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Does providing agricultural and nutrition information to both men and women improve household food security? Evidence from Malawi

Catherine Ragasa[a,*], Noora-Lisa Aberman[b], Cristina Alvarez Mingote[c]

[a] Development Strategy and Governance Division, International Food Policy Research Institute (IFPRI), 1201 Eye Street, Washington, DC 20005, NW, USA
[b] Development Strategy and Governance Division, International Food Policy Research Institute (IFPRI), Accra, Ghana
[c] Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, USA

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ABSTRACT

We examine the role of gender in various pathways to food security in Malawi, emphasizing improved access to agriculture and nutrition information along these pathways and considering the implications of gender targeting for agriculture and nutrition extension services. We propose a gendered typology of households: those with both male and female adults, those with only adult males, and those with only adult females. We take a mixed-methods approach of sequential quantitative-qualitative data collection, consisting of focus group discussions in eight districts and nationally representative household and community surveys. The results show that food insecurity is highest in male-only and female-only households. In dual-headed households, in which women are frequently tasked with attending trainings and meetings but have little power to implement lessons, joint access to information is a more powerful driver of food security than women's access.

1. Introduction

Food security is a major development problem confronting many countries, including the overwhelming majority in Africa south of the Sahara. In Malawi, despite significant investments in the Farm Input Subsidy Program, improvements in overall national food availability, and record economic growth between 2005 and 2011, household food insecurity and undernutrition are still significant challenges for many Malawians (Verduzco-Gallo et al., 2014; Harris et al., 2015; Pauw et al., 2015). An estimated 37% of children under age five are stunted, and 6.7 million people were in need of food assistance in the 2016/2017 production year (Malawi, 2016; NSO and Macro, 2016).

The causes of persistent food insecurity in Malawi are numerous, including social, economic, political and environmental factors, and policy failures (Bezner Kerr and Patel, 2015; Kassie et al., 2015a, 2015b). Many authors emphasize environmental and agroeconomic causes such as the overuse of land due to high population growth, deforestation, limited access to and use of improved inputs and dependence on rainfed agriculture under a highly variable climate (Babu and Sanyal, 2007; Benson, 2015; Bezner-Kerr and Patel, 2015). Others focus on historical and political economic drivers. In particular, the adoption of agricultural policies and structural programs that favored elites and international companies at the expense of smallholder farmers (Bezner Kerr and Patel, 2015). Chief among these policies was the promotion of maize and the adoption of a monocropping system among smallholder farmers to the detriment of diverse diets and incomes (Bezner Kerr and Patel, 2015). Moreover, supports to the maize economy, specifically the subsidy program, are often used as a tool for political patronage and electoral support among politicians (Chinsinga and Poulton, 2014; Bezner Kerr and Patel, 2015). As well, dependency on donor funding leaves Malawi subject to inconsistent donor policies and external ideological influences (Bezner-Kerr and Patel, 2015).

Understanding food insecurity in Malawi also requires considering the relevance of gender norms and inequalities, which affect agricultural production, knowledge acquisition, innovation and decisions over food choices – and therefore household food security and nutrition (e.g., Kilic et al., 2013; Bezner-Kerr and Patel, 2015; Bezner Kerr et al., 2016; Andersson-Djurfeldt et al., 2018). Women's lower levels of education, together with their lack of decision-making power over fertility, farming and resource allocation, contribute to poor food choices and limited food expenses (Bezner-Kerr and Patel, 2015). Furthermore, gender norms influence women's ability to attend agricultural trainings and to implement the lessons learned at such trainings (Mudege et al., 2016, 2017).

In this paper, we explore further the role that promoting greater gender equality plays in making households more food secure in Malawi. Our research departs from previous studies in a number of ways. First, we expand on the simple female-headed households (FHHs)

* Corresponding author.
E-mail addresses: c.ragasa@cgiar.org (C. Ragasa), n.aberman@cgiar.org (N.-L. Aberman), alvarez9@illinois.edu (C. Alvarez Mingote).

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versus male-headed households (MHHs) comparison, and apply a gendered typology of households differentiating those with (1) both male and female adults or dual-headed households (DHH), (2) sole male adults (SMHH), and (3) sole female adults (SFHH). Several studies have shown that FHHs have substantially higher food insecurity than MHHs (Tibesiga and Visser, 2016; Kassie et al., 2013, 2015a), but our typology allows us to estimate the contribution of males and females (jointly or separately) to household food security (HFS). Experts have also cautioned the use of FHH/MHH dichotomy in gender targeting, due to its definitional and methodological challenges and the possible perverse incentive effects as a result of targeting benefits or services to single mothers that may promote rather than discourage single motherhood (see Buvinic and Gupta, 1997). Moreover, the concept of headship is particularly challenging in Malawi, wherein women within predominantly matrilineal systems and settlement patterns may self-identify as household heads and farm managers even when a husband is present and is a main decisionmaker in agriculture-related activities (Andersson-Djurfeldt et al., 2018).

Second, we focus on the different pathways from agriculture to food security and explore whether significant differences exist in the pathways across these gendered household types. We show how gender gaps in access to resources, information, and education within dual-headed households affect HFS. We also examine how access to advice on crucial topics—agricultural production, agroprocessing, and market access and nutrition—along the pathway affects HFS. By analyzing this information pathway, we evaluate whether the topic and the gender of the person receiving such information matter for improving HFS. This contributes not only to the literature on gender-focused strategies and their connection to food security in Malawi and Sub-Saharan Africa more broadly, but also to understanding how variations in extension services (i.e., different types of messages and delivery approaches) effect food security. Analyzing different extension messages is also a substantial improvement over current research, which typically captures access to extension services with a simple dummy variable (e.g., Babatunde et al., 2008) or by considering the distance to the nearest extension office (e.g., Kassie et al., 2013, 2015a) in survey-based quantitative studies.

Lastly, we take a mixed-methods research approach that utilizes quantitative and qualitative analysis to illuminate aspects of gender and intrahousehold dynamics relating to access to information and its effect on food security. This approach enables us to triangulate the results from different sources and enrich the discussion with insights on pathways and mechanisms. It uses a nationally representative household dataset to draw a picture of the national HFS situation and identifies plot, intrahousehold, household, and community characteristics and location-specific factors to explain variation in HFS via statistical inference. Various highly-valuable qualitative and case study approaches have analyzed gender relations and social norms in the context of agriculture, food security, and nutrition in Malawi (Bezner Kerr et al., 2016; Riley and Dodson, 2016; Tiessen, 2004, 2008). This paper complements such studies with descriptive and quantitative approaches that examine food (in)security and its connection to women's empowerment and gender gaps in access to resources, education, and information. Furthermore, and in alignment with existing studies (e.g., Bezner Kerr et al., 2016; Lentz, 2018), the qualitative analysis emphasizes the relevance of gender norms around typical roles for men and women as well as women's agency in navigating such environments. These considerations are essential to understanding gender dynamics around household food security.

The paper is structured as follows. Section 2 explains why focusing on the gendered pathways to food security is relevant for our study. Section 3 describes our methods and data sources. Section 4 discusses the main results: comparing HFS status across gendered household types, explaining determinants of HFS by gendered household types, discussing the relationship between gender inequalities and HFS, and analyzing the effect on HFS of different types of extension services and provision of information to women and men jointly or separately. Section 5 concludes and highlights the major implications of our findings.

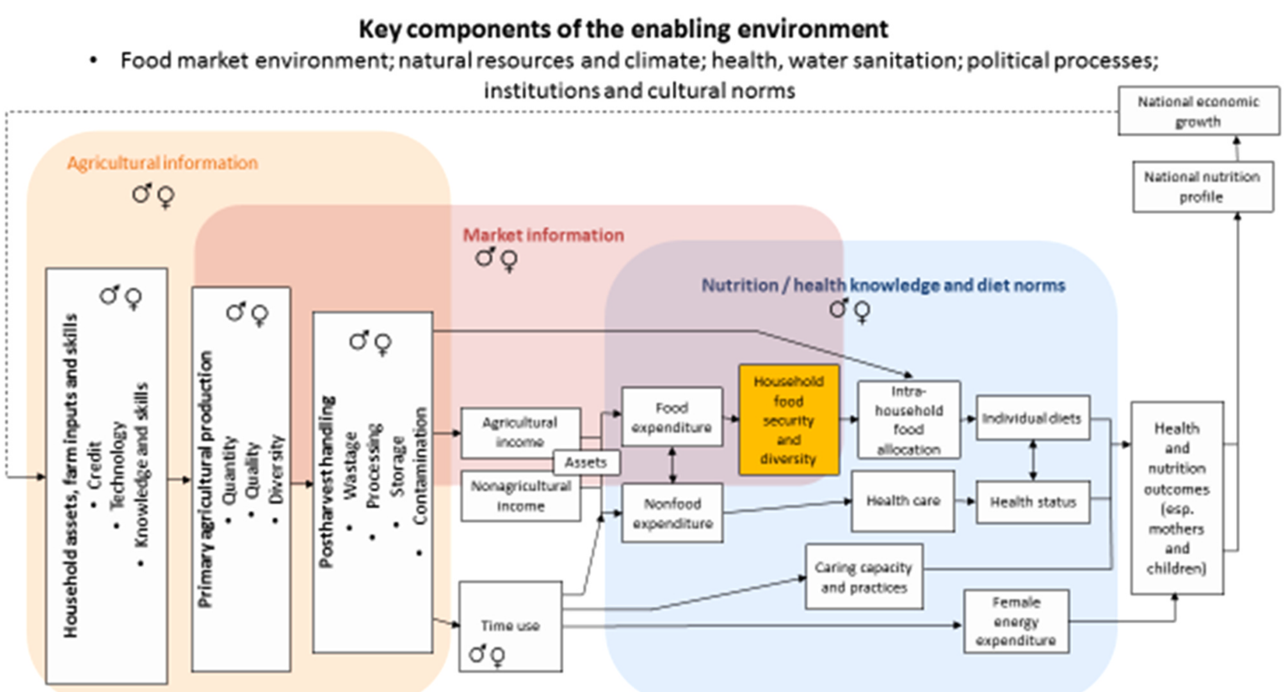

Fig. 2.1. Gendered pathways from agriculture to food security and nutrition. Note: To illustrate gender gaps: ♂ = male; ♀ = female.
Source: Modified from Harris et al. (2015) and Herforth and Harris (2014).

2. Gendered pathways from agriculture to food security

One approach to study gender equality and food security is via the analysis of pathways. Fig. 2.1 shows the different pathways from agriculture to HFS. It highlights the roles of gender relations and information along these pathways. It also highlights the crucial importance that external factors such as shocks, weather risks, political processes, institutions, and social norms play in influencing gender relations and access to resources and information along these pathways.

The ownership, use, and accumulation of physical and human capital play a role in determining productive capacity. In turn, productive capacity affects food security directly when households consume what they grow and indirectly because of its effect on food markets, prices, and income from crop sales. Diverse agricultural production supports the availability of diverse foods in markets. Furthermore, agricultural produce can be sold to provide the resources to buy various food items and so improve diets (Hawkes and Ruel, 2007; Herforth and Harris, 2014). Agricultural production and income (from crop sales or nonfarm sources) determine the quantity and quality of food available to the household. Of particular interest, is the role of specific types of information along these pathways: agricultural, market, and nutrition information. Across these pathways, gender norms and social biases limit access to productive assets, information, and opportunities to certain groups and can lead to sub-optimal allocation of resources, productivity, food availability, and food choices.

The connections between gender and food security are complex – signaling the importance of analyzing these gendered pathways. While much research has pointed out that FHHs are more food insecure than MHHs due to limited access to resources, labor, and opportunities across different countries and contexts (Babatunde et al., 2008; Kassie et al., 2013, 2015a, 2015b; Tibesiga and Visser, 2016), other authors present more detailed explanations. Mallick and Rafi (2010), for example, focus on indigenous groups in Bangladesh and show that FHHs are not less food secure than MHHs. This is true even when considering informal redistributive mechanisms and fewer restrictions on women's access to labor markets within these groups. In Kenya and Malawi, Kennedy and Peters (1992) find that the interaction between income and gender matters most, as the proportion of income controlled by women is positively associated with a higher caloric intake. Levin et al. (1999) and Schmeer et al. (2015) also emphasize strong association between women's access to resources and better household food security in Ghana and Nicaragua, respectively. Interestingly, several experts have already highlighted the need for separate analysis and policies for FHHs and females/wives in MHHs:

> Beyond ensuring that female farmers have access to improved technologies, separate policies that are specifically aimed at female household heads vs. wives in MHHs might be needed to completely eliminate the gender gap in adoption of modern maize in Malawi. (Fisher and Kandiwa, 2014, 111)

Shying away from FHH/MHH dichotomy, a few researchers look at women's empowerment and gender gaps within dual-headed households. For example, Sraboni et al. (2014), using the Women's Empowerment in Agriculture Index (WEAI), conclude that increasing women's empowerment in agriculture is positively associated with better diets in Bangladeshi households. Moreover, a study by Malapit and Quisumbing (2015), also using WEAI, show the complexity of the relationship between different domains of women's empowerment and nutrition. In their study, women's empowerment is more strongly associated with the quality of infant and young child feeding practices and only weakly associated with child nutrition status. Women's empowerment in credit decisions is positively and significantly correlated with women's dietary diversity but not body mass index. Therefore, improved nutritional status is not necessarily correlated with empowerment across all domains, and these domains may have different impacts on nutrition in the context of Ghana.

Furthermore, many researchers have shown that women tend to be disadvantaged in these pathways since they have less access to land, labor, agricultural inputs, and extension services (see, for example, Staudt, 1978; Doss, 2001; Ragasa et al., 2013). Women also have less access to education, fewer employment opportunities, and limited decision-making power, but are considered responsible for feeding and care in the household, as well as many other agricultural tasks (Bezner-Kerr and Patel, 2015; Bezner Kerr et al., 2016). This gender inequality negatively affects the adoption of agricultural innovations, agricultural productivity, income generation, and food security (Chipande, 1987; Udry et al., 1995; Doss, 2001; Ibnouf, 2011; Meinzen-Dick et al., 2011; Kilic et al., 2013). In Malawi, less access to resources and services has exacerbated gender gaps in technology adoption and agricultural productivity (Fisher and Kandiwa, 2014), which ultimately contributes to food insecurity in the country (Riley, 1995; Takane, 2009; Kilic et al., 2013; Snapp and Fisher, 2015). For instance, previous studies have shown that extension services are mostly directed to male heads, who often do not work with female household members, and also tend to overlook the fact that women have "different roles, resources, constraints and responsibilities" (Riley, 1995, 31; Mudege et al., 2016).

Moreover, while most districts and ethnic groups in Malawi are classified as matrilineal (Berge et al., 2014), agricultural decisions, regardless of tenure systems, are predominantly a male domain (Andersson-Djurfeldt et al., 2018). As summarized by the members of the female focus group discussion in Andersson-Djurfeldt et al. (2018): "*The fact that it is a matrilineal system does not affect the power relations in the family. It is still the man who makes the decisions although he is farming his wife's land.*"

For certain crops, gender biases are much pronounced. The gendered segmentation of the tobacco market – a result of the considerable travel involved in reaching auction floors, as well as gender discriminating rules of membership in the tobacco marketing association – means that proceeds from tobacco sales were generally commanded by the husbands (Andersson-Djurfeldt et al., 2018). Participation in producers' or industry associations, organizations, and committees are generally less likely for women compared to men based on the IFPRI (2016) survey. In many communities, income raised by the male spouse was kept for both personal and family use, with women supplementing this income through engaging in *ganyu* (casual farm labor) to cover the food needs of the household during the lean season (Andersson-Djurfeldt et al., 2018). Moreover, habitual male alcohol consumption aggravates gendered patterns of income generation and control by shifting the burden of securing food through engaging in *ganyu* onto their wives (Andersson-Djurfeldt et al., 2018). In general, the joint use and control over income within DHHs was rare in many communities in Malawi, regardless of the tenure system and settlement patterns (Andersson-Djurfeldt et al., 2018).

Gender norms may also limit women's ability to access information and attend training sessions (for example, due to perceptions that women cannot understand) as well as their influence over the adoption of messaging and decisions about the use of agricultural produce (Mudege et al., 2016, 2017). This situation not only hinders nutrition and food security practice education, but also having a say in households' decisions around dietary and agricultural diversification choices. In Malawi, gender norms also affect the distinctive responsibilities of men and women in agricultural production and land management, which at the same time are conditioned by community cultures such as the presence of patriarchal or matriarchal societies (Mutenje et al., 2016). Other studies also point toward stereotypical gender roles affecting the type of training Malawian women are most likely to attend, since 'business' trainings are regarded as male while 'food processing, cooking' ones are designated for females (Mudege et al., 2017). Importantly, these gender norms affect all community members, including extension workers and Village Chiefs, which perpetuates women's limitations to access information about training and acquire new skills (Mudege et al., 2016, 2017).

Research suggests that addressing these gender differences improves food security. For instance, multiple studies link women's power over farmland, income, and resource allocation with higher spending on food, which positively affects child health and nutrition (Agarwal, 1994; Hoddinott and Haddad, 1995; Quisumbing, 2003; Duflo and Udry, 2004; Doss, 2006). Other work shows that by adapting extension services to women's needs, through, for example the hiring of more female workers, these services increase production and can be equally useful to men and women (Alene et al., 2008). Various reviews of agricultural interventions (e.g., homestead gardening, livestock distribution, land rights) also conclude that, despite methodological limitations, programs that include gender considerations, empower women, make nutrition a key element, and target behavior change are better at accomplishing nutritional outcomes (e.g., Leroy and Frongillo, 2007; Arimond et al., 2011; Girard et al., 2012; Pandey et al., 2016). However, several studies and reviews of development projects show mixed results of explicit gender targeting in terms of improving women's decision-making power (see Johnson et al., 2017; Handa et al., 2009; Andersson-Djurfeldt et al., 2018). Cash transfers can improve incomes and nutrition but have limited impact on women's decision-making power and spending behavior changes (Handa et al., 2009). Land reform can improve women's land rights and agricultural investments (Santos et al., 2014) but not enough to empower women and address food insecurity problems (Andersson-Djurfeldt et al., 2018). Development projects involving provision of good and services, extension services, and strengthening organizations can potentially improve incomes, but greater attention would be needed to address gender norms through awareness campaigns and community discussions involving both women and men (Johnson et al., 2017).

In this paper, we measure and compare HFS status per gendered typology of households, examine the determinants of HFS per typology, and highlight the role of gender gaps in HFS in dual-headed households as well as the role of education and access to information in sole female adult and sole male adult households. We highlight the role of joint access to information and joint participation in community processes and organizations by women and men within the household as pathways for greater food security and a potential empowerment tool to challenge existing gender norms.

3. Methodology

3.1. Q-squared approach

The data sources used for this study include household and community surveys and focus group discussions. We followed a Q-squared research approach in which qualitative and quantitative rounds are undertaken separately but timed to create a process of “sequential mixing” (Grbich, 2012; Kanbur, 2003). This allows for the qualitative and quantitative research approaches to address the requirements of their respective traditions, while still learning and adapting from each other. Specifically, the open questions that arose from the quantitative analysis were more deeply explored through the qualitative analysis process.

The quantitative data consisted of household and community surveys conducted by the International Food Policy Research Institute (IFPRI) between August and October 2016, with the assistance of Wadonda Consult. The community survey covers 299 randomly selected communities in each district, excluding Likoma (see Ragasa and Niu, 2017 for details). Within these 299 sample communities, a total of 3001 households were randomly selected. This sample size enables analysis and statistical inference concerning Malawi's farming population with a margin of error of less than 3% at a 95% confidence level. This sample size is nationally representative and above the minimum sample size estimated using power calculations based on per capita expenditure and receipt of agricultural advice as the outcome variables.

Within each sample household, the primary female and male adults (which is often the husband and wife) were interviewed separately for key modules of the survey including that of access to information, participation in formal and informal groups and networks, and technology awareness and adoption. In total, 5069 female and male primary adults were included in the dataset. This enables intrahousehold analysis, particularly looking at women's empowerment and gender gaps in these dimensions within dual-headed households (DHHs).

The sample households were also asked to list all their plots. Therefore, the same household dataset also contains detailed information on 6282 plots, of which 43% are jointly managed by females and males, 22% are managed solely by females, and 34% are managed solely by males. Maize is the dominant crop, planted in 67% of plots, either alone or intercropped. Maize occupies 61% of total crop acreage, followed by beans (12%), groundnuts (9%), and tobacco (5%). This plot-level dataset allows for detailed analysis of agricultural practices and production in relation to the gender of the plot manager and gender composition of the farm labor.

In addition, 22 gender-disaggregated focus group discussions were undertaken, with a total of 113 male and 141 female respondents, sampled from 11 communities in eight districts from the same geographic areas as the household and community surveys. The locations of these focus group discussions are illustrated in Fig. 3.1. The eight districts were sampled purposively using a maximum variation approach to capture different agroeconomic and social characteristics, such as soil type, main crops produced, and dominant tribal affiliation. Two communities from each of these districts were randomly sampled from the survey population, one very remote and one more central, as we hypothesized that quality and frequency of service delivery might differ according to remoteness. Adults from households (6–8 per community) were purposively sampled based on different headship and wealth characteristics. However, fewer men were willing to participate, decreasing somewhat the number and variation of the sample of men.

Focus group discussions were completed in January–February 2017 and were led by local enumerators fluent in the local Chichewa, Chibandya, and Chinyika languages. Enumerators were experienced in qualitative data collection and were asked to encourage the active participation of all and the articulation of differing viewpoints among participants. Discussions were recorded, transcribed, and translated and then thematically coded using NVivo 11. The focus group discussions included modules on gendered access to extension and training on agriculture, markets, and nutrition; information sharing among household members; and gendered barriers to the application of extension information.

3.2. Quantitative analysis

The indicators used in the quantitative analysis are defined in Table A1.

3.2.1. Food security

We use several food security indicators. First, the household dietary diversity score (HDDS) is applied, which is a count of food groups that household members have consumed over a 24-h or seven-day reference period, following the approach documented by Swindale and Bilinsky (2006). Past studies show that a higher HDDS is associated with higher per capita consumption of calories from both staples and non-staples (Hoddinott and Yohannes, 2002). Second, the food consumption score (FCS) is used which calculates the frequency of consumption of different food groups by a household during a seven-day reference period, using weights assigned to each food group by nutritional value, adapted from the World Food Programme (WFP, 2008). Results of HDDS and FCS are similar, so we reported only one in this paper. Third, the household food insecurity access score (HFIAS) captures the experience of food insecurity, calculated following the questions adopted by Coates et al. (2007) reflecting the food insecurity of members of the household.

Fig. 3.1. Map of Malawi and the locations of the focus group discussions and districts covered in the household and community surveys used in this paper. *Source*: IFPRI (2016) surveys, which cover all districts (except Likoma), and 22 focus group discussions conducted by IFPRI in January–February 2017 in 11 communities in eight districts, as marked above. The areas shaded blue are bodies of water

3.2.2. Value of crop production and productivity

We measure (1) the value of production of all cropland as a proxy for food access from own production and agricultural income of the household; and (2) the value of yield per hectare of various crops to measure land productivity (in Malawi Kwacha, MWK). We used farm-gate or market price for the production at the household or village level (whichever is available in the datasets). For productivity, the value of production is used instead of quantity of harvest because most of the plots were intercropped, making area estimates for each crop difficult to calculate. Crop production and productivity measures pertain to the rainy season cropping and include only field or annual crops – excluding that of cassava and trees which are difficult to measure and quantify. Because of this, we only include cassava and fruit trees harvests as dummy variables in our models. Similarly, dry season gardens are relatively smaller plots and the multiple harvests and products from vegetable gardens are challenging to measure. Thus, we included them as dummy variables in the model. Livestock and aquaculture production are also included as dummy variables in the models.

3.2.3. Access to extension and advisory services

Access to agricultural extension and advisory services is measured here as a dummy variable corresponding to the question, "Did you or anyone in your household receive any advice on agricultural production or marketing or nutrition?" The question is asked pertaining to both the last 12 months and the last two years. The sources and the types of topics addressed by the extension services received (agricultural production, marketing, postharvest handling, and nutrition) are included in the datasets, and we use them for disaggregated analysis and measuring heterogeneous effects.

3.2.4. Gender gaps

The dataset collected by IFPRI (2016) included basic characteristics of all adults in the household (female and male), all plots cultivated with field crops by households and the corresponding plot managers or decision makers, and data on access to knowledge, participation in community process, and technology adoption by the main female and male adult with the household. As mentioned previously, the household dataset covers 5065 individual respondents (54% female, 46% male) from interviews with the main female and male adults in the 3001 sample households (if applicable and available). Following the different pathways in Fig. 2.1, we computed the difference between female and male adults within the household in terms of access to extension service, technology awareness and adoption, nutrition information, participation in community processes, education, and land access. Our indicators are categorical variables representing no gap (both female and male receives, adopts, or participates), and the presence of a gender gap in either direction (solely male or solely female). Table A2 describes the various indicators used for gender gaps.

To describe HFS status per gendered household typology, we used descriptive analysis, including simple mean comparison tests, and multivariate regression analysis. The latter uses simple ordinary-least-squares (OLS) method, which aims to establish correlations and not causal impacts of variables of interest with HFS. To compare determinants of HFS across gendered household typology, we again used simple OLS models, disaggregated by typology. Within DHHs, we particularly investigate the relationship of gender gaps in access to resources, land, education, and extension services. To further investigate the role of information access in HFS, we used an instrumental variable (IV) approach to address the possible endogeneity of information access in the HFS model. The instruments for receipt of agricultural, market, or nutrition advice are the presence of an extension agent living in the community, number of extension agents and lead farmers working in the community, and frequency of using radio or cellphone (descriptive statistics are in Table A1). These variables are highly significant determinants of receipt of information (first-stage model), but do not significantly and directly affect HFS, beyond the effect of information access (second-stage model). These instruments pass the validity and strength test of an instrument within the IV method. Moreover, we used community and district fixed effects to account for heterogeneity at those levels.

3.3. Textual analysis

The qualitative data examine behaviors and preferences related to accessing extension and advisory services for agriculture, marketing, and nutrition. Specifically, women and men were asked, in separate interviews, to discuss who usually attends training and meetings or receives information on these topics (women, men, or both). In addition, the sharing of information was discussed, as well as differences in the application of the information depending on who attended the training or meeting. An *a priori* coding schema on gendered participation in meetings and receipt of information was derived from early analysis of the quantitative data. Interviews were systematically coded against this schema using NVivo 10, then coded data were compiled into a framework matrix to elucidate patterns of responses across interviews and empirically-driven sub-codes.

3.4. Limitations of the study

As recognized by many studies before this (see Riley and Dodson, 2016), we are only able to scratch the surface of the complexity of gender relations and food insecurity in Malawi. We were not able to explore the interaction of kinship and gender relations. We were also not able to empirically test the links between women's time use and household food security. We are not able to describe food security among all members in the household. And lastly, the statistical associations established in the paper are correlations, rather than causal impacts, of various pathways from agriculture to food security.

Nonetheless, we adopted a gendered household typology and their interactions with other dimensions of food security, including age, wealth, and income indicators. Moreover, we examined, with rigor and confidence, the effect of information (about agriculture, markets, and nutrition) on food security using both quantitative and qualitative approaches. We show a consistently significant effect of joint access to information by women and men, compared to no access or access by only one gender. Furthermore, we contribute nationally-representative data to describe HFS levels and how they differ by gendered household types and other socioeconomic indicators. While purely numeric scores, like the WEAI index, are useful, others question whether a concept as intangible and unquantifiable as empowerment can be adequately captured by such a quantitative instrument (Akter et al., 2017). Although these numerical scores can be used to estimate the impact of empowerment on welfare outcomes, such a quantitative analysis would not be effective in identifying the factors that lead to such differences in women's empowerment across different societies (Akter et al., 2017). We attempted to address these limitations in this paper by first, presenting a general picture of HFS using numerical scores, and second, showing the statistical significance of various determinants and specifically focusing on a key determinant – the role of information - to further investigate using qualitative methods.

4. Discussion of results

4.1. Food security status by gendered household types

Table 4.1 shows the food security status by gendered household types. We find that SFHHs (commonly known in the literature as *de jure* FHHs) have the lowest food security status as measured by HDDS, FCS, and HFIAS compared to other household types on average (Table 4.1). SMHHs have statistically lower HDDS than DHHs in mean comparison tests (Table 4.1). After controlling for observable characteristics, including farm and nonfarm income, wealth indicators, and other household and community characteristics (Table 4.2), we find somewhat muted results for the difference in HFS between FHHs and MHHs, which is heavily emphasized in the literature. SFHHs have the lowest HFIAS but do not have statistically different HDDS than other household types, after controlling for various socioeconomic characteristics in regressions models (Table 4.2). SMHHs have the lowest HDDS among household types, after controlling for various socioeconomic characteristics in regressions models in Table 4.2.

On average, SFHHs are the poorest, have less crop area, with the lowest educational attainment, and are the oldest among the household types (Table 4.1). Assets and crop land holdings of the household are strong correlates of HFS (Table 4.2). Education level of the household

Table 4.1
Descriptive statistics of HFS indicators and key socioeconomic indicators, by gendered household type.
Source: IFPRI (2016) survey. USD 1 = MWK 720 (average in 2016).

Indicators	Dual-headed household (DHH)	Female-adult only (SFHH)	Male-adult only (SMHH)
HDDS [/a]	5.134 (116.51)	4.446*** (51.85)	4.963** (25.58)
HFIAS	9.260 (59.39)	12.141*** (34.56)	10.096 (14.68)
Asset Value (MWK)	58,274.208 (11.63)	12,776.583*** (6.81)	42,329.176*** (2.86)
Crop land area (hectares)	2.681 (59.26)	1.745*** (28.76)	2.109*** (9.61)
Household size	5.578 (112.26)	4.195*** (48.93)	2.297*** (18.11)
Highest grade level of education head attained	6.388 (82.17)	4.020*** (25.71)	6.342 (17.16)
Age of head	42.118 (51.21)	46.795* (61.26)	36.422*** (21.36)

Note: Figures are the averages (means), and standard errors are in parentheses. ***, **, * Significantly different from DHHs at 1%, 5%, and 10% level, respectively. [/a] Similar patterns as FCS.

head is highly correlated with HFS. Bigger household size is associated with higher food insecurity (HFIAS). These are additional factors accentuating low levels of HFS among SFHHs. A particular constraint for SFHHs is the available labor for agricultural production. With no male adult in the household, and limited resources to hire *ganyu* (casual labor), SFHHs are particularly constrained in this aspect. Based on IFPRI (2016), SFHHs are less likely to hire labor than other household types. Average hired labor by SFHHs during the main cropping season in 2016 was 6 person-days, compared to 11 person-days by SMHHs and 16 person-days by DHHs (IFPRI, 2016).

On the other hand, SMHHs are the smallest in household size and the youngest among the household types, on average. Among SMHHs, 38% of men have never been married, 40% are separated or divorced, and 22% are widowers (Table 4.1). Within dual-headed households (DHHs), polygamous households are more likely to be food insecure (higher HFIAS) than monogamous households (Table 4.2). Religion does not seem to statistically affect HFS, after controlling for various other factors (Table 4.2).

We also investigate the interactions between gendered types and wealth and age (Table 4.2). Age of the head does not seem to be a significant factor. However, the interaction of wealth and gendered types seem to tell a more nuanced picture. For DHHs, HFS indicators seem to be significantly different for the bottom quintile (poorest group) than the rest. For SMHHs, HFS indicators are similar among bottom 80%, which are similar to the bottom 20% in DHHs, and are significantly different from the top quintile in SMHHs. For SFHHs, HFS indicators of the bottom 40% are similar, and are statistically different from the top 60%. This indicates the relationship of gender types and HFS is mediated by asset levels, and vice versa, the relationship of assets and HFS can be different across gender types. The results in Table 4.2 show that SFHHs are not always the poorest. This implies that targeting for interventions and support to improve food security should pay close attention to poverty or asset indicators, but at the same time the cut-off or threshold for who is poor and vulnerable may be different across different household types.

4.2. Consumption of food groups by gendered household types

Table 4.3 shows consumption across food groups for different

Table 4.2
Socioeconomics correlates of household food security.
Source: IFPRI (2016) survey. District fixed effects were used in these models. USD 1 = MWK 720 (average in 2016).

	HDDS				HFIAS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gendered household type /a								
HH has only male adults,	− 0.426**				0.307			
compared to DHHs	(0.187)				(0.659)			
HH has only female adults	− 0.148				1.697***			
compared to DHHs	(0.104)				(0.357)			
Age	− 0.001	− 0.001	− 0.001		− 0.003	− 0.004	− 0.000	
	(0.001)	(0.001)	(0.001)		(0.003)	(0.003)	(0.003)	
Asset value (MWK)	0.000**	0.000*		0.000**	− 0.000***	− 0.000***		− 0.000***
	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)		(0.000)
Crop land area (hectare)	0.091***	0.097***	0.046**	0.096***	− 0.437***	− 0.471***	− 0.256***	− 0.451***
	(0.020)	(0.023)	(0.020)	(0.021)	(0.070)	(0.075)	(0.068)	(0.071)
Highest grade level of Education	0.124***	0.112***	0.102***	0.122***	− 0.444***	− 0.397***	− 0.338***	− 0.438***
	(0.011)	(0.012)	(0.011)	(0.011)	(0.037)	(0.041)	(0.036)	(0.038)
Household size	− 0.013	− 0.019	− 0.022	− 0.007	0.212***	0.183***	0.269***	0.195***
	(0.017)	(0.019)	(0.017)	(0.019)	(0.059)	(0.064)	(0.058)	(0.064)
Religion (control = no religion) /a								
Roman Catholic	− 0.098	− 0.210	− 0.049	− 0.084	− 0.036	− 0.122	− 0.370	0.068
	(0.236)	(0.270)	(0.233)	(0.236)	(0.817)	(0.895)	(0.790)	(0.815)
Protestant (= 1)	− 0.057	− 0.204	− 0.021	− 0.048	− 0.212	− 0.401	− 0.525	− 0.096
	(0.222)	(0.254)	(0.219)	(0.222)	(0.769)	(0.843)	(0.744)	(0.767)
Muslim (= 1)	0.122	0.024	0.145	0.123	− 0.164	− 0.064	− 0.442	− 0.039
	(0.262)	(0.299)	(0.259)	(0.262)	(0.905)	(0.993)	(0.875)	(0.903)
Others (= 1)	− 0.472	− 0.689	− 0.392	− 0.441	− 0.434	− 2.330	− 1.146	− 0.351
	(0.453)	(0.565)	(0.447)	(0.453)	(1.602)	(1.967)	(1.549)	(1.604)
Polygamous DHHs (= 1)		− 0.119				1.353**		
		(0.181)				(0.598)		
Gendered type-age cohort (control = Youth head in DHH) /a								
Non-youth in DHH				− 0.109				0.209
				(0.097)				(0.335)
Youth head in SMHH				− 0.349				0.046
				(0.225)				(0.801)
Non-youth head in SMHH				− 0.683**				1.046
				(0.314)				(1.095)
Youth head in SFHH				− 0.181				2.122***
				(0.169)				(0.577)
Non-youth head in SFHH				− 0.219				1.611***
				(0.134)				(0.459)
Gendered type-asset cohort (control = Poorest quintile DHH) /a								
Second poorest DHH			0.143				− 1.114**	
			(0.151)				(0.508)	
Third poorest DHH			0.396***				− 2.691***	
			(0.128)				(0.433)	
Second richest quintile DHH			0.640***				− 3.794***	
			(0.127)				(0.428)	
Richest quintile DHH			1.060***				− 5.753***	
			(0.131)				(0.442)	
Poorest SMHH			− 0.190				− 1.305	
			(0.289)				(0.991)	
Second poorest SMHH			− 0.072				0.540	
			(0.494)				(1.653)	
Third poorest SMHH			− 0.751*				− 2.135	
			(0.428)				(1.567)	
Second richest quintile SMHH			0.028				− 4.866***	
			(0.429)				(1.494)	
Richest quintile SMHH			1.603***				− 4.505***	
			(0.487)				(1.675)	
Poorest SFHH			0.021				0.613	
			(0.141)				(0.472)	
Second poorest SFHH			0.297				0.905	
			(0.343)				(1.149)	
Third poorest SFHH			0.500*				− 3.076***	
			(0.275)				(0.920)	
Second richest quintile SFHH			1.121***				− 4.620***	
			(0.381)				(1.273)	
Richest quintile SFHH			1.006***				− 6.141***	
			(0.350)				(1.169)	
Constant	4.048***	4.259***	3.865***	4.032***	12.596***	12.529***	14.033***	12.338***
	(0.246)	(0.277)	(0.251)	(0.240)	(0.849)	(0.917)	(0.850)	(0.830)

(*continued on next page*)

Table 4.2 (*continued*)

	HDDS				HFIAS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Observations	2948	2304	2948	2949	2893	2259	2893	2894
R^2	0.096	0.088	0.126	0.096	0.132	0.116	0.194	0.132
Adjusted R^2	0.072	0.069	0.119	0.072	0.118	0.107	0.178	0.118

Note: Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; (= 1) represents dummy variables and coefficients represent discrete change of dummy variable from 0 to 1; /[a] Categorical variables or cohorts represent the differential effect of the particular cohort compared to the control.

Table 4.3
Difference in consumption of food groups by gendered household types.
Source: IFPRI (2016) survey.

Food groups	Total	Dual-headed households (DHH)	Households with sole female adults (SFHH)	Households with sole male adults (SMHH)
Whether household members consumed the food group in the last 24 h (figures are the proportion of those households consuming)				
Grains and cereals	0.96	0.96	0.97	0.90
Root, tubers	0.37	0.39	0.29	0.30
Legumes and nuts	0.43	0.45	0.39	0.31
Vegetables	0.85	0.85	0.85	0.72
Meat, fish, egg	0.49	0.51	0.37	0.45
Fruits	0.21	0.22	0.17	0.20
Milk and milk products	0.11	0.11	0.07	0.19
Fats and oil	0.43	0.45	0.34	0.45
Sugar	0.34	0.35	0.29	0.37
Spices	0.63	0.63	0.65	0.61
Count of days in a week when household members consumed the particular food group (figures are the average number of days per week, 0–7)				
Grains and cereals	6.33	6.36	6.31	5.88
Root, tubers	1.38	1.48	0.99	1.04
Legumes and nuts	1.28	1.34	1.10	0.85
Vegetables	4.68	4.71	4.72	3.79
Meat, fish, egg	1.51	1.59	1.06	1.82
Fruits	0.84	0.89	0.67	0.66
Milk and milk products	0.48	0.48	0.34	0.96
Fats and oil	2.21	2.33	1.58	2.43
Sugar	1.78	1.83	1.46	2.05
Spices	4.35	4.34	4.40	4.16

household types. One challenge to attaining diverse diets for Malawians is the strong preference for maize *nsima*, a dish made mostly of maize flour (see Table 4.3, in which the grains and cereals category is mostly maize *nsima*). We find that, regardless of the household type, there is very low consumption of milk products and fruits but a very high consumption of grains and cereals. Only 11% of households consume milk or milk products daily, and the average frequency of consumption is about once every two or three weeks. Even for non-maize staple crops such as roots, tubers, legumes, and nuts, only 37–43% of households are consuming these daily – instead consuming only once every week or two on average. Vegetable consumption is generally high across all household types.

Across household types, SMHHs consume less grains, cereals, legumes, nuts, and vegetables than other households on average. However, SFHHs consume less meat, milk products, fats and oil, and sugar than other households. On the other hand, SMHHs consume more of these than other households. Both SMHHs and SFHHs consume less roots, tubers, fruits, legumes and nuts than DHHs on average. These figures generally support the common understanding that SFHHs are typically less food secure than DHHs, but the results also suggest that SMHHs are less food secure in other measures and should not be excluded from nutrition-related knowledge campaigns. It illuminates the need for men to also receive nutrition information, especially those in SMHHs, even though gender norms may limit their willingness to engage in the topic, as described in Bezner Kerr et al. (2016) and Riley and Dodson (2016). Gender norms in Malawi generally still largely equate cooking, taking care of the children, and household chores as women's responsibility and income-earning activities as men's responsibility (Bezner Kerr et al., 2016; Riley and Dodson, 2016).

4.3. Determinants of household food security by gender household types

Table 4.4 shows the determinants of HFS by gendered household type, closely following the different pathways in Fig. 2.1. For DHHs, measures of gender gaps or gender parity are statistically associated with HFS. Those in which both female and male adults within the household receive nutrition education have the highest HFS. These results align with studies that emphasize the importance of nutrition education (Arimond et al., 2011; Girard et al., 2012; Bezner Kerr et al., 2016). Moreover, receipt of agricultural and market information for both male and female adults is also associated with higher HFS. This is consistent with studies highlighting the importance of joint participation of male and female household members in trainings and other extension modalities, such as in Lambrecht et al. (2014).

Still within DHHs, gendered plot management seems to matter both directly, through consumption of own production (Table A3), and indirectly, as an asset useful for food purchase and risk management (Table 4.4). Within DHHs, greater acreage jointly managed by women and men is associated with greater HFS. Our data show that regardless of the crop, roughly 43–49% of plots are jointly managed, and 22–33% are managed by women or men only. The proportion of plots managed solely by women is not very different from that of plots managed solely by men, with a slightly greater proportion of female-only managers for vegetables and a greater proportion of male-only managers for tobacco. This result contributes to our understanding of gendered division of labor and notions of gendered crops; supporting past studies that find more nuanced division of crops and responsibilities between males and females in a household (Doss, 2001; Aberman and Roopnaraine, 2015). Our results show complex patterns of gendered management and division of labor in farming. We find no clear evidence of men's crops versus women's crops, and that most farms in Malawi are jointly managed and attended to by female and male members of households based on the IFPRI (2016) survey. Joint management by women and men is associated with greater HFS than separately-managed plots. This may be related to joint ideas and efforts towards plot productivity.

Education level of the household head is a significant predictor of HFS. Within DHHs, closing the gender gap in education (that is, female adults having an education level that is closer to that of their husbands or male adults) within the household is associated with greater HFS (Table 4.4). This may be due to the effect education level has on comprehension of extension messages and due to effects of education on women's empowerment and income generation activities.

For SFHHs, production of annual field crops during the main cropping season is correlated with higher HFS. As well, more land cultivated is associated with greater crop production and improved HFS (Table 4.4) during the main season (Table A3). This is in contrast to DHHs, in which diversification to fruits and cassava were the more important determinants of HFS.

For SMHHs, the strongest associations with HFS is whether nutrition information was provided and the formal education level of the head.

Table 4.4
Estimation results on determinants of household dietary diversity score (HDDS), disaggregated by gendered household types.
Source: IFPRI (2016) surveys.

Indicators	(1) Dual-headed households (DHH)	(2) HHs with sole female adults (SFHH)	(3) HHs with sole male adults (SMHH)
Gender gaps [/a]			
Both female and male receive nutrition advice, compared to no advice	0.544*** (0.130)		
Only male receives nutrition advice, compared to no advice	0.398*** (0.135)		
Only female receives nutrition advice, compared to no advice	0.062 (0.145)		
Both female and male receive market access advice, compared to no advice	0.877*** (0.233)		
Only male receives market access advice, compared to no advice	0.310** (0.135)		
Only female receives market access advice, compared to no advice	0.543*** (0.207)		
% of acreage jointly managed by female and male	0.004*** (0.001)		
% of acreage managed solely by female	− 0.001 (0.003)		
Gender gap in education (male – female)	− 0.085*** (0.015)		
Own production and agriculture income			
Value of annual crop production (MWK 000) during rainy season [/b]	0.000 (0.000)	0.003*** (0.001)	0.002 (0.001)
Cultivated during dry season (= 1)	0.328*** (0.096)	0.315* (0.186)	− 0.338 (0.579)
Simpson index of diversification [/c]	0.088 (0.178)	− 0.565* (0.296)	
% of fruits harvested and consumed by household	0.004** (0.002)	0.006** (0.003)	
% of fruits harvested sold	0.003 (0.004)	0.004 (0.008)	
% of cassava harvested and consumed by household	0.003 (0.002)	0.003 (0.005)	
% of cassava harvested sold	0.008** (0.003)	0.033*** (0.011)	
% of harvests sold (weighted by crop acre)	0.005 (0.003)	0.013* (0.007)	− 0.009 (0.019)
% of loss or wastage during postharvest	− 0.012*** (0.003)	− 0.013** (0.006)	
Nonfarm income and assets			
Number of goats, sheep, and pigs owned	0.014 (0.013)	0.010 (0.048)	
Number of cattle and oxen owned	− 0.008 (0.029)	0.005 (0.174)	
Number of poultry owned	0.014*** (0.005)	0.037** (0.015)	
Off-farm is main income of household	0.426*** (0.100)	0.373** (0.184)	0.163 (0.582)
Value of 11 asset types owned by HH in 2015 [/d]	0.544*** (0.177)	0.794 (3.175)	0.256 (2.300)
Nutrition information			
Received nutrition advice (= 1) [/e]		0.334* (0.187)	1.366** (0.576)
Household characteristics			
Household size	− 0.017 (0.022)	− 0.010 (0.045)	− 0.256 (0.176)
Age of head	− 0.000 (0.004)	− 0.004 (0.006)	− 0.003 (0.015)
Highest grade level of education attained by head	0.129*** (0.017)	0.109 (0.075)	0.095*** (0.029)
District fixed effects [/f]	YES	YES	YES
Constant	3.249*** (0.234)	3.578*** (0.449)	3.508*** (1.053)
Observations	1938	444	120
R^2	0.158	0.261	0.173
Adjusted R^2	0.133	0.173	0.085

Note: Standard errors in parentheses; (= 1) represents dummy variables and coefficients represent discrete change of dummy variable from 0 to 1; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [/a] Several other gender gaps indicators were used but are not significant, so they are not included here to save on space; [/b] USD 1 = MWK 720 (average in 2016). We also used landholdings or cropland area in place of production, which yielded similar results. We could not use both simultaneously in the estimation models due to their high correlation. [/c] SID = Simpson index of diversification = where p = share of land allocated to crop i. [/d] We also used the 2010 figures to address possible simultaneity, but results are similar. [/e] We instrumented for the receipt of nutrition advice to account for unobserved heterogeneity. [/f] We also used community fixed effects and the results are similar, although the adjusted R-squared becomes low.

The IFPRI (2016) survey shows that SMHHs have the lowest access to nutrition advice and therefore are least likely to be aware of messages such as the need to consume six food groups daily. Low access to nutrition education, and high food insecurity as described above, is likely due to the strong social imperative that women be responsible for food preparation, so men are not usually trained in these activities. Furthermore, divorce or separation and remarriage is common in Malawi (as described in Schatz, 2005), suggesting that improved nutrition knowledge for these men in SMHHs may also benefit a potential future family.

Across household types, our results also emphasize the critical importance of assets (especially livestock units and particularly poultry) and other sources of food or income (dry-season farming, harvesting tree crops and cassava, and nonfarm income), both to directly purchase food and to increase own production (Table 4.4 and Table A3).

There is some evidence in the literature that commercialization of production (percent of field crop harvest sold) is a significant predictor of HFS (Kennedy, 1994; Mazunda et al., 2015). This is especially important for SFHHs (Table 4.4). There are also indications of postharvest losses affecting HFS for both SFHHs and DHHs (Table 4.4), in line with earlier studies (see FAO, 2013; Gustavsson et al., 2011; HLPE, 2014; Chaboud and Daviron, 2017). However, we did not find evidence of a positive association between field crop diversification and HFS, in contrast to other studies (see Jones et al., 2014; Mazunda et al., 2015). However, we do find evidence of other types of agricultural diversification (for example, from maize farming to planting cassava and fruit trees and harvesting fruits and cassava), either for own consumption or for sale, to be significant correlates of HFS (Table 4.4).

We also find a positive association between participation in agricultural and development committees and production (Table A3), although not directly on HFS (Table 4.4) (in contrast to Sraboni et al., 2014). Similar to the training and meetings discussed above, participation in agricultural and development committees, by both women and men within the household, is associated with higher HFS.

Access to agricultural information is a predictor of own production (Table A3), which in turn influences HFS. Access to market information, in addition to production advice, is associated with higher production and HFS (Tables 4.4 and A3). Based on these results, the combination of agriculture, market, and nutrition information provision to rural producers is a significant driver for HFS.

4.4. Explaining the role of joint access to information in HFS

We further examine the information pathway and reasons for its importance through insights from the focus group discussions. The qualitative results yield a typology of gendered approaches to extension services and other human capacity strengthening activities in the household and the community. The first approach divides capacity-strengthening activities such that only women attend nutrition-focused training and meetings and only men attend agriculture and marketing training and meetings. This approach was commonly followed in remote communities. The second approach emphasizes attendance for men and women across all categories of training and meetings. In the third approach, women more frequently attended agricultural or nutrition training and meetings than men, even in the case of dual-headed households. This third approach was the most common across respondents. However, rather than being viewed as an empowering opportunity to participate in more trainings than their husbands or other men in the community, it was described as a burden placed on them by busy or disinterested husbands. This reflects the tendency to place a heavy activity burden on women's time through extra responsibilities in productive, reproductive, and community realms (Blackden and Wodon, 2006; World Bank et al., 2009). Furthermore, it contrasts somewhat with the view that participation in meetings or trainings is inherently empowering for women or an indicator of their empowerment.

Common understandings of gendered roles and responsibilities reflected in the literature describe food security and nutrition as the women's realm. As Bezner Kerr et al. (2016) explain, in Malawi, childcare and knowledge of appropriate child feeding practices is not considered a male activity and participating in this realm of activities conflicts with the dominant concepts of masculinity; potentially bringing criticism from other community members. This gendered division of responsibilities was reflected in the first approach, wherein women were described as responsible for caring for the home and kitchen while men were described as "directors of agriculture" and income generation.

In communities where women participated more than men across all realms, which was the most common result, women and men both explained that men were disinterested or too prideful to participate. Sometimes men explained that they were busy doing piecework or fishing, which made it impossible for them to participate in training. Men often explained they were busier than women, so they sent their wives to participate. The presence of groups, projects, or cooperatives was frequently described as a reason why men and women would both attend a training session. This could be due to the projects' insistence on having both household members present, but further research to confirm this connection would be necessary. The quotes below illustrate the frequent depiction from respondents that women were tasked with participation in trainings, either because men were busy with productive activities and earning income or because men were negligent, which was a common explanation given by women, but also by men in some instances:

> Female respondent: "Men are not always around home; they are even somewhere playing Bawo [board game], or having a drink. Whilst women we are mostly at the house, so any message that wants a family representation, women find themselves there, and men just hear the end results."

> Male respondent: *"In most meetings it is the women that dominate because for us men we go to look for money to buy food for the house."*

There were some exceptions to the approaches to participation described above. Even in the communities wherein women were responsible for attending most meetings and trainings, men were still said to have higher access to market information. And even when respondents described joint participation in most meetings, nutrition sessions were still primarily attended by women, which aligns with the social expectation that nutrition is a women's topic and responsibility, as described above.

We also explored the patterns of information sharing within the household when only one household member attended. While it was common to share information, a number of constraints were mentioned, both to sharing and to applying the information learned. Women reported having to approach information sharing cautiously so as not to hurt the pride of their husbands, or to avoid times when they had been drinking, so as to avoid angering them. This result reflects both gendered power imbalances and the risks women take to expand their role in household decision making and the subtle circumventive approaches employed to do so (Aberman et al., 2018; Gates, 2002; Schatz, 2005). The following quotes illustrate challenges to sharing information in the household, including the potential for domestic violence towards women:

> Female respondent: "We just need to find a good time to tell the husband, and see his mood at the time before telling them what we want to say. Otherwise they will beat you."

> Male respondent: "When the males learn separate, the female will oppose because they have not heard, and also when the female learn in absence of a male, the males will also argue because they were not taught together."

This demonstrates how women adopt different strategies to circumvent their limited agency and work to avoid risk of domestic violence. Previous studies have also emphasized the importance of women's agency in adopting different tactics in response to, for example, HIV/AIDS in Malawi (Schatz, 2005), climate change and land inequalities in Ghana (Nyantakyi-Frimpong and Bezner-Kerr, 2015), and domestic violence in Bangladesh (Lentz, 2018).

Men sometimes questioned the ability of their wives to comprehend training messages and noted that their wives, at times, resisted new approaches the men learned without them. The following quote illustrates the barriers to accepting the shared messages when men question women's understanding of the messages they learn:

> Male respondent: *"I might think she is lying [incorrect] and the extension agent can explain better, and because she did not ask, the extension worker did not explain."*

A number of respondents described the potential benefits of learning together. In addition to ensuring that the family retained the information, frequently, they described a need for the household to learn together to support a unified vision for the development of the household moving forward. This idea is illustrated in the quote below:

> Female respondent: "[If we learn together] there won't be any tricks towards each other. If you have agreed on what to grow, let's say peas, then come the time of selling, everyone will have the sense of ownership and with equal contribution we can all make sure that the money is [going] towards improving the household, because the woman's money is mostly used on the household. But such things can only happen if we would have more of these kinds of meeting that would see both men and women together and learn as a family."

This finding also resonates with the results of Bezner Kerr et al. (2016) who show that joint participation in nutrition trainings increased not only men's sense of responsibility on the topic, but also women's control and decision-making power over food resources within the household. The mere act of joint participation may already be a product of bargaining within the household and a reflection of co-operation and joint decision-making.

5. Conclusions

This study compares HFS status across gendered household types, explaining determinants of HFS by gendered household types. It further assesses gendered access to and application of different types of extension services and provision of information, and the subsequent effects on HFS for women and men jointly or separately. Results align with earlier findings that education, assets, various supplementary livelihoods approaches, and access to information are all significant correlates of HFS. In addition, we find that the type of information provided matters for HFS, and patterns of gendered participation in trainings and capacity-strengthening processes have implications for women's time-use and the application of the information in the household. By expanding the gendered household typology beyond the simple female-headed/male-headed dichotomy, a more nuanced analysis and interpretation of gender and HFS emerged.

A number of factors were found to be correlated with HFS. Education, assets, and livestock units, in particular, are important. In addition, other sources of food or income, such as dry-season farming, planting trees and harvesting fruits, planting root crops, and nonfarm income are all associated with better HFS. Reductions in postharvest losses are particularly significant determinants of improved HFS.

With respect to gendered household types, this paper analyzed the distinct food security situation for various household types, differentiating those with (1) both male and female adults or dual-headed households, (2) sole male adults, and (3) sole female adults. Our analysis indicates that, contrary to widespread belief, female-headed households are not always the poorest and most food insecure. We find a more nuanced story, wherein households with a sole male adult are worse off in terms of their HDDS, while those with a sole female adult (or those commonly called *de jure* FHHs in the literature) are worse off in terms of their experience of food insecurity (HFIAS). This highlights the problem with targeting nutrition messaging to only women, as is commonly done, and leaving out sole male adult households.

For households with sole male adults, formal education and literacy levels and nutrition education appear to lead to improved food security. For households with sole female adults, landholdings, livestock units (especially poultry), having other assets, planting tree and root crops, and nutrition-related information seem to be the most important drivers of food security.

Access to information and training is found to be correlated with food security, and the information type or content also matters. For instance, training on nutrition and market access is consistently and positively associated with better food security, while advice on agricultural production and market access is consistently and positively associated with better agricultural production, which is a critical pathway to HFS. For DHHs, joint access to information for the man and the woman has a stronger effect on food security, whether related to nutrition, markets, or agriculture.

However, we find that women in DHHs are frequently given the responsibility of attending training and meetings without their spouses. Rather than being viewed as an empowering opportunity, women find it to be a burden placed on them by busy or disinterested husbands. This reflects the discourse on women's time poverty, wherein women are burdened with additional responsibilities across a variety of realms (Blackden and Wodon, 2006; World Bank et al., 2009; Herforth and Harris, 2014)

Women and men both report barriers to sharing and applying information learned from training sessions and meetings attended alone. Men often questioned the ability of their wives to comprehend the extension messages and complained that women were cautious about new approaches they had not learned firsthand. Women reported fear of conflict and even domestic violence when sharing information learned. Furthermore, barriers to the sharing and adoption of the information learned by women likely diminish the importance of receiving those messages, as women in DHHs are tasked with hearing the messages but have limited ability to apply them, similar to the findings of Mudege et al. (2016). In addition, joint attendance was viewed—by men and women—as important both to reinforce the messages learned to facilitate adoption and to promote a unified whole-family approach to household development, as suggested by Cornwall (2000) and by Bezner Kerr et al. (2016). Joint participation can either be a manifestation or a factor leading to intrahousehold harmony. Particularly for nutrition education, joint participation in trainings and meetings can also help make men key partners in ensuring good household nutritional outcomes along with women. Thus, targeting both women and men for nutrition extension is potentially empowering, as it not only works on changing behavior, but also starts to challenge gender norms of women's roles in domestic tasks and food preparation versus men's roles in productive and business activities.

Our results have implications on targeting of beneficiaries and partners in development projects. While the foundation of targeting for the provision of goods and services and capacity strengthening in most development and food security projects is based on poverty and vulnerability, additional considerations in project design will be necessary to address gender-based constraints, in particular, access to resources and opportunities for SFHHs, gender norms affecting access to nutrition education by SMHHs, and women's agency, time burden, and potential for domestic violence within DHHs. While the need for improved education, provision of goods and services, and support in commercialization and diversification are important for the resource-poor, regardless of the gendered household type, a differentiated strategy can be adopted for DHHs to ensure that both women and men within the household have joint access to information and to close the gender gaps in terms of education, participation in community committees and processes, and plot management. For households with a sole male adult, formal education and literacy levels and nutrition education seem to be significant pathways to improved food security. For households with a sole female adult, gender-based discrimination in accessing markets, organizations, associations, labor, and opportunities should be addressed in project designs.

Our results also have implications for national nutritional policy. Recent efforts toward "gender-sensitive" nutrition policies still consider nutrition a women's responsibility (Mkandawire et al., 2018). However, our results indicate that food and nutrition security should be a shared, joint responsibility of women and men. Household food and nutrition security can be improved by delivering nutritional advice to men and women jointly at the household and the community level and by making both men and women responsible for HFS and nutritional outcomes.

Conflict of interest declaration

We declare no conflict of interest.

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Appendix A

See Appendix Tables A1–A3.

Table A1
Descriptive statistics of variables used in the estimations (N = 3001 households; 299 communities).
Source: IFPRI (2016) survey.

Variable	Mean	SD	Min.	Max.
Outcome variables				
Household dietary diversity score (HDDS)	4.82	2.15	0.00	10.00
Food consumption score (FCS)	34.60	18.52	0.00	126.00
Household food insecurity access score (HFIAS)	9.91	7.61	0.00	27.00
Value of production (MWK 000) during 2016 rainy season[a]	201.64	297.38	1.96	4043.25
Value of production (MWK 000/hectare) during 2016 rainy season[a]	81.99	74.69	1.28	704.15
Agricultural diversification, commercialization, and postharvest loss				
% of fruits harvested that are consumed by household	17.02	31.46	0.00	100.00
% of fruits harvested that are sold	2.74	11.56	0.00	100.00
% of cassava roots harvested that are consumed by household	6.49	22.79	0.00	100.00
% of cassava roots harvested that are sold	1.97	11.92	0.00	100.00
Simpson crop diversification index[a]	0.60	0.30	0.00	1.00
% of harvest sold (weighted by crop acreage)	7.70	14.09	0.00	100.00
Cultivated during dry (second) cropping season (0/1)[a]	0.38	0.49	0.00	1.00
Number of maize bags wasted or lost during postharvest of 10 bags	0.40	1.42	0.00	10.00
Indicators of income and assets				
Main source of income is off-farm (0/1)	0.34	0.47	0.00	1.00
Landholding (acre)[a]	2.78	3.22	0.00	79.47
Livestock units owned				
Number of goats, sheep, and pigs owned	1.78	3.55	0.00	71.00
Number of cattle and oxen owned	0.34	1.62	0.00	26.00
Number of poultry owned	5.01	8.88	0.00	120.00
Nonfood per capita expenditure (MWK 000,000)	0.18	0.04	0.00	11.00
Value of assets (MWK 000,000)	0.05	0.27	0.00	8.89
Access to extension and advisory services[a]				
Received some nutrition- or health-related advice in past 2 years (0/1)	0.58	0.49	0.00	1.00
Received some agriculture-related advice in past 2 years (0/1)	0.52	0.50	0.00	1.00
Received some market-access-related advice in past 2 years (0/1)	0.21	0.41	0.00	1.00
Received some processing- or postharvest-related advice in past 2 years (0/1)	0.31	0.46	0.00	1.00
Awareness of improved practices[a]				
Number of improved agricultural technologies members have knowledge of	4.67	3.08	0.00	11.00
Members have knowledge of dietary diversity practices (0/1)	0.73	0.45	0.00	1.00
Indicators of connectivity				
Number of associations that head is a member of	0.35	0.66	0.00	7.00
Members participate in village agricultural committees (0/1)[a]	0.37	0.48	0.00	1.00
Frequency of going to markets (1 = most frequent, 5 = least frequent)	3.25	1.03	1.00	5.00
Frequency of going to town (1 = most frequent, 5 = least frequent)	1.92	0.92	1.00	5.00
Adoption of technologies[a]				
Quantity of inorganic fertilizer applied (kg)	105.63	162.07	0.00	2725.00
Applied organic fertilizer (0/1)	0.45	0.50	0.00	1.00
% of crop area planted with modern varieties	0.80	0.34	0.00	1.00
Number of improved practices adopted	2.06	1.24	0.00	9.00
Household characteristics				
Age of head	40.72	15.81	15.00	90.00
Highest education grade level attained by head	5.82	3.80	0.00	15.00
Male head (0/1)	0.75	0.43	0.00	1.00
Member is a lead farmer (0/1)	0.16	0.36	0.00	1.00
Household size	5.07	2.39	1.00	32.00
Community characteristics (N = 299)				
Distance to nearest market (km)	3.67	4.96	0.00	30.00
Distance to nearest paved road (km)	15.42	18.36	0.00	132.00
Number of development projects in community	3.01	1.61	0.00	9.00
Community has adopted Model Village concept (0/1)	0.20	0.40	0.00	1.00
Community has elementary school (0/1)	0.81	0.40	0.00	1.00
Community has mills (0/1)	0.70	0.46	0.00	1.00
Community has storage facility (0/1)	0.20	0.40	0.00	1.00
Community has irrigation infrastructure (0/1)	0.26	0.44	0.00	1.00
Number of farmer clusters in the community	3.44	25.98	0.00	400.00
Instruments for advice tried				
Number of extension workers working in the community	1.19	0.73	0.00	8.00
Extension worker lives in the community (0/1)	0.24	0.43	0.00	1.00
Frequency of using radio (1 = most frequent, 5 = least frequent)	2.42	1.50	1.00	5.00
Frequency of using cell phone (1 = most frequent, 5 = least frequent)	2.30	1.53	1.00	5.00
Number of lead farmers in the community	2.60	2.97	0.00	40.00

Note:.
[a] Variables with gender gap within households in the datasets. Simpson index of diversification $= 1 - \sum_{i=1}^{k} p_i^2$, where p = share of land allocated to crop i. USD 1 = MWK 720 (average in 2016).

Table A2
Descriptive statistics of gender gap variables used in the estimations (N = 3001 households).
Source: IFPRI (2016) survey.

Variable	Mean	SD	Min.	Max.
Gender gap in access to nutrition extension				
No member received nutrition advice (0/1)	0.42	0.49	0.00	1.00
Both female and male received nutrition advice (0/1)	0.20	0.40	0.00	1.00
Only male received nutrition advice (0/1)	0.16	0.37	0.00	1.00
Only female received nutrition advice (0/1)	0.21	0.41	0.00	1.00
Gender gap in access to production extension				
No member received production advice (0/1)	0.48	0.50	0.00	1.00
Both female and male received production advice (0/1)	0.16	0.37	0.00	1.00
Only male received production advice (0/1)	0.20	0.40	0.00	1.00
Only female received production advice (0/1)	0.16	0.37	0.00	1.00
Gender gap in access to market access extension				
No member received market access advice (0/1)	0.79	0.41	0.00	1.00
Both female and male received market access advice (0/1)	0.03	0.17	0.00	1.00
Only male received market access advice (0/1)	0.12	0.33	0.00	1.00
Only female received market access advice (0/1)	0.06	0.24	0.00	1.00
Gender gap in access to postharvest extension				
No member received postharvest advice (0/1)	0.69	0.46	0.00	1.00
Both female and male received postharvest advice (0/1)	0.07	0.26	0.00	1.00
Only male received postharvest advice (0/1)	0.14	0.35	0.00	1.00
Only female received postharvest advice (0/1)	0.10	0.30	0.00	1.00
Gender gap in participation in community committees and meetings				
No member participates (0/1)	0.63	0.48	0.00	1.00
Both female and male participate (0/1)	0.08	0.27	0.00	1.00
Only male participates (0/1)	0.17	0.38	0.00	1.00
Only female participates (0/1)	0.12	0.32	0.00	1.00
Gender gap in land access				
% of plot acreage managed by female solely	25.16	42.63	0.00	100.00
% of plot acreage managed by male solely	34.78	46.15	0.00	100.00
% of plot acreage managed by both female and male jointly	40.07	47.87	0.00	100.00
Gender gap in education				
Highest education grade level of male minus education grade level of female	1.28	4.17	− 15.00	15.00

Table A3
Estimation results on determinants of value of crop production and productivity during main season, disaggregated by household type.
Source: IFPRI (2016) survey.

Indicators	(1) Value of prod. (DHH)	(2) Value of prod. (SFHH)	(3) Value of prod. (SMHH)	(4) Value of prod. per ha (DHH)	(5) Value of prod. per ha (SFHH)	(6) Value of prod. per ha (SMHH)
Gender gaps						
Both female and male receive production advice, compared to no advice	33.741**			8.175*		
	(16.310)			(4.947)		
Only male receives production advice, compared to no advice	4.891			10.099**		
	(14.473)			(4.396)		
Only female receives production advice, compared to no advice	− 17.989			− 4.524		
	(19.732)			(5.992)		
% of acreage jointly managed by female and male	0.278**			0.036		
	(0.118)			(0.036)		
% of acreage managed solely by female	0.429			− 0.011		
	(0.405)			(0.123)		
Gender gap in education (male – female)	0.412			− 0.224		
	(1.816)			(0.551)		
Both female and male participate in committees, compared to no participation	33.524*			4.229		
	(19.564)			(5.943)		
Only male participates in committees, compared to no participation	21.536			1.685		
	(14.310)			(4.346)		
Only female participates in committees, compared to no participation	− 6.047			− 3.462		
	(20.921)			(6.354)		
Input use and technology adoption						
Quantity of inorganic fertilizer used (kg)	0.462***	0.411***	0.420*			
	(0.035)	(0.089)	(0.211)			
Quantity of inorganic fertilizer used (kg/acre)				0.001***	0.042**	0.028
				(0.000)	(0.016)	(0.021)
Applied organic fertilizer (= 1)	1.384	0.065	12.500	4.363	6.284	2.810
	(11.243)	(10.613)	(24.836)	(3.415)	(6.263)	(15.297)
% of cropland acres with modern variety	28.728*	12.198	32.443	5.305	5.362	37.023*
	(17.159)	(13.189)	(30.313)	(5.203)	(7.817)	(18.818)
Number of improved management practices adopted	6.493	− 4.370	10.512	3.496**	0.733	− 0.444
	(4.684)	(5.109)	(13.290)	(1.423)	(3.022)	(8.270)

(*continued on next page*)

Table A3 (*continued*)

Indicators	(1) Value of prod. (DHH)	(2) Value of prod. (SFHH)	(3) Value of prod. (SMHH)	(4) Value of prod. per ha (DHH)	(5) Value of prod. per ha (SFHH)	(6) Value of prod. per ha (SMHH)
Nonfarm income and assets						
Off-farm is main source of income (= 1)	− 3.175	− 9.284	− 20.255	0.656	− 0.187	− 21.520
	(11.801)	(10.788)	(23.800)	(3.584)	(6.400)	(14.823)
Crop acre (acre)	54.429***	24.535***	61.194***	− 5.446***	− 16.171***	− 5.691*
	(3.202)	(5.261)	(4.773)	(0.905)	(2.928)	(2.935)
Value of 11 asset types owned by household in 2015	17.703	378.517*	251.295***	11.272*	206.822*	76.886
	(21.465)	(193.790)	(91.984)	(6.423)	(114.789)	(51.332)
Number of goats, sheep, and pigs owned	6.519***	12.753***	7.665	1.770***	3.292**	− 1.061
	(1.505)	(2.748)	(8.365)	(0.455)	(1.621)	(5.227)
Number of cattle and oxen owned	11.026***	16.091	4.784	1.759*	− 0.781	5.630
	(3.369)	(10.783)	(12.050)	(1.020)	(6.397)	(7.083)
Number of poultry owned	2.626***	1.975**	− 1.462	0.915***	1.502***	− 0.684
	(0.606)	(0.917)	(2.110)	(0.184)	(0.545)	(1.314)
Access to extension services						
Received production advice (= 1)		− 6.403	− 28.406		− 0.584	− 9.649
		(11.652)	(24.312)		(6.922)	(15.130)
Received market access advice (= 1)		13.898	53.247		− 3.206	− 0.422
		(17.010)	(33.305)		(10.086)	(20.703)
Agroecological conditions						
10-year average temperature (Celsius)	− 17.762**	− 8.517*	− 10.538	− 12.995***	− 9.509***	− 7.163
	(8.987)	(4.929)	(11.211)	(2.726)	(2.902)	(6.974)
Number of abnormal months in 2015	5.751	18.858***	18.663	− 6.520	6.974*	16.551
	(16.850)	(7.180)	(16.902)	(5.117)	(4.179)	(10.308)
Household characteristics						
Highest grade level of education attained by head	2.475	3.444*	5.150	2.158***	3.455***	3.220
	(2.036)	(1.823)	(3.223)	(0.617)	(1.062)	(1.956)
Household size	0.681	1.827	− 15.184*	0.410	0.847	− 2.135
	(2.641)	(2.709)	(8.376)	(0.800)	(1.597)	(5.334)
Age of head	− 1.180***	0.084	− 1.016	− 0.206	0.218	− 0.627
	(0.430)	(0.336)	(0.622)	(0.131)	(0.198)	(0.386)
Member participates in committees (= 1)		4.049	0.009		− 1.351	6.061
		(12.723)	(26.893)		(7.560)	(16.876)
District fixed effects	YES	YES	YES	YES	YES	YES
Constant	336.664	138.404	176.435	380.059***	249.561***	200.331
	(228.223)	(130.276)	(288.145)	(69.261)	(76.658)	(179.316)
Observations	1961	447	120	1961	447	120
R^2	0.451	0.432	0.825	0.094	0.194	0.311
Adjusted R^2	0.435	0.408	0.783	0.068	0.161	0.147

Note: Standard errors in parentheses; (= 1) represents dummy variables and coefficients represent discrete change of dummy variable from 0 to 1; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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