments valid		0.473		0.213		0.607		0.770
Under ID test p, Ho: underidentified		0.000		0.000		0.000		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		11.450		11.450		10.940		10.691
Anderson-Rubin, Ho: endogvars irrelevant								
A-R Wald test, p-value		0.000		0.000		0.689		0.640
A-R Wald Chi2 test, p-value		0.000		0.000		0.679		0.629
Endogeneity test p, Ho: exogenous		0.000		0.000		0.890		0.147

Note: Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

The interactions of the women's empowerment indicators with the size of owned land are significant only in some models, and these results should also be taken with caution, given the performance of the instruments. Calorie availability tends to decrease in larger landowner households where women own more assets (column 2 of Model 4, Table 14.9) and diet diversity decreases in larger landowner households where women take more decisions concerning assets (column 4 of Model 5, Table 14.9).¹⁰ For households owning more land, women who are involved in a greater number of groups and make more decisions on credit tend to have lower BMI (column 7 of Models 2 and 3). With appropriate caveats, these results appear to indicate that the positive effect of different dimensions of female empowerment on food security outcomes is greater for smaller landowners, that is, for less well-off households. While these results are broadly consistent with the findings of Eswaran, Ramaswami, and Wadhwa (2013), they also point to the potential positive redistributive effect of focusing women's empowerment efforts on poorer households.

14.4.3 Magnitudes of Women's Empowerment Effects

Table 14.10 presents the elasticities of per capita calorie availability, household dietary diversity, and adult BMI with respect to the empowerment indicators and three household characteristics—number of food crops produced by household, years of education of household head, and area of cultivable land owned by household. Although the endogeneity tests lead to the rejection of the null hypothesis that the empowerment variables are exogenous, the IV diagnostics lead us to doubt the validity of our 2SLS estimates for some of the measures of empowerment.¹¹ Moreover, although the empowerment indicators emerged as significant in the 2SLS base regressions, because the elasticities computed from the 2SLS specification use predicted values of both dependent and explanatory variables, the standard errors of the IV elasticities are quite large. These large standard errors lead to the inability to estimate elasticities precisely using the IV specification, and lead one to accept the null hypotheses that these elasticity estimates are insignificant, even if they are larger in magnitude than the OLS estimates. We therefore base our discussion of the elasticity estimates mostly on the OLS results, treating them as a lower bound, given the imprecision of the IV elasticity estimates. We find that the magnitude of the impact on calorie availability (column 1) and dietary diversity (column 3)

¹⁰ However, both of these regressions have weak instruments, and the model is underidentified in the diet diversity regression with land interactions.

¹¹ For Models 2 and 3 (group membership and credit decisions, respectively), instruments are weak in the calorie availability and diet diversity regressions; in Model 5 (women's rights over assets), the Hansen J test rejects the null hypothesis that instruments are valid in the calorie availability regression.

of the overall empowerment score is the highest—a 10 percent increase in the empowerment score leads to a 6.3 percent increase in calorie availability and a 3.5 percent increase in dietary diversity in the OLS regressions. After controlling for the potential endogeneity of empowerment and crop production diversity, the magnitudes are even higher; a 10 percent increase in the empowerment score leads to a 24 percent increase in calorie availability (column 2) and a 13.6 percent increase in dietary diversity (column 4), although as mentioned above, these elasticities are imprecisely estimated. Among the component indicators, the largest elasticities are with respect to women's rights over assets (0.027 for calorie availability and 0.022 for diet diversity) and women's ownership of assets (0.026 for calorie availability and 0.021 for diet diversity) for the OLS estimates.¹² We also find that most empowerment indicators have larger effects on calorie availability and dietary diversity than selected household variables, for both OLS and IV estimates. For example, based on the OLS estimates, we find that a 10 percent increase in the assets owned by woman has an effect of increasing calorie availability by 2.6 percent. However, the same proportional increase in the number of food crops, years of education of household head, and area of land owned lead to respective increases of 1.8, 0.09, and 0.11 percent in calorie availability. The relative magnitudes of empowerment elasticities compared to household characteristics are similar for the IV elasticities.

The magnitudes of the effects of the empowerment indicators on adult BMI are relatively smaller than the effects on other food security outcomes; OLS elasticities range from 0.001 (effect of number of groups women is active in on female BMI) to 0.008 (effect of overall empowerment on female BMI). For both OLS and IV estimates, we also find that the impacts of various indicators of empowerment on BMI are relatively smaller than that of other household characteristics.

Although the results of elasticities analysis point to the importance of women's empowerment in general, and women's asset ownership in particular, for improving household food security, they do not yield conclusive evidence that prioritizing women's empowerment alone should take precedence over improving other determinants of food security. The magnitudes of the elasticity estimates, even where significant, are small. Moreover, one must recognize the limitations of elasticity analyses in general, because elasticities isolate the effects of a single variable, whereas food security is determined by the interaction of many variables, not just women's empowerment. This analysis also does not indicate, in practice, how increases in these underlying variables are to be achieved. Because our elasticity estimates are computed at the sample means, they may not be indicative of differential responses across the empowerment or wealth distribution. This can be explored in future work.

¹² For the 2SLS elasticities, the largest are with respect to credit, however, the instruments are weak.

Table 14.10: Elasticities of Calorie Availability, Dietary Diversity, and Adult BMI with respect to Empowerment Indicators and Other Household Characteristics

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (8)	2SLS (9)
Empowerment score of woman	0.063*** (0.013)	0.240 (224.877)	0.035*** (0.008)	0.136 (139.752)	-0.004 (0.007)	-0.015 (125.432)	-0.008 (0.009)	0.001 (138.552)
Number of groups woman is an active member of	0.005* (0.003)	0.107 (118.956)	0.004* (0.002)	0.058 (70.462)	-0.004** (0.002)	-0.002 (52.659)	0.001 (0.002)	0.008 (57.681)
Average number of decisions over credit	-0.000 (0.004)	0.310 (584.159)	-0.002 (0.003)	0.094 (264.171)	-0.006*** (0.002)	-0.028 (179.205)	-0.003 (0.003)	-0.041 (221.669)
Number of assets woman has self/joint ownership of	0.026*** (0.007)	0.115 (126.640)	0.021*** (0.004)	0.037 (77.334)	0.003 (0.003)	-0.007 (68.572)	0.005 (0.004)	-0.013 (78.939)
Number of self/joint decisions over purchase, sale or transfer of assets made by woman	0.027*** (0.006)	0.094 (118.856)	0.022*** (0.004)	0.020 (75.924)	-0.003 (0.003)	0.001 (64.359)	0.004 (0.004)	0.001 (77.964)
Gender parity (=0 if woman enjoys gender parity, 'gap' if not)	-0.011*** (0.004)	-0.086 (83.338)	-0.007*** (0.002)	-0.045 (51.081)	0.002 (0.002)	0.007 (45.363)	0.003 (0.002)	0.002 (48.585)
Range of elasticity estimates for other household characteristics								
Number of food crops produced by household	0.017*** -0.020***	-0.019 - 0.021	0.009*** -0.011***	0.018- (0.026)	-0.006** - -0.005**	-0.006 - 0.001	0.002 - 0.003	-0.007 - 0.001
	(0.005)	(134.99-58.31)	(0.003)	(35.957- 60.373)	(0.002)	(31.487- 36.018)	(0.003)	(37.044- 51.617)

Continued

Continued from Table 14.10

Variable	Per capita calorie availability		Household dietary diversity		Male BMI		Female BMI	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (8)	2SLS (9)
Years of education of household head	0.009*** -0.011*** (0.004)	0.005-0.021 (19.39-36.018)	0.022*** 0.023*** (0.002)	0.021- 0.026 (11.434- 16.385)	0.017*** 0.018*** (0.002)	0.017- 0.018 (10.652- 12.662)	0.016*** 0.017*** (0.003)	- 0.018 (14.342- 16.210)
Area of cultivable land owned by household (in decimals)	0.010*** -0.012*** (0.003)	0.008-0.017 (16.887- 26.744)	0.003* 0.004** (0.002)	0.003- 0.007 (8.864- 11.183)	0.007*** 0.008*** (0.002)	- 0.008 (9.369- 9.762)	0.006*** 0.006*** (0.002)	0.006 -0.007 (10.255- 10.844)
Observations*	3,273	3,273	3,273	3,273	3,150	3,150	3,263	3,263

Note: Calculated from base regressions without land interactions, and evaluated at the mean. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For analyses involving the gender parity variable, the number of observations is reduced to 3,213 for calorie availability and household dietary diversity, 3,094 for male BMI, and 3,203 for female BMI.

Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011-2012.

Table 14.11: Model 1: Women's Empowerment Score and Per Adult Equivalent Calorie Availability

Variable	Per adult equivalent calorie availability	
	OLS (1)	2SLS (2)
Empowerment score of woman	288.921*** (62.155)	1,100.588*** (222.549)
Age (in years) of household head	15.973* (8.263)	10.402 (8.878)
Age-squared of household head	-0.125 (0.091)	-0.070 (0.098)
Years of education of household head	10.697** (4.301)	10.458** (4.359)
Household head is farmer (=1, 0 otherwise)	113.970*** (34.050)	128.657*** (44.806)
Household head is trader (=1, 0 otherwise)	59.686 (49.750)	31.296 (51.950)
Household size	-96.703*** (11.207)	-91.121*** (11.835)
Proportion of males 0-4 years old	-944.962*** (262.404)	-979.262*** (273.466)
Proportion of males 5-10 years old	-957.435*** (245.035)	-1,031.235*** (254.336)
Proportion of males 11-18 years old	-1,067.528*** (239.740)	-1,142.455*** (248.049)
Proportion of males 19-59 years old	-1,333.262*** (201.741)	-1,336.144*** (207.133)
Proportion of females 0-4 years old	-962.667*** (261.802)	-947.325*** (271.576)
Proportion of females 5-10 years old	-502.199** (251.845)	-598.276** (259.839)
Proportion of females 11-18 years old	-401.619 (258.228)	-533.342** (265.836)
Proportion of females 19-59 years old	-647.129** (293.254)	-710.284** (301.181)
Proportion of females 60 years and older	-22.718 (328.560)	-67.253 (336.961)

Continued

Continued from Table 14.11

Variable	Per adult equivalent calorie availability	
	OLS (1)	2SLS (2)
Number of food crops produced by household	46.953*** (11.552)	38.191 (30.280)
Number of dairy cows owned	61.363*** (13.387)	53.355*** (14.755)
Price of rice (in taka)	-4.741 (5.073)	-1.389 (5.225)
Ln (owned cultivable land+1)	37.980*** (10.885)	39.720*** (11.116)
Owens hand tube well (=1, 0 otherwise)	119.506*** (34.431)	50.227 (37.775)
Access to electricity (=1, 0 otherwise)	11.354 (29.507)	-19.400 (31.497)
Division level fixed-effects	Yes	Yes
Constant	4,008.168*** (282.009)	3,575.073*** (309.563)
Observations	3,273	3,273
F	18.594	17.909
Adjusted R ²	0.187	0.142
Hansen J p, Ho: instruments valid		0.249
Under ID test p, Ho: underidentified		0.000
Weak ID test stat (Kleibergen-Paaprk Wald F)		41.798
Anderson-Rubin, Ho: endogvars irrelevant		
A-R Wald test, p-value		0.000
A-R Wald Chi2 test, p-value		0.000
Endogeneity test p, Ho: exogenous		0.000

14.5 Conclusions and Policy Implications

This chapter demonstrates that the recently-developed WEAI can be used not only to assess the extent of women's empowerment in agriculture, but also to identify areas where the gaps in empowerment are greatest. By breaking down the WEAI into its component domains and indicators, we have identified that the domains of leadership in the community and

control of resources are the most promising areas for policy intervention. Our analysis also highlights the importance of increasing the number of groups in which women actively participate and increasing women's control of assets. To what extent are the strategic and programmatic priorities of government and civil society aligned with closing empowerment gaps, specifically in these areas of greatest disempowerment? Because the NGOs sector has emerged as an important alternative delivery channel for social services, and provides complementary avenues for poor women to access basic services alongside state-run services (Nazneen, Hossain, and Sultan 2011), we consider both government and civil society initiatives in answering this question.

These empowerment gaps must be taken in the context of the country's impressive gains in women's health and girls' education relative to comparator countries in the past two decades (Nazneen, Hossain, and Sultan 2011), with rapid reduction in fertility rates, infant and child mortality, and maternal mortality, and the closing of the gender gap in primary and secondary enrollment. Women's economic and social advancement are also stated goals of public policy, falling under the purview of the Ministry of Women and Children Affairs (MOWCA). In assessing progress in implementing the government's policy commitments to gender equality, MOWCA (2010) finds that the greatest emphasis of government ministries is on improving the gender balance of staff and working conditions of women. However, less than a third of the ministries (14 out of 47 responding to a questionnaire) identify economic advancement as a programmatic area, and within this area, women's economic participation in the labor force is emphasized, not increasing control over assets or income derived from economic activities. Protection of legal rights focused on birth registration, eliminating child labor, and combating early marriage and dowry-related violence, not on equal rights to own assets. The only program that explicitly mentions strengthening women's rights to assets is a program of the Ministry of Land that leases out *khas* (government-owned) land to wives and husbands on an equal rights basis in the Model Village and Cluster Village Project (MOWCA 2010, 42).

With regards to leadership in the community, despite the two top political leaders being women, Bangladeshi women in general have fared far less well with respect to participation in national politics than women in comparator countries (Nazneen, Hossain, and Sultan 2011, 12). The established political parties tend to focus on conventional and uncontroversial women's issues such as maternal healthcare, girl's education, political participation, violence against women in the public sphere, and certain forms of domestic violence

such as dowry-related violence (Nazneen, Hossain, and Sultan 2011, 24). Policy documents and pronouncements on strengthening women's leadership in the community are quite vague, although MOWCA (2011, authors' translation) mentions the role of District Women Affairs Officers and Upazila Women Affairs Officers in implementing programs undertaken for development of women in economic advancement ministries, as well as a move to organize women into self-sustained groups at the village and union levels, with the possibility of registering these groups as formal organizations under different government organizations.

Donor policy documents do not highlight women's participation in mass party politics as a route to women's empowerment, but make greater reference to working with civil society as a route to strengthening women's voice at the local levels (Nazneen, Hossain, and Sultan 2011). Nevertheless, civil society efforts need a supportive policy environment to be effective, and often work against deep-seated economic and social barriers to women's empowerment. While NGOs have been active in increasing their membership base among poor rural women, women with more bargaining power within their households (owing to greater schooling or assets brought to marriage) are more likely to participate in NGOs (Quisumbing 2009). Group-based efforts have often been unable to reach the ultra-poor, because many group-based activities, such as those in microfinance, require a minimum level of resources for participation, such as funds for compulsory savings requirements.

Long-seated systems of property rights that favor men in terms of inheritance, and the difficulty that women face in accumulating assets that they can control, need to be addressed so that women can build up their control of assets. This suggests that reforms of inheritance and property rights law more broadly, and specific interventions to increase women's control of assets, would be important parts of the policy agenda to reduce gender inequality. These could include targeted asset transfers to poor women (similar to those implemented by BRAC through its Targeting the Ultra Poor [TUP] Program) as well as efforts to improve women's access to financial instruments (both savings and credit) so they can accumulate assets. However, even if assets are transferred to women, a recent impact evaluation of BRAC's TUP program shows that there is no guarantee that they will retain control of the transferred assets or other assets acquired from incomes generated from the transferred assets (Das et al. 2013). While the National Women's Development Policy formulated by the Ministry of Women and Children Affairs aims to 'ensure full control of women of the property earned through own labor, inheritance, debt, land

and market management' (MOWCA 2011, authors' translation), it does not offer specific pronouncements about efforts to reform property law to improve gender equity. Our finding that not only absolute empowerment, but relative empowerment of women within households, also positively affects household food security provides additional support for policies to narrow the gender gap in Bangladesh.

Our results also highlight the importance of investing in the agriculture sector as a whole to increase production diversity. The BIHS results show that about 77 percent of the total cropped area in Bangladesh is under rice cultivation, implying very little crop diversity. Significant advances in agricultural research have focused mainly on rice. Our findings call for increased investment in agricultural research to enhance productivity of non-rice food crops such as pulses, vegetables and fruits. The positive impacts of tube well ownership and access to electricity also suggest that investments in complementary infrastructure will be important to increase household level food energy availability and dietary diversity. Lastly, continued investments in schooling, particularly of women and girls, will be important not only to increase food security, but also to narrow the gender gap in human capital.

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