



Women's empowerment in agriculture and dietary diversity in Ethiopia

Feiruz Yimer and Fanaye Tadesse

TABLE OF CONTENTS

Abstract	2
1. Introduction	2
2. Conceptual Framework	3
3. Data and Methodology	4
4. Results and Discussion	10
5. Conclusion	12
References	13
Appendices	14

LIST OF TABLES

Table 2.1 The Five Domains of Empowerment in the Women's Empowerment in Agriculture Index	4
Table 3.1 Descriptive statistics of variables used in the regression for child diet diversity	8
Table 3.2 Descriptive statistics of variables used in the women dietary diversity regression	9
Table 4.1: Coefficient estimates women's empowerment indicators and children's dietary diversity	11
Table 4.2: Coefficient estimates women's empowerment indicators and women's dietary diversity	12

LIST OF FIGURES

Figure 3.1. Contribution of each of the five domains to disempowerment of women	6
Figure 3.2. Contribution of each of the five domain indicators to disempowerment of women	6

APPENDICES

Appendix Table 1: Results of the first stage regression on empowerment measures for children dietary diversity	14
Appendix Table 2: Results of the first stage regression on empowerment measures for women dietary diversity	15
Appendix Table 3: Control variables in estimation of children dietary diversity	16
Appendix Table 4: Control variables in estimation of women's dietary diversity	17

ABSTRACT

Intra-household resource allocation has a considerable role to play in nutritional status in developing countries. Maternal and children's dietary diversity are linked, not only with the circumstances of the household in general, but also with the status of women in particular. The extent to which women have access to and control over resources largely determines the kind of care they provide for their children and for the rest of the household. As recognized by the National Nutrition Program, women's lack of control over household resources, time, knowledge, and social support networks constitutes a major barrier to improving poor nutritional outcomes in Ethiopia. Using household survey data from 2013, we investigate the impact of women's empowerment in agriculture on the nutrition outcomes of children and women. The data were collected in five regions of the country from more than 7,000 households in 84 woredas. We use multivariate regression methods and instrumental variable techniques to establish the relationship between women's empowerment and the dietary diversity of women and children. The results indicate that all of the women's empowerment indicators used are positively related to better dietary diversity for both children and women. As women's empowerment leads to improvements in children's and women's dietary diversity, it follows that interventions which increase women's empowerment contribute to improving child nutrition as well as their own well-being.

I. INTRODUCTION

Achieving improved mother and child nutritional outcomes is one of the major goals of developing countries like Ethiopia. This challenge is particularly pronounced in rural areas where access to improved food sources, health facilities, and other infrastructure is very limited. It is generally thought that providing sufficient food through increasing agricultural productivity leads to better nutritional outcomes. However, this relationship is not always straightforward. Other household level variables also contribute both to increases in agricultural productivity and to the pathways through which increased agricultural productivity can result in better nutritional outcomes.

The means by which increased agricultural productivity brings about improvement in nutritional outcomes are affected by gender roles within households. In most rural households, the responsibility for the nutrition of household members, in general, and for the nutritional outcomes of children, in particular, falls on the mother. Ethiopia's National Nutrition Program recognizes that the general lack of control of women over household resources, time, knowledge, and social support networks constitutes a major barrier to improving poor nutritional outcomes in Ethiopia (GFDRE, 2013)

This study attempts to investigate the link between women's empowerment and dietary diversity in rural Ethiopia. It employs the recently developed Women's Empowerment in Agriculture Index (WEAI). Recent studies have used the WEAI and its component indicators to assess the extent of women's empowerment in agriculture and the impact this has through different measurable aspects on women and children's nutrition outcomes (for instance, Sraboni et al. (2014) on Bangladesh and Malapit et al. (2013) on Nepal).

Since women's empowerment could be determined by the same factors that determine the dietary diversity variable, instrumental variable regressions are employed. The results indicate that women's empowerment leads to improvements in children's and women's nutrition as measured by dietary diversity. Women's empowerment is positively and significantly related to dietary diversity of both children and women. All the empowerment indicators, both in aggregate and separately, are found to have a positive and significant impact on the dietary diversity of women and children.

2. CONCEPTUAL FRAMEWORK

Agriculture is closely linked to food security in rural parts of Ethiopia. This is mainly because household agricultural production is the primary source of nutrients and income for households. Change in agricultural productivity is generally believed to have both direct and indirect implications on nutritional outcomes. There are various ways through which an increase in agricultural productivity can translate to a change in nutritional outcomes. Arimond et al. (2010) studied this relationship and presented five pathways through which interventions in agriculture can affect nutrition. These are: increased food for own consumption, increase in income, reduction in market prices, changes in preferences, and shifts in the control of resources within households. In all of the five pathways, gender roles have a significant influence. This is particularly true of the own consumption and the increase in income pathways (Malapit et al., 2013).

Intra-household resource allocation affects child nutritional outcomes. The 1990 UNICEF framework of the determinants of child nutritional status has helped to show how different types of maternal resources are key determinants of child nutritional status (UNICEF 1990). It strongly highlights how the care of children is linked not only with the state of the household in general, but also the situation of the woman in particular. The extent to which women have access to and control over resources largely determines the quality of care they provide for their children. The framework also notes that the lack of control over household resources, time, knowledge, and social support networks constitute a major underlying cause of poor nutritional outcomes. As Thomas (1990) indicated, households where a mother has greater control over resources, rather than any other family member including the father, have more positive outcomes on the health of children in the household. This is because, compared to men, women tend to allocate more resources towards expenditures that improve the nutrition of their family, and particularly of their children.

Other empirical researches have also shown that greater control by women of household resources has an impact on the nutritional and educational outcomes of children (Quisumbing, 2003; Quisumbing & Maluccio, 2003). The more a woman has control over household economic resources and her own time, the more likely she is to source special foods for herself and her child and to use this food at appropriate times (Smith et al. 2003). In addition, the woman will be in a position to make timely decisions on health issues for either a sick child or herself.

However, these linkages are complex, and the relationship between the women's status and nutrition are not straight forward. For instance, in some cases, women's empowerment through engagement in agriculture or other paid work could reduce the amount of time available for them to take care of themselves as well as their children. On the other hand, the additional time spent on agriculture or on other income generating activities could have a positive income effect which could in turn contribute towards improving nutritional outcomes.

Also, there is the argument that the relative power and control over resources in some households may not have a significant effect on women's well-being and on the state of health of children in the household. In certain households, for example, both men and women work together and resources are pooled so as to improve the well-being of the household. In such cases, the women's status with respect to a decision making role will not impact health in the same way (Smith et al., 2003).

Likewise, part of this ambiguity may be attributed to the fact that measuring women's empowerment is not straight forward. Quantifying the linkages between women's empowerment and nutritional outcomes heavily relies on how empowerment is measured. Current attempts to define and measure empowerment have depended on Kabeer's (1999) definition of empowerment which indicates that the ability to make choices that incorporate three dimensions: resources, agency and achievements. The Women's Empowerment in Agriculture Index (WEAI) was developed by focusing on the less studied 'agency' aspect. The index was developed by researchers at USAID, IFPRI, and the Oxford Poverty and Human Development Initiative (OPHI) to track changes in women's empowerment levels that occurs as a direct or indirect result of interventions under Feed the Future, the U.S. government's global hunger and food security initiative. Although WEAI was initially developed for the purpose of evaluating the Feed the Future program, it is also a useful tool for other stakeholders, such as policymakers and development

organizations, in analyzing the impact of different efforts and interventions that are planned to increase women's empowerment.

WEAI is composed of two sub-indexes which measure the five domains of empowerment in agriculture (5DE) (Table 2.1) and gender parity in empowerment within the household (GPI). It is an aggregate index reported at the country or regional level that is based on individual-level data on men and women within the same households.

The 5DE sub-index measures the empowerment of women by capturing the roles of women's engagement in the agricultural sector in five domains. These five domains of empowerment comprise decisions over production, access to and decision making power over productive resources, control over the use of income, leadership in the community, and time use. The domains are constructed using 10 indicators, defined in Table 2.1. A woman is defined as empowered in 5DE if she has achieved a certain level in four of the five domains, or is empowered in some combination of the weighted indicators that reflect 80 percent of total adequacy. The GPI reflects the percentage of women who are equally empowered as the men in their households. The GPI gap indicates the empowerment gap that needs to be closed for women to be equally empowered as men in their households. The overall WEAI comprises a combination of 5DE and GPI, each contributing 90 percent and 10 percent, respectively, to the index.

Table 2.1 The Five Domains of Empowerment in the Women's Empowerment in Agriculture Index

Domain (each weighted 1/5 of 5DE sub-index)	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, for example, what inputs to buy, what crops to grow, what livestock to raise, and so on. This reveals the extent to which the respondent's motivation for decision making is reflected his or 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 the respondent participates in decisions to buy, sell, or transfer his or her owned assets	1/15
	Access to & decisions about 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 the respondent is an active member in at least one economic or social group, for example, 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, ensuring proper payment of wages for public work programs, and so on.	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).

3. DATA AND METHODOLOGY

In this study, we use primary data from a baseline survey conducted for the evaluation of the Feed the Future (FtF) program in Ethiopia. The data were collected in June 2013 from five regions of the country – Tigray, Amhara, Oromiya, Southern Nations Nationalities and Peoples Region (SNNP), and Somali - comprising 7011 households from 84 *woredas* (districts) by the Central Statistical Agency (CSA) in collaboration with IFPRI (International Food Policy Research Institute) with funding from the United States Agency for International Development (USAID). The questionnaire used for the survey included modules on basic demographic information; household

consumption and expenditure; women empowerment indicators; women dietary diversity and anthropometry; child anthropometry and infant and young child feeding; employment, agricultural productivity and input use; and other relevant information.

The outcome variables are children's and women's dietary diversity. Since the empowerment measures may be affected by the same factors that influence nutritional status of women and children, there is a possible endogeneity of the empowerment measure. We also suspect production diversity to be endogenous, as it can be affected by the same factors that affect dietary diversity. Hence, we use a Two Stage Least Squares (2SLS) analytical approach by first estimating the women's empowerment indicators and in the second stage looking at the impact of the women's empowerment indicators on children and women's dietary diversity.

Hence, in order to examine the relationship between women's empowerment in agriculture and mothers' and children's nutritional outcomes, we estimate the following equation:

$$Y_i = b_0 + b_1 \text{empowerment}_i + b_3 I_i + b_4 H_i + \varepsilon_i$$

where Y is a vector of women and child nutritional outcomes. The nutritional outcomes of women and children are measured by dietary diversity. I is a vector of individual characteristics, H are household characteristics and ε is the error term. Our measure of empowerment in the above specification is the women's 5DE score, as it contributes about 90 percent of the overall WEAI. We also employ other specifications that use the different empowerment domains separately to tease out which domains have a specific impact on dietary diversity.

Definition of the Outcome Variables

The outcome variables that we consider in this paper are dietary diversity for children and women.

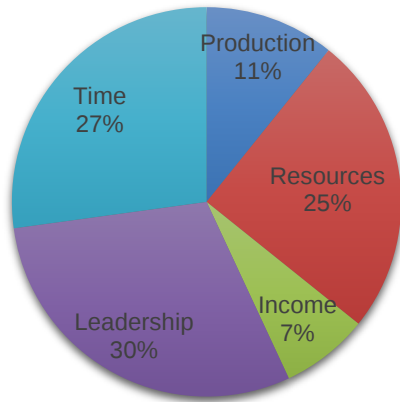
Dietary diversity for children refers to the mean number of food groups consumed by children under 72 months of age on the day preceding the interview. The food groups were assessed using the protocol recommended by the World Health Organization for assessing infant and young child feeding practices. Mothers were asked what types of foods they had fed their children in the 24 hours preceding the interview. The kind of food the children ate was further categorized into seven major food groups: 1) Grain, roots and tubers; 2) Legumes and nuts; 3) Dairy products (milk, yogurt, cheese); 4) Flesh foods and other miscellaneous small animal protein, including organ meat; 5) Eggs; 6) Vitamin A rich vegetables and fruits; and 7) Other fruits and vegetables (WHO, 2006).

Dietary diversity for women refers to the mean number of food groups consumed by women of reproductive age in the day preceding the interview. The nine food groups used to construct the variable suggested by Kennedy et al. (2011) are 1) Grain, roots and tubers; 2) Legumes and nuts; 3) Dairy products (milk, yogurt, cheese); 4) Organ meat; 5) Eggs; 6) Flesh foods and other miscellaneous small animal protein; 7) Vitamin A dark green leafy vegetables; 8) Other Vitamin A rich vegetables and fruits; and 9) Other fruits and vegetables.

Key Independent Variables

Women's Empowerment in Agriculture Index: To measure the empowerment of women in agriculture we use the individual level computed 5DE. The index further identifies the domains in which women are disempowered. This helps to identify empowerment indicators that contribute substantially to the degree of disempowerment. The domains that contribute the most to the disempowerment of women are then chosen as empowerment indicators. Once these domains are selected, a continuous measure of empowerment is developed for the selected indicators. Accordingly, from the results of our dataset, the domain that contributes the most to the disempowerment of women is leadership, followed by time and resources (Figure 3.1).

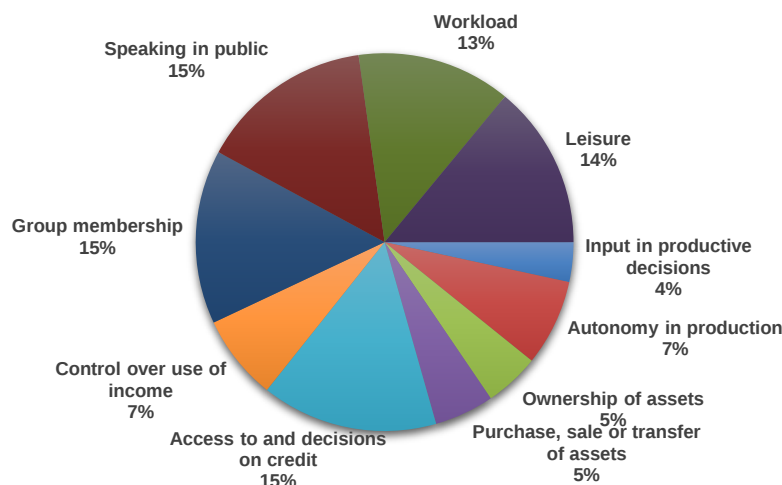
Figure 3.1. Contribution of each of the five domains to disempowerment of women



Source: Authors' compilation using FtF baseline Survey, 2013

Figure 3.2 below presents a further breakdown of the contribution of each sub-domain to the disempowerment of women. Group membership emerges as the indicator that contributes most to the disempowerment in the leadership domain, while access to and a decision on credit contributes the most to disempowerment in the resources domain. Workload and control over income also contribute the most to disempowerment in the time and income domain respectively, while autonomy in production decision is the major contributor of disempowerment in the production domain.

Figure 3.2. Contribution of each of the five domain indicators to disempowerment of women



Source: Authors' compilation using FtF baseline Survey, 2013

In addition to the aggregate empowerment score, we construct four other indicators that contribute the most to the disempowerment of women in each of the five domains. The four major domains that contribute to disempowerment are leadership, time, resources, and production, and under these domains the most significant contributors to disempowerment are group membership, workload, access to and decision on credit, and autonomy in production, respectively. We use these as explanatory variables to see how these domain indicators correlate with the nutritional outcomes that are under consideration. Therefore, for each of the dependent variables, we estimate four additional specifications in addition to the aggregate empowerment score or the 5DE. The key dependent variables in all the specifications are as follows:

Model 1: Aggregate empowerment score – The sum of the weighted adequacy score.

Model 2: Group membership – Number of community groups in which the respondent is an active member.

Model 3: *Autonomy in production* – Number of production decisions in which a woman participates.

Model 4: *Workload* – The total time spent by the respondent in paid and unpaid activities, including domestic chores and caring for children and the elderly.

Model 5: *Access to and decisions on credit* – Number of credit decisions in which the woman participates, or feels that she can make credit decisions.

To deal with the endogeneity of the empowerment measures and production diversity, we employ an instrumental variable regression method. The instruments chosen should be correlated with the endogenous variables but not with the dependent variable directly, except through the endogenous explanatory variable. Since each component of the aggregate empowerment score may be affected by different determinants (for instance, factors affecting group membership of women could be different from those affecting autonomy in production), finding instruments for the aggregate empowerment score is very challenging. However, different studies have shown that the gender norms in the community dictate, for instance, the kinds of economic activities in which a woman engages (Kevane and Wydick 2001; Balagamwala, Gazdar, and Mallah 2015). Since women's empowerment in general could also be dictated by community level gender norms, we try to measure social norms by the leave out means¹ of the empowerment score in the village. The social norm in the village is measured by the average village level women's empowerment score excluding the woman in consideration. This directly affects the empowerment level of the particular woman but does not affect the woman's and her children's nutritional outcome directly.

For the second model, we instrument group membership with the number of groups in the community and the percentage of women members that are in village women groups. The number of groups in the community captures the issue of access and is expected to be corrected with the woman's participation in such groups, while the percentage of women in women groups captures the community norm. However, these variables are less likely to have any direct impact on nutritional outcomes except through the woman's participation in such groups.

For the third model, we instrumented autonomy in production with the leave out means of autonomy in production to capture community norms. In addition, the average distance to the land parcels that the household cultivates is also included as an additional instrument. The nearer the parcels are, the more likely the woman will be engaged in production decisions. This is mainly true of backyard parcels which are usually designated for vegetables and fruits and are mostly managed by women.

Workload and access to and decisions on credit are instrumented by distance to markets and village level access to credit, respectively. The community level questionnaire included questions on whether there are credit sources in the village which could determine the woman's ability to participate in such groups, the extent to which the credit market has developed within the village, and also the level of access women have to credit (Sraboni et al. 2014). The distance to market at cluster level also indicates the exclusion of women from the community in general and from community groups (Bhoj et al. 2013) and also their work load (Malapit et al. 2013). To capture community norms, we also include the leave out means of workload and decision on credit to instrument workload and decision on credit, respectively.

Production diversity is instrumented using agro-ecological indicators which are likely to affect production diversity but are exogenous to nutritional outcomes. The variables used as instruments are the average rainfall and temperature of the village for the past 30 years and also the proportion of fertile plots that are owned by the household. These indicators are likely to determine the mix of crops and livestock which households produce, but do not affect nutritional outcomes directly.

The other explanatory variables in the regression include mother, child, and household characteristics. Child age and gender; and mother's age, level of schooling, and whether or not the mother is the head of the household were individual level variables included as controls. Other household characteristics include household

¹ A' leave out means' refers to the average empowerment score of women in the community, excluding the woman of that particular household.

size, land size in hectares, dependency ratio, household wealth (measured using principal component analysis on the household assets owned by the household and then categorized by quintiles), and production diversity. The production diversity was mapped to the seven food groups used in measuring the dietary diversity score.

Table 3.1 below presents the description of the variables that are included in the child diet diversity regression. We can see that the average diet diversity score is about 1.25 out of the 7 food groups. The 5DE score for the women with children under 6 years old, for whom we have dietary diversity scores, is about 0.67. In terms of the explanatory variables, the average age of mothers is about 29 years, while the average age of children under 6 is about 37 months (3 years). From the children in the sample, about 27 percent are under 2 years while 51 percent are male. In terms of mothers' education, the majority of the mothers (close to 82 percent) are not educated, only 17 percent have primary education, while the percentage of mothers with secondary and tertiary education is a mere 1 percent. The average size of the households in which these children live is about 6 people, with a dependency ratio of 1.64. Households on average produce around two food groups out of eight food group categories.

Table 3.1 Descriptive statistics of variables used in the regression for child diet diversity

Dependent variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Child outcomes					
Diet diversity score (7 food groups)	2617	1.25	1.09	0	7
Empowerment variables					
Aggregate empowerment score	2617	0.67	0.17	0	1
Number of groups woman is an active member of	2617	0.8	1.1	0	7
Number of decisions a woman makes on credit	2617	0.2	0.4	0	4
Total time spent in paid and unpaid work (in hours)	2617	9.78	3.13	0	19
Number of production decisions a woman participates in	2617	2.4	1.6	0	4
Control variables					
Age (in years) of mother	2617	29.25	7.33	15	80
Age (in months) of child	2617	36.67	17.69	6	71
Child is under 2 years old (=1, 0 otherwise)	2617	0.27	0.44	0	1
Child is male (=1, 0 otherwise)	2617	0.51	0.50	0	1
Level of education of mother (=1, 0 otherwise)					
Primary Education	2617	0.17	0.38	0	1
Secondary Education	2617	0.01	0.10	0	1
Tertiary Education	2617	0.00	0.06	0	1
Household size	2617	5.74	1.94	2	15
Dependency ratio	2617	1.64	0.92	0.2	7.0
Wealth quintiles					
1st quintile	2617	0.17	0.37	0	1
2nd quintile	2617	0.19	0.39	0	1
3rd quintile	2617	0.19	0.39	0	1
4th quintile	2617	0.21	0.41	0	1
5th quintile	2617	0.24	0.43	0	1
Production Diversity score (7 food groups)	2617	2.02	1.19	0	7
Shock (whether the household has experienced drought, erosion, flood or price rise in the past 10 years)	2617	0.24	0.42	0	1
Instruments					
Leave out means of women empowerment score	2617	0.66	0.10	0.25	1.00
Leave out means of production autonomy	2617	2.28	0.98	0	4
Leave out means of work load (in minutes)	2617	9.73	1.54	0.0	14.5
Leave out means of number of credit decisions	2617	0.17	0.19	0	1
Number of groups in the community	2617	2.30	1.76	0	10
Percentage of women who are group members in the community	2617	19.58	29.33	0	100

Dependent variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Distance to market (in kilometer)	2445	6.22	10.25	0	90
Average distance to parcels (in minutes)	2341	16.35	26.74	0	304
Availability of a credit institution in the village	2578	0.55	0.50	0	1
Average rainfall (1983-2013)	2617	4.58	1.85	0.93	8.49
Average temperature in degree Celsius (1983-2013)	2617	20.02	2.99	14.0	30.3
Proportion of infertile plots	2617	0.20	0.36	0	1
Proportion of fertile plots	2617	0.60	0.46	0	1

Source: Authors' computation from FtF baseline survey, 2013

Table 3.2 presents the descriptive statistics of variables included in the women's dietary diversity regression. The women's dietary diversity score is about 1.6 out of the nine food categories. In terms of the empowerment variables, the aggregate empowerment score is 0.66. Women on average are a member of one organization with the maximum being seven. Women generally make very few credit related decisions (about 0.16) and they spend an average of 557 minutes (about 10 hours) daily doing both paid and unpaid work in the household and outside of the household. The number of production decisions a woman participates in is a bit higher than the number of decisions on credit at 2.25. The average age of the women is 34 years, with 82 percent of them having no formal education. Around 22 percent of the households these women live in have experienced some sort of shock (drought, erosion, price rises) in the past 10 years. The average number of groups in a community is about two and the percentage of women who are women group members in the community is about 20 percent on average.

Table 3.2 Descriptive statistics of variables used in the women dietary diversity regression

Dependent variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Women outcomes					
Diet diversity score (9 food groups)	5318	1.56	1.23	0	9
Empowerment variables					
Aggregate empowerment score	5318	0.66	0.17	0	1
Number of groups woman is an active member of	5318	0.86	1.10	0	7
Number of decisions a woman makes on credit	5318	0.16	0.44	0	6
Total time spent in paid and unpaid work (in minutes)	5318	9.30	3.15	0	19
Number of production decisions a woman participates in	5318	2.25	1.67	0	4
Control variables					
Age of woman (in years)	5318	34.4	11.0	15	88
Education level of woman (=1, 0 otherwise)					
No Education	5318	0.82	0.38	0	1
Primary Education	5318	0.16	0.37	0	1
Secondary Education	5318	0.01	0.10	0	1
Tertiary Education	5318	0.00	0.06	0	1
Household size	5318	5.33	2.13	1	15
Dependency ratio	5318	1.06	0.85	0	7
Wealth quintiles					
1st quintile	5318	0.17	0.37	0	1
2nd quintile	5318	0.18	0.39	0	1
3rd quintile	5318	0.20	0.40	0	1
4th quintile	5318	0.21	0.41	0	1
5th quintile	5318	0.24	0.43	0	1
Production Diversity score (7 food groups)	5318	1.97	1.15	0	7
Shocks(whether the household has experienced drought, erosion, flood and/or price rise in the past 10 years)	5318	0.22	0.41	0	1
Instruments					

Dependent variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Leave out means of women empowerment score	5317	0.64	0.10	0.24	0.86
Leave out means of production autonomy	5317	2.20	0.91	0	4
Leave out means of work load (in minutes)	5317	556.7	81.4	157.5	755.4
Leave out means of number of credit decisions	5317	0.16	0.16	0.00	0.84
Number of groups in the community	5318	2.23	1.80	0	10
Percentage of women who are group members in the community	5317	20.32	29.40	0	100
Distance to market (in kilometer)	4822	15.05	26.14	0	480
Average distance to parcels (in minutes)	4989	5.81	10.20	0	90
Availability of a credit institution in the village	5254	0.55	0.50	0	1
Average rainfall (1983-2013)	5318	4.64	1.77	0.93	8.49
Average temperature in degree Celsius (1983-2013)	5318	19.75	2.74	14.0	30.3
Proportion of moderately fertile plots	5318	0.19	0.35	0	1
Proportion of fertile plots	5318	0.63	0.45	0	1

Source: Authors' computation from FtF baseline survey, 2013

4. RESULTS AND DISCUSSION

Table 4.1 presents the regression results for children's dietary diversity. The Durbin-Wu-Hausman test of endogeneity rejects the null of exogenous regressors for all models presented except model 5 (model with workload). For model 5, since we cannot reject the null of exogenous regressors, we rely on the OLS estimation results. The Hansen J statistics indicates that the instruments are valid in all models. The Kleibergen-Paap LM test is also significant for all the models, indicating that the excluded instruments are correlated with the endogenous regressors. Given that the Kleibergen-Paap Wald F statistics exceed the Stock and Yogo (2005) critical values at 20 percent, the instruments are not weak. The first stage estimation also indicates the significant and positive relationship between the empowerment variables and the leave out means of these empowerment variables. The test of excluded instruments in the first stage for all models are significant, which affirms the validity of the instruments (see Appendix Table 1).

The IV estimate results for all the models indicate that the women's empowerment variables affect children's dietary diversity positively. The OLS results for all models, including model 3 for which the null of exogenous regressors could not be rejected, also reveals that all the women's empowerment indicators are positively and significantly related to dietary diversity scores. The more women are empowered within their households, the better the diet diversity of their children are going to be. These results are in line with other studies done in Ghana (Malapit and Quisumbing, 2014) and Nepal (Malapit et al., 2015). Also, other factors that significantly contribute to an improvement in children's dietary diversity include production diversity and education of mothers, especially primary education (see Appendix Table 3). On the other hand, the experience of shock by the family has negative implication on the dietary diversity of children.

Tables 4.2 and Appendix Table 4 present the estimation result of the effect of women's empowerment indicators on women's dietary diversity score. The Durbin-Wu-Hausman test of endogeneity rejects the null of exogenous regressors for all models which leads us to the use IV estimation results. The Hansen J statistics indicates that the instruments are valid for all of the models except for models 2 and 5 (number of group membership and workload). The Hansen J statistics indicates that the instruments are valid in all models. The Kleibergen-Paap LM test is significant for all the models, indicating that the excluded instruments are correlated with the endogenous regressors. The first stage regression (see Appendix Table 2) shows the strong positive relationship between the empowerment variables and the leave out means of the empowerment variables. Also, the test of excluded instruments indicates the validity of these instruments.

The results indicate that all the empowerment measures are positively and significantly related to women's dietary diversity. In addition to the aggregate empowerment score, group membership, the amount of time spent on paid and unpaid activities, decision on income, and autonomy on production decisions all have a positive and significant effect on the number of food groups that women consume. Similar strong relationship of empowerment of women and nutritional status of women are shown in other studies such as Ross et al. (2015) and Malapit et al. (2015).

As presented in Appendix 2, the other factors that appear to significantly affect women's dietary diversity are production diversity, the woman's education, and wealth of the household. The fact that the empowerment indicators are all positive and significant in explaining women's dietary diversity, even after controlling for all the individual and household level effects, implies that empowering women in agriculture gives them more power to improve their own wellbeing and nutritional outcomes.

Table 4.1: Coefficient estimates women's empowerment indicators and children's dietary diversity

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Five domains of empowerment		Number of group membership		Decisions on credit matters		Autonomy in production		Workload	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Five domains of empowerment	0.821*** (0.122)	3.034*** (0.430)								
No. of group membership			0.134*** (0.019)	0.270*** (0.057)						
Decision on credit					0.106** (0.046)	0.624** (0.296)				
Autonomy in production							0.084*** (0.012)	0.281*** (0.055)		
Workload									0.017** (0.006)	0.079*** (0.033)
R squared		0.160		0.320		0.160		0.180		0.150
N	2621	2620	2735	2732	2735	2734	2735	2558	2735	2691
Hansen J (p value)		0.545		0.148		0.652		0.438		0.948
Kleibergen-Paap Wald F		10.288		9.871		10.894		9.555		9.244
Kleibergen-Paap LM (p-value)		0.000		0.000		0.000		0.000		0.000
Durbin-Wu-Hausman test (p-value)		0.000		0.009		0.000		0.096		0.137

Source: Authors' estimation using the Ethiopian Feed the Future baseline survey 2013

Note: IV is instrumental variable estimation and OLS is the ordinary least squares estimation. The figures in the parenthesis are standard errors clustered at village level; *** p<0.01, **p<0.05 and * p<0.1.

Table 4.2: Coefficient estimates women's empowerment indicators and women's dietary diversity

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Five domains of empowerment		Number of group membership		Decisions on credit matters		Autonomy in production		Workload	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Five domains of empowerment	1.119*** (0.097)	4.556*** (0.700)								
No. of group membership			0.150*** (0.015)	0.437*** (0.058)						
Decision on credit					0.077*** (0.009)	1.414*** (0.471)				
Autonomy in production							0.031*** (0.005)	0.227*** (0.079)		
Workload									0.147*** (0.036)	0.119*** (0.038)
R squared	0.158		0.151		0.145		0.140		0.137	
N	5323	5322	5570	5565	5570	5499	5570	5022	5570	5223
Hansen J (p value)		0.992		0.087		0.480		0.663	0.03	0.03
Kleibergen-Paap Wald F		2.744		21.364		38.364		2.384	22.833	22.833
Kleibergen-Paap LM (p-value)		0.029		0.000		0.000		0.037	0.000	0.000
Durbin-Wu-Hausman test (p-value)		0.000		0.000		0.028		0.025	0.019	0.019

Source: Authors' estimation using the Ethiopian Feed the Future baseline survey 2013

Note: IV is instrumental variable estimation and OLS is the ordinary least squares estimation. The figures in the parenthesis are standard errors clustered at village level; *** p<0.01, **p<0.05 and * p<0.1.

5. CONCLUSION

Topics incorporating children and maternal health pose burning issues for developing countries like Ethiopia. Consequently, the Ethiopian government is designing different policies and interventions to enhance the health status of children and mothers. One aim of these interventions is to empower women with the purpose of improving general health and nutritional status. Women who are disempowered through lack of control over household resources, time, knowledge, and social support networks constitute a major barrier to improving poor nutritional outcomes in Ethiopia.

This study has explored the impact of women's empowerment on the nutritional outcomes of children and mothers. The newly developed women's empowerment index, Women Empowerment in Agriculture Index (WEAI), is used as a measure for women's empowerment. The study has utilized the five domains of empowerment, which is one part of WEAI, to demonstrate degrees of empowerment. The nutrition level of mothers and children is represented by the dietary diversity of women and children.

The estimation of women's empowerment and crop diversity as control variables on dietary diversity imposes an endogeneity problem. Hence, the instrumental variable estimation technique is used and OLS results are also reported and interpreted in cases when the endogeneity test rejects the null. The results clearly indicates that the empowerment of women in general, as well as engagement of women in the different activities, has positive and significant impacts on the nutritional outcomes of children and women. Hence, efforts made towards enhancing women's involvement in economic activities and simultaneously empowering them are highly likely to generate an improvement in nutrition of both children and mothers.

REFERENCES

- Alkire, S., R. Meinzen-Dick, A. Peterman, A.R. Quisumbing, G. Seymour, and A. Vaz. 2013. The Women's Empowerment in Agriculture Index. *World Development* 52: 71-91.
- Arimond, M., C. Hawkes, M.T. Ruel, Z. Sifri, P.R. Berti, J.L. Leroy, J. Low, L.R. Brown, and E.A. Frongillo. 2010. Agricultural Interventions and Nutrition: Lessons from the Past and New Evidence. In *Combating Micronutrient Deficiencies: Food-Based Approaches*, edited by B. Thompson and L. Amoroso. Rome: Food and Agriculture Organization of the United Nations and CAB International. 41-75.
- Balagamwala, M., H. Gazdar, and H. B. Mallah. 2015. *Women's Agricultural Work and Nutrition in Pakistan: Findings from Qualitative Research*. LANSa Working Paper Series 2015 (02)
- Bhoj S., D. Bardhan, and A. Kumar. 2013. Determinants and Implications of Rural Women's Participation in Microfinance Programme: An Analysis of Dairy Self-help Group in Uttarakhand State of India. *Livestock Research for Rural Development* 25 (185).
- Government of the Federal Democratic Republic of Ethiopia (GFDRE). *National Nutrition Programme June 2013- June 2015*. Addis Ababa: GFDRE
- Kabeer, N. 1999. Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment. *Development and Change* 30 (3): 435-464.
- Kennedy, G., T. Ballard, and M. Dop. 2011. Guidelines for Measuring Household and Individual Dietary Diversity. United Nations, Food and Agriculture Organization: Nutrition and Consumer Protection Division.
- Kevane, M., and B. Wydick. 2001. Microenterprise Lending to Female Entrepreneurs: Sacrificing Economic Growth for Poverty Alleviation. *World Development*. 29 (7): 1225-1236.
- Malapit, H.J.L., S. Kadiyala, A.R. Quisumbing, K. Cunningham, and P. Tyagi. 2013. *Women's Empowerment in Agriculture, Production Diversity, and Nutrition: Evidence from Nepal*. IFPRI Discussion Paper 01313. Washington, DC: International Food Policy Research Institute.
- Malapit, H. J. L., S. Kadiyala, A.R. Quisumbing, K. Cunningham & P. Tyagi. 2015. Women's Empowerment Mitigates the Negative Effects of Low Production Diversity on Maternal and Child Nutrition in Nepal. *Journal of Development Studies* 51 (8): 1097-1123.
- Malapit, H.J. and A.R. Quisumbing. 2014. *What Dimension of Women's Empowerment in Agriculture Matter for Nutrition-Related Practices and Outcomes in Ghana?* IFPRI Discussion Paper 1367. Washington, DC: International Food Policy Research Institute.
- Quisumbing, A. R. 2003. *Household decisions, gender, and development: A synthesis of recent research*. Washington, DC: International Food Policy Research Institute.
- Quisumbing, A.R., and J.A. Maluccio. 2003. Resources at marriage and intrahousehold allocation: Evidence from Bangladesh, Ethiopia, Indonesia, and South Africa. *Oxford Bulletin of Economics and Statistics* 65 (3): 283-327.
- Ross, K. L., Y.A. Zereyesus, A. Shanoyan and V. Amanor-Boadu. 2015. The Health Effects of Women Empowerment: Recent Evidence from Northern Ghana. *International Food and Agribusiness Management Review* 18 (1).
- Smith, L.C, U. Ramakrishanan, A. Ndiaye, L. Haddad and R. Martorell. 2003. *The Importance of Women's Status for Child Nutrition in Developing Countries*. IFPRI Research Report 131. Washington, DC: International Food Policy Research Institute,
- Sraboni, E., H.J. Malapit, A.R. Quisumbing and A.U. Ahmed. 2014. Women's Empowerment in Agriculture: What Role for Food Security in Bangladesh? *World Development* 61: 11-52.
- Stock, J.H. and Yogo, M., 2005. *Testing for Weak Instruments in Linear IV Regression*. In Andrews AWK and J.H. Stock (eds.) *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*. Cambridge: Cambridge University Press. 80-108
- Thomas, D. 1990. Intra-household resource allocation: An inferential approach. *The Journal of Human Resources* 25 (4): 635-664.
- UNICEF (United Nations Children's Fund). 1990. *Strategy for Improved Nutrition of Women and Children in Developing Countries*. New York: UNICEF.
- WHO. 2006. WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatrica*; Suppl 450: 76-85.

APPENDICES

Appendix Table 1: Results of the first stage regression on empowerment measures for children dietary diversity

	Five domains of empowerment	Number of group membership	Decisions on credit matters	Autonomy in production	Workload
Mother's age(in years)	0.004 (0.000)	-0.008 (0.014)	-0.002 (0.007)	-0.002 (0.027)	0.020 (0.057)
Mother's age squared	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.001 (0.001)
Child age	0.000 (0.001)	0.010 (0.007)	0.001 (0.004)	-0.011 (0.012)	-0.007 (0.025)
Child age squared	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Child is under 2 (yes=1)	-0.001 (0.013)	0.015 (0.079)	0.020 (0.043)	-0.074 (0.145)	0.179 (0.289)
Child is male (yes=1)	0.003 (0.006)	-0.037 (0.032)	0.016 (0.017)	-0.081 (0.056)	-0.068 (0.116)
Education (Omitted=No education)					
Primary education	0.028*** (0.011)	0.048 (0.075)	0.067** (0.027)	-0.069 (0.090)	-0.249 (0.197)
Secondary education	0.050* (0.028)	0.189 (0.272)	-0.068* (0.039)	-0.871*** (0.314)	-1.220*** (0.592)
Tertiary education	0.052 (0.058)	-0.156 (0.282)	-0.090 (0.104)	0.957** (0.451)	-0.194 (0.587)
log (household size)	-0.004 (0.013)	0.116 (0.080)	-0.001 (0.037)	-0.023 (0.139)	0.603** (0.238)
Dependency ratio	0.010** (0.004)	-0.026 (0.031)	0.010 (0.013)	-0.050 (0.042)	-0.092 (0.101)
Wealth (omitted=1st quintile)					
2nd quintile	0.002 (0.011)	-0.006 (0.067)	0.027 (0.033)	0.243** (0.105)	0.009 (0.258)
3rd quintile	-0.021* (0.012)	-0.086 (0.082)	-0.017 (0.024)	0.286** (0.130)	-0.011 (0.237)
4th quintile	-0.006 (0.012)	-0.025 (0.084)	0.024 (0.026)	0.250** (0.108)	-0.287 (0.244)
5th quintile	0.019 (0.013)	0.129 (0.094)	0.009 (0.028)	0.249** (0.108)	-0.078 (0.244)
Shock	-0.001 (0.010)	0.169** (0.077)	0.022 (0.029)	-0.061 (0.098)	0.232 (0.200)
Region (omitted=Tigray)					
Amhara	-0.018* (0.010)	-0.043 (0.208)	-0.075** (0.033)	-0.076 (0.077)	0.021 (0.168)
Oromiya	-0.022** (0.010)	0.289 (0.221)	-0.082** (0.033)	-0.019 (0.089)	-0.010 (0.190)
Somali	-0.009 (0.011)	0.115 (0.197)	-0.056 (0.036)	-0.175* (0.094)	0.531** (0.258)
SNNP	-0.037*** (0.013)	0.336 (0.222)	-0.171*** (0.037)	-0.143 (0.098)	-0.226 (0.179)
Proportion of moderately fertile plots	0.001 (0.013)	-0.023 (0.083)	-0.016 (0.025)	0.297*** (0.112)	0.082 (0.214)
Proportion of fertile plots	-0.007 (0.013)	-0.044 (0.092)	0.035 (0.042)	0.444*** (0.154)	0.021 (0.239)
log (average temperature)	-0.027 (0.021)	0.492 (0.370)	0.118** (0.055)	-0.011 (0.217)	-0.259 (0.425)
log (average rainfall)	0.011 (0.021)	0.021 (0.120)	0.096*** (0.026)	-0.005 (0.071)	0.246* (0.144)
Leave out means of women empowerment score	0.775*** (0.033)				
Number of groups in the community	0.128 (0.093)	0.320*** (0.027)			
Percentage of women who are group members in community		-0.001 (0.002)			
Leave out means of number of credit decisions			0.040*** (0.015)		
Leave out means of number of credit decisions			0.592*** (0.054)		

	Five domains of empowerment	Number of group membership	Decisions on credit matters	Autonomy in production	Workload
Average distance to parcels (in minutes)				0.001 (0.002)	
Leave out means of production autonomy				0.766*** (0.031)	
Distance to market (in kilometer)					0.002 (0.004)
Leave out means of work load (in minutes)					0.697*** (0.041)
Constant	0.128 (0.093)	-1.833 (1.251)	-0.386 (0.232)	0.496 (0.844)	2.811 (1.642)
Centered R-squared	0.16	0.32	0.16	0.18	0.15
N	2620	2732	2691	2734	2558
Test of excluded instruments (p-value)	0.000	0.000	0.000	0.000	0.000

Source: Authors' estimation using the Ethiopian Feed the Future baseline survey 2013

Note: The figures in the parenthesis are clustered standard errors at village level; *** p<0.01, **p<0.05 and * p<0.1.

Appendix Table 2: Results of the first stage regression on empowerment measures for women dietary diversity

	Five domains of empowerment	Number of group membership	Decisions on credit matters	Autonomy in production	Workload
Woman's age (in years)	0.008*** (0.001)	0.019** (0.007)	0.011*** (0.003)	-0.010 (0.013)	0.079*** (0.024)
Woman's age squared	0.000*** (0.000)	0.000** (0.000)	0.000** (0.000)	0.000 (0.000)	0.000*** (0.000)
Education (Omitted=No education)					
Primary education	0.029*** (0.008)	0.039* (0.054)	0.051** (0.020)	0.085 (0.068)	-0.115 (0.138)
Secondary education	0.063*** (0.022)	0.375 (0.223)	0.027 (0.057)	-0.010 (0.201)	-1.608*** (0.459)
Tertiary education	0.061* (0.036)	-0.253 (0.203)	0.006 (0.071)	0.559 (0.426)	0.257 (0.496)
Dependency ratio	0.006** (0.003)	-0.020 (0.022)	0.019** (0.008)	-0.028 (0.032)	-0.014 (0.063)
log (household size)	-0.021*** (0.008)	0.092** (0.045)	-0.022 (0.017)	0.146* (0.076)	0.366** (0.142)
Wealth (omitted=1st quintile)					
2nd quintile	0.007 (0.008)	-0.012 (0.045)	0.005 (0.019)	0.199*** (0.069)	0.024 (0.157)
3rd quintile	0.000 (0.009)	-0.055 (0.054)	-0.012 (0.019)	0.103 (0.083)	0.126 (0.168)
4th quintile	0.011 (0.009)	0.079 (0.052)	0.019 (0.022)	0.182** (0.073)	0.083 (0.157)
5th quintile	0.038*** (0.008)	0.213*** (0.073)	0.019 (0.021)	0.267*** (0.074)	0.173 (0.153)
Shock	0.002 (0.007)	0.183** (0.080)	0.039** (0.017)	-0.054 (0.063)	-0.016 (0.113)
Region (omitted=Tigray)					
Amhara	-0.038*** (0.008)	0.029 (0.203)	-0.054*** (0.017)	-0.036 (0.071)	0.147 (0.090)
Oromiya	-0.031*** (0.009)	0.359 (0.220)	-0.066*** (0.018)	-0.080 (0.079)	0.127 (0.098)
Somali	-0.016 (0.013)	0.285 (0.197)	-0.084*** (0.023)	-0.115 (0.114)	0.148 (0.152)
SNNP	-0.058* (0.012)	0.462** (0.217)	-0.119*** (0.019)	-0.143* (0.085)	0.011 (0.106)
Proportion of fertile plots	-0.011* (0.006)	0.025 (0.067)	-0.004 (0.018)	0.045 (0.151)	0.045 (0.145)
Proportion of moderately fertile plots	-0.008 (0.010)	-0.040 (0.071)	0.015 (0.025)	0.136 (0.176)	0.196 (0.185)
log (average temperature)	-0.031 (0.023)	0.116 (0.299)	0.047 (0.034)	0.141 (0.141)	0.069 (0.220)
log (average rainfall)	0.033*** (0.010)	0.066 (0.132)	0.064*** (0.013)	-0.005 (0.061)	0.101 (0.114)
Leave out means of women empowerment score	0.587*** (0.031)				
Number of groups in the community		0.345*** (0.024)			
Percentage of women who are group members in community		0.000 (0.001)			
Availability of a credit institution in the village			0.018** (0.009)		
Leave out means of number of credit decisions			0.604*** (0.036)		

	Five domains of empowerment	Number of group membership	Decisions on credit matters	Autonomy in production	Workload
Average distance to parcels (in minutes)				-0.002 (0.001)	
Leave out means of production autonomy				0.862*** (0.018)	
Distance to market (in kilometer)					0.001 (0.003)
Leave out means of work load (in minutes)					0.769*** (0.029)
Constant	0.218** (0.085)	-1.257 (0.989)	-0.327 (0.125)	-0.188 (0.532)	0.268 (0.877)
Centered R-squared	0.21	0.35	0.08	0.24	0.15
N	5322	5565	5499	5022	5223
Test of excluded instruments (p-value)	0.000	0.000	0.000	0.000	0.000

Source: Authors' estimation using the Ethiopian Feed the Future baseline survey 2013

Note: The figures in the parenthesis are clustered standard errors at village level; *** p<0.01, **p<0.05 and * p<0.1.

Appendix Table 3: Control variables in estimation of children dietary diversity

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Five domains of empowerment		Number of group membership		Decisions on credit matters		Autonomy in production		Workload	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Production diversity	0.147*** (0.018)	0.185** (0.089)	0.157*** (0.017)	0.147* (0.088)	0.152*** (0.017)	-0.013 (0.108)	0.164*** (0.017)	0.200** (0.091)	0.165*** (0.017)	0.184** (0.090)
Mother's age (years)	0.009 (0.016)	0.002 (0.020)	0.011 (0.016)	0.011 (0.020)	0.010 (0.016)	0.01 (0.018)	0.011 (0.016)	0.007 (0.021)	0.011 (0.016)	0.004 (0.022)
Mother's age squared	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Child age	0.038*** (0.008)	0.038*** (0.009)	0.039*** (0.008)	0.038*** (0.009)	0.040*** (0.008)	0.040*** (0.009)	0.039*** (0.008)	0.038*** (0.009)	0.039*** (0.008)	0.038*** (0.009)
Child age squared	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Child is under 2 (yes=1)	0.126 (0.094)	0.113 (0.096)	0.160* (0.092)	0.163* (0.099)	0.163* (0.092)	0.177* (0.105)	0.152 (0.093)	0.144 (0.103)	0.157* (0.093)	0.143 (0.098)
Child is male (yes=1)	-0.058 (0.039)	-0.059 (0.046)	-0.059 (0.039)	-0.060 (0.039)	-0.055 (0.039)	-0.055 (0.044)	-0.058 (0.039)	-0.071 (0.044)	-0.061 (0.039)	-0.069 (0.043)
Education (Omitted=No education)										
Primary education	0.112** (0.055)	0.025 (0.079)	0.136** (0.054)	0.125* (0.067)	0.138*** (0.054)	0.122* (0.070)	0.155*** (0.054)	0.195*** (0.070)	0.138** (0.054)	0.111 (0.072)
Secondary education	-0.023 (0.202)	-0.153 (0.298)	-0.044 (0.198)	-0.075 (0.273)	0.054 (0.198)	0.137 (0.314)	0.026 (0.20)	0.177 (0.287)	0.000 (0.200)	0.076 (0.279)
Tertiary education	-0.001 (0.307)	-0.178 (0.375)	0.077 (0.306)	0.085 (0.335)	0.003 (0.307)	-0.144 (0.383)	0.076 (0.309)	0.108 (0.420)	0.078 (0.309)	0.120 (0.394)
log (household size)	-0.122 (0.075)	-0.134 (0.120)	-0.130* (0.074)	-0.141 (0.109)	-0.111 (0.074)	-0.047 (0.107)	-0.133* (0.075)	-0.199 (0.125)	-0.122 (0.075)	-0.131 (0.111)
Dependency ratio	-0.001 (0.024)	-0.024 (0.037)	0.006 (0.024)	0.003 (0.033)	0.011 (0.024)	0.008 (0.035)	0.012 (0.024)	0.028 (0.035)	0.007 (0.024)	0.007 (0.035)
Wealth (omitted=1st quintile)										
2nd quintile	-0.126* (0.067)	-0.165** (0.083)	-0.107* (0.065)	-0.101 (0.076)	-0.131** (0.065)	-0.132* (0.080)	-0.113* (0.066)	-0.144* (0.081)	-0.115* (0.066)	-0.138* (0.082)
3rd quintile	-0.046 (0.068)	-0.016 (0.093)	-0.034 (0.067)	-0.019 (0.087)	-0.062 (0.067)	-0.045 (0.094)	-0.050 (0.067)	-0.094 (0.092)	-0.044 (0.067)	-0.023 (0.093)
4th quintile	0.025 (0.067)	0.019 (0.089)	0.046 (0.065)	0.049 (0.084)	0.021 (0.065)	0.020 (0.089)	0.046 (0.066)	0.048 (0.085)	0.043 (0.066)	0.022 (0.085)
5th quintile	0.232*** (0.068)	0.130 (0.117)	0.229*** (0.066)	0.199* (0.107)	0.237*** (0.066)	0.280** (0.111)	0.262*** (0.066)	0.241** (0.109)	0.259*** (0.066)	0.228** (0.113)
Shock	-0.119** (0.048)	-0.130* (0.075)	-0.159*** (0.048)	-0.208*** (0.074)	-0.096** (0.047)	-0.059 (0.081)	-0.112** (0.047)	-0.128* (0.078)	-0.111** (0.048)	-0.121 (0.076)
Region (omitted=Tigray)										
Amhara	-0.124* (0.072)	0.084 (0.107)	-0.135* (0.070)	-0.082 (0.117)	-0.162** (0.070)	-0.175 (0.117)	-0.204*** (0.071)	-0.243* (0.129)	-0.175** (0.071)	-0.099 (0.135)
Oromiya	0.429*** (0.066)	0.548*** (0.094)	0.433*** (0.065)	0.473*** (0.106)	0.413*** (0.065)	0.401*** (0.101)	0.376*** (0.066)	0.339*** (0.118)	0.408*** (0.066)	0.496*** (0.119)
Somali	0.036 (0.095)	0.248 (0.188)	0.050 (0.094)	0.133 (0.173)	0.052 (0.094)	0.133 (0.181)	-0.055 (0.094)	-0.179 (0.186)	-0.004 (0.094)	0.141 (0.204)
SNNP	0.620*** (0.076)	0.926*** (0.108)	0.538*** (0.073)	0.551*** (0.121)	0.603*** (0.073)	0.707*** (0.124)	0.516*** (0.073)	0.489*** (0.120)	0.554*** (0.074)	0.697*** (0.151)
Constant	-0.530* (0.313)	-1.953*** (0.443)	-0.160 (0.299)	-0.239 (0.391)	-0.286 (0.301)	-0.523 (0.358)	-0.223 (0.306)	-0.730* (0.432)	-0.111 (0.302)	-0.168 (0.423)
R-squared	0.149		0.15		0.15		0.137		0.137	
N	2621	2620	2735	2732	2735	2734	2735	2558	2735	2691
Hansen J (p-value)		0.545		0.148		0.652		0.438		0.948
Kleibergen-Paap (Wald F)		10.288		9.871		10.894		9.555		9.244

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Five domains of empowerment		Number of group membership		Decisions on credit matters		Autonomy in production		Workload	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Kleibergen-Paap LM (p-value)		0.000		0.000		0.000		0.000		0.000
Durbin-Wu-Hausman test		0.000		0.009		0.000		0.096		0.137

Source: Authors' estimation using the Ethiopian Feed the Future baseline survey 2013

Note: IV is instrumental variable estimation and OLS is the ordinary least squares estimation. The figures in the parenthesis are clustered standard errors at village level; *** p<0.01, **p<0.05 and * p<0.1.

Appendix Table 4: Control variables in estimation of women's dietary diversity

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Five domains of empowerment		Number of group membership		Decision on credit matters		Autonomy in production		Workload	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Production diversity	0.159*** (0.014)	0.227*** (0.088)	0.160*** (0.014)	0.185** (0.082)	0.162*** (0.014)	0.192** (0.082)	0.173*** (0.014)	-0.07 (0.383)	0.170*** (0.014)	0.226*** (0.083)
Woman's age (years)	-0.016** (0.008)	-0.040*** (0.013)	-0.011 (0.008)	-0.017* (0.010)	-0.007 (0.008)	-0.019 (0.012)	-0.01 (0.008)	-0.009 (0.011)	-0.009 (0.008)	-0.018 (0.011)
Woman's age squared	0.000** (0.000)	0.000*** (0.000)	0.000* (0.000)	0.000* (0.000)	0.000 (0.000)	0.000* (0.000)	0.000** (0.000)	0.000 (0.000)	0.000* (0.000)	0.000** (0.000)
Education (Omitted=No education)										
Primary education	0.179*** (0.045)	0.011 (0.068)	0.235*** (0.044)	0.189*** (0.057)	0.229*** (0.044)	0.143** (0.066)	0.254*** (0.044)	0.173** (0.068)	0.237*** (0.044)	0.237*** (0.065)
Secondary education	0.504*** (0.151)	0.234 (0.203)	0.584*** (0.149)	0.507*** (0.151)	0.633*** (0.150)	0.593*** (0.187)	0.695*** (0.150)	0.675*** (0.223)	0.624*** (0.150)	0.927*** (0.196)
Tertiary education	0.444 (0.278)	0.165 (0.354)	0.555** (0.279)	0.528* (0.284)	0.516* (0.280)	0.544* (0.312)	0.540* (0.281)	0.534* (0.312)	0.554** (0.282)	0.495 (0.316)
log (household size)	-0.004 (0.021)	-0.014 (0.030)	0.012 (0.020)	0.015 (0.028)	0.013 (0.020)	-0.024 (0.031)	0.012 (0.020)	-0.005 (0.036)	0.007 (0.021)	0.031 (0.028)
Dependency ratio	0.003 (0.045)	0.028 (0.073)	-0.038 (0.043)	-0.074 (0.064)	-0.037 (0.044)	-0.021 (0.070)	-0.039 (0.044)	0.023 (0.121)	-0.025 (0.044)	-0.108 (0.067)
Wealth (omitted=1st quintile)										
2nd quintile	-0.009 (0.053)	-0.068 (0.079)	0.008 (0.052)	-0.006 (0.075)	-0.019 (0.052)	-0.033 (0.078)	-0.009 (0.052)	0.006 (0.103)	-0.006 (0.052)	-0.036 (0.079)
3rd quintile	0.137*** (0.053)	0.12 (0.087)	0.147*** (0.052)	0.126 (0.088)	0.132** (0.052)	0.14 (0.093)	0.132** (0.052)	0.198 (0.169)	0.137*** (0.052)	0.053 (0.096)
4th quintile	0.134** (0.052)	0.064 (0.078)	0.148*** (0.051)	0.078 (0.075)	0.150*** (0.051)	0.136 (0.085)	0.152*** (0.051)	0.228 (0.161)	0.157*** (0.052)	0.074 (0.085)
5th quintile	0.370*** (0.053)	0.144 (0.102)	0.376*** (0.052)	0.238** (0.096)	0.405*** (0.052)	0.363*** (0.098)	0.417*** (0.052)	0.524* (0.273)	0.417*** (0.052)	0.354*** (0.103)
shock	-0.072* (0.039)	-0.112 (0.082)	-0.098** (0.039)	-0.190** (0.079)	-0.029 (0.039)	-0.089 (0.080)	-0.044 (0.039)	0.101 (0.117)	-0.051 (0.039)	-0.016 (0.077)
Region (omitted=Tigray)										
Amhara	-0.047 (0.059)	0.232* (0.119)	-0.073 (0.058)	0.069 (0.126)	-0.109* (0.058)	0.049 (0.137)	-0.156*** (0.059)	-0.202 (0.234)	-0.110* (0.059)	-0.247* (0.129)
Oromiya	0.610*** (0.058)	0.784*** (0.109)	0.590*** (0.057)	0.673*** (0.106)	0.578*** (0.057)	0.755*** (0.128)	0.525*** (0.057)	0.601*** (0.174)	0.570*** (0.057)	0.486*** (0.116)
Somali	0.238*** (0.092)	0.602*** (0.191)	0.184** (0.091)	0.403** (0.192)	0.175* (0.091)	0.524** (0.220)	0.068 (0.091)	0.206 (0.295)	0.134 (0.091)	0.053 (0.185)
SNNP	0.771*** (0.062)	1.189*** (0.159)	0.624*** (0.061)	0.721*** (0.157)	0.685*** (0.062)	0.952*** (0.188)	0.600*** (0.061)	0.685*** (0.257)	0.646*** (0.062)	0.592*** (0.158)
Constant	0.241 (0.160)	-1.797*** (0.405)	0.812*** (0.148)	0.697*** (0.222)	0.666*** (0.150)	0.667*** (0.234)	0.624*** (0.152)	0.749 (0.620)	0.837*** (0.149)	-0.08 (0.351)
R-squared	0.158	-0.049	0.151	0.091	0.145	-0.062	0.14	0.083	0.137	0.084
N	5323	5322	5570	5565	5570	5499	5570	5022	5570	5223
Hansen J (p-value)		0.942		0.13		0.426		0.694		0.052
Kleibergen-Paap (Wald F)		19.835		18.404		34.96		2.225		19.081
Kleibergen-Paap LM (p-value)		0.000		0.000		0.000		0.052		0.000
Durbin-Wu-Hausman test		0.000		0.000		0.030		0.024		0.018

Source: Authors' estimation using the Ethiopian Feed the Future baseline survey 2013

Note: IV is instrumental variable estimation and OLS is the ordinary least squares estimation. The figures in the parenthesis are clustered standard errors at village level; *** p<0.01, **p<0.05 and * p<0.1.

About the Authors

Feiruz Yimer and **Fanaye Tadesse** are Research Officers in the Ethiopia Strategy Support Program (ESSP), a joint program of the International Food Policy Research Institute and the Ethiopian Development Research Institute, based in Addis Ababa, Ethiopia.

About ESSP

The Ethiopia Strategy Support Program is an initiative to strengthen evidence-based policymaking in Ethiopia in the areas of rural and agricultural development. Facilitated by the International Food Policy Research Institute (IFPRI), ESSP works closely with the government of Ethiopia, the Ethiopian Development Research Institute (EDRI), and other development partners to provide information relevant for the design and implementation of Ethiopia's agricultural and rural development strategies. For more information, see <http://www.ifpri.org/book-757/ourwork/program/ethiopia-strategy-support-program> or <http://essp.ifpri.info/> or <http://www.edri-eth.org/>.

About these working papers

The ESSP Working Papers contain preliminary material and research results from IFPRI and its partners in Ethiopia. These papers are circulated in order to stimulate discussion and critical comment.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

2033 K Street, NW | Washington, DC 20006-1002 USA
T: +1.202.862.5600 | F: +1.202.457.4439
Skype: ifprihomeoffice | ifpri@cgiar.org | www.ifpri.org

IFPRI-ESSP ADDIS ABABA

P.O. Box 5689, Addis Ababa, Ethiopia
T: +251.11.617.2000 | F: +251.11.646.2318
mahlet.mekuria@cgiar.org | <http://essp.ifpri.info>

ETHIOPIAN DEVELOPMENT RESEARCH INSTITUTE

P.O. Box 2479, Addis Ababa, Ethiopia
T: +251.11.550.6066; +251.11.553.8633 | F: +251.11.550.5588
info@edri-eth.org | www.edri-eth.org



The Ethiopia Strategy Support Program (ESSP) is financially supported by the United States Agency for International Development (USAID) and the Department for International Development (DFID) of the government of the United Kingdom and is undertaken as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM) led by the International Food Policy Research Institute (IFPRI). This publication has been prepared as an output of ESSP and has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and do not necessarily reflect those of IFPRI, the Ethiopian Development Research Institute, USAID, DFID, PIM, or CGIAR.

Copyright © 2015 International Food Policy Research Institute. All rights reserved. To obtain permission to republish, contact ifpri-copyright@cgiar.org.