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RESEARCH ARTICLE

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Feeding the future in Ghana: Gender inequality, poverty, and food insecurity

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Abstract

As women's empowerment is critical for the adoption of agricultural technologies by farmers, some governments have over the last three decades adopted a gender equality approach to food security. In Ghana, women play a vital role as farmers and food processors, which means they impact household nutrition in important ways. In this article, we explore women's empowerment in maize-producing sites in Ghana by drawing on original data collected from over 400 farmers and service providers as part of a United States Agency for International Development-funded Feed the Future project. We employ a quasi-"women's empowerment in agriculture index" to measure the extent to which men and women maize producers are either empowered or disempowered in the domains of production, access to resources, control over income, leadership, and time allocation. Our study reveals that cost and time poverty are the main factors that influence the adoption of technologies to reduce postharvest losses. We also find that women are disproportionately disempowered in the areas of control over the use of income and time poverty. Importantly, we further find that researchers need to account for perceived versus actual empowerment when examining gender inequality in agriculture. Our study findings and policy recommendations will be of interest to policymakers, scholars, and development practitioners.

KEYWORDS

food security, gender, Ghana, women's empowerment

Key points

- Cost and time poverty are the main factors that influence the adoption of technologies to reduce postharvest food losses in Ghana.
- Ghanaian women are critically disempowered in the areas of control over the use of income and time poverty.
- Researchers need to account for perceived versus actual empowerment when examining gender inequality in agriculture.

INTRODUCTION

Postharvest losses and contamination impact food security, nutrition, and health, particularly in developing nations, and they pose serious challenges to smallholder farmers by causing food insecurity and reducing income. Tefera et al. (2011, p. 240) state, "Traditional storage practices in developing countries cannot guarantee protection against major storage pests of staple food crops like maize, leading to 20–30% grain losses, particularly due to post-harvest insect pests and grain pathogens. As a result, smallholder farmers end up selling their grain soon after harvest, only to buy it back at an expensive price just a few months after harvest, falling in a poverty trap." Further, "pests in stored grain are also linked to aflatoxin contamination and poisoning" (Tefera et al., 2011). A key cause of postharvest losses is fungal contamination of grains (especially from mycotoxin-producing fungi in maize) that affects nutrition and health. Reducing this contamination could significantly help improve nutrition in many countries.

Women farmers are key actors to help address this public health issue in sub-Saharan Africa (SSA), where most postharvest activities are performed by women. Notably, in the literature on postharvest losses in SSA, Affognon et al. (2015, p. 60) find that "out of the 213 documents reviewed, only three (or less than 1.5%) explored gender issues," and add: "In many SSA countries, postharvest systems underperform because women lack the resources and opportunities they need to access technologies and services to help transform agricultural produce" (Okorley et al., 2001). Our study answers a call to increase gender research and analysis to improve food security and decrease postharvest losses (Domingo et al., 2015, p. 61; Doss, 2011). Not only is gender analysis needed to fill a gap in the literature, but women's empowerment is imperative to improve postharvest systems and our study examines women's empowerment in agriculture.

Studies show that women's empowerment improves food security, nutrition, and health, while gender inequalities exacerbate food security gaps (Food and Agriculture Organisation [FAO], 2011; O'Brien et al., 2016). Reducing gender disparities by increasing women's physical and human capital promotes agricultural growth, greater income for women, and better food and nutrition security in households (Quisumbing, 1995).

> "The research also highlights the complex nature of empowerment and illustrates that different dimensions of empowerment support different outcomes. For instance, women's greater autonomy in agricultural production and control over their own workload are key determinants of their own dietary diversity and their children's nutrition (Malapit et al., 2013). Evidence from a nationally representative survey data from Bangladesh also finds that the overall women's empowerment score, the number of groups in which women actively participate,

> women's control of assets, and a narrowing gap in empowerment between men and women within households are positively associated with calorie availability and dietary diversity (Sraboni et al., 2013) … [T]here is an established body of evidence that demonstrates that women's increased control over income and greater-decision making in the household improves their own and their children's health and well-being…" (Domingo et al., 2015, pp. 76, 88).

Our study adds to this literature by analyzing women's empowerment in maize-producing communities in Ghana, a nation where agriculture employs approximately 45% of the workforce and maize "is the largest staple crop," contributing significantly to consumer diets, and "is the number one crop in terms of area planted and accounts for 50–60% of total cereal production" (Norman et al., 2016, p. 13; see also Okudzeto et al., 2015). Baoua et al. (2014, p. 20) write, "Maize is a key food crop in West Africa, where Benin, Ghana, Burkina Faso and Nigeria account for most of the regional production. Storage pests are major constraints in the maize value chain, with [postharvest] losses reaching 30%." In Ghana, "70% of food crop growers, 95% of actors in agro-processing and 85% in food distribution are women" (Pepper, 2016, p. 22; see also Hagan & Opare, 2011). Given the postharvest losses of maize and the high percentage of female labor in the agricultural sector, Ghana offers fertile ground to analyze gender and food security.

We present the first stage of gender analysis in an agricultural technology project that seeks to reduce postharvest losses in the maize value chain in Ghana. In Africa, where postharvest grain losses most often occur due to insect infestation during storage and poor drying after harvest, causing mold contamination, Ghana offers an opportunity to better understand both women's empowerment in agriculture and postharvest losses in SSA. Our study is a part of the Feed the Future Innovation Lab for the Reduction of Postharvest Loss (PHLIL). PHLIL is a strategic, applied, research and education program aimed at improving global food security by reducing postharvest losses in long-term storage crops, such as grains, oilseeds, legumes, root crops, and seeds. The Lab's efforts focus on four Feed the Future countries, including Ghana, and are funded by United States Agency for International Development. Through collaborations between US universities and local universities, research institutions, and other partner organizations, PHLIL conducts research, testing, and outreach related to drying, storage, and mycotoxin detection for key crops. PHLIL seeks to increase understanding of current postharvest loss factors and task division—including gender division of labor—in rural communities and households, and works toward the development of technologies usable by all household members. Informed by the aforementioned literature on women's empowerment as important for improved food security and nutrition across households, PHLIL is exploring women's empowerment in agriculture.

Addressing women's empowerment in an agricultural technology project, such as PHLIL, requires gender-sensitive data collection and analysis. Doss (2011, p. 11) writes:

To support gender analyses in agriculture, data collection efforts need to do two things. First, they need to ensure that women farmers are interviewed and that their voices are counted. Second, the information should identify which people are involved in various activities, as owners, managers, workers, and decisionmakers.

Our study heeds this call by collecting data from women and men farmers, owners, managers, and others along the maize value chain in four regions of Ghana through focus group discussions (FGDs), surveys, and interviews. In addition to collecting data on women's empowerment in agriculture, we examine study participants' perceptions of and experiences with postharvest technologies and institutions (e.g., credit) related to gender-based constraints and opportunities that could impact technology adoption in the PHLIL project. Women's empowerment is a distinct concept that this study explores in support of

the development goal of gender equality. (For more on the difference between gender equality and women's empowerment, see, e.g., O'Brien et al., 2022.)

In the next section, we present the methodology of the data collection for gender analysis in the PHLIL Ghana project. Following the Methodology section, we present this study's results and discuss our findings. Our study confirms that postharvest technologies improve household food security. We find that cost and demand on time are important factors that impact technology adoption. While women's disempowerment may create a barrier to technology uptake, we stress that the relationship between the empowerment results and the technology uptake is suggestive, not conclusive. Further, we find that women are more disempowered than men in the maize value chain, but data from this study also reveal a few areas in which women's empowerment may surpass men's in the PHLIL project sites. We explain these findings and discuss how disempowerment related to gender, especially the division of labor, can impact the adoption and effective utilization of technologies that can improve food and nutrition security. We conclude with specific policy recommendations and strategies for governments and implementing partners to improve women's empowerment in agriculture.

METHODOLOGY

Overview and conceptual and analytical tools

To enhance food security in developing nations, the adoption and proper use of postharvest loss reduction technologies by smallholder farmers is important to decrease postharvest losses from pests in stored grain and grain pathogens. Such technologies target interventions in storage by using silos, bags, traps, and moisture meters, among others. Increasing the ability of smallholder farmers, many of whom are women, to effectively dry and store crops long-term will increase their household food security. For households with a surplus to market, it will also increase their incomes by enabling them to store until the lean season when crop prices are much higher.

In the PHLIL Ghana project, a combination of 10 ISCTs was identified in maize-producing communities in the 10 regions of Ghana. The technologies include tools for testing moisture content, presence of fungus, management of insects and mycotoxins, and storage containers (plastic and metal silos; hermetic grain bags—GrainPro Super Grain bags and Purdue Improved Crop Storage [PICS] bags). These technologies were introduced by different state and nonstate agencies in the last two decades or more. Awareness of ICSTs and their benefits is necessary for and can encourage technology adoption to improve the drying and storage of cereal grains and grain legumes.

According to the aforementioned studies on gender equality and women's empowerment in agriculture, technology interventions for food security and development projects need to consider gender's role in technology adoption by smallholder farmers. Informed by the literature on gender issues in agriculture and food security, we expect that gender inequalities create barriers to technology adoption. Therefore, we assess gender relationships among maize value chain actors, primarily farmers, in this study.

In this first gender analysis in the multiple-year PHLIL Ghana project, our study uses FGDs, interviews, and surveys as well as a quantified scoring of men's and women's empowerment to assess gender differences in ICST awareness and adoption factors, women's empowerment in agriculture, and gender roles in farming and nonfarming activities, namely, gender division of labor. Gender inequalities may limit the adoption, transfer, and scale-up of ICSTs, and the ultimate impact of ICSTs on food security for smallholder farm families.

The analytical tool from which we draw to develop questions for the FGDs, interviews, and surveys as well as to quantify data on men's and women's empowerment is the women's empowerment in agriculture index (WEAI). The WEAI was developed by the International Food Policy Research Institute to aid the monitoring of gender results in agricultural development projects (Alkire et al., 2013). As Table 1 shows, the WEAI measures the roles and extent of women's engagement in agriculture in five domains: decisions about agricultural production, access to and decision-making power over productive resources, control over the use of income, leadership in the community, and time use (Alkire et al., 2013).

The index also measures women's empowerment relative to men within their households.

In this study, we adapted the WEAI in two ways due to time and financial limitations. First, the WEAI involves a household survey to obtain data from farm families' heads of households and their spouses. Due to the survey's length and implementation cost, we collected data from men and women from different households within the same farm communities through FGDs and as individuals through a shorter survey than the WEAI to compare women's and men's empowerment in agriculture in our study sites. (Since our study began, an Abbreviated WEAI, a shorter, streamlined version of the original WEAI was released.) We also conducted interviews. Since we drew from the WEAI to develop questions for our FGDs, survey, and interviews, we refer to our study as a quasi-WEAI (Q-WEAI) study. Second, while we ask questions based on the WEAI through multiple methods to assess women's empowerment in agriculture generally, we also incorporate questions that focus on the adoption of postharvest technologies in our project sites. The WEAI's focus is production-heavy, and our Q-WEAI study includes questions to better understand what factors influence the adoption of ISCTs by men and women in the maize value chain.

Our research questions are: (1) what barriers and motivations impact the adoption of ISCTs in our project sites, and (2) what is the status of women's empowerment in comparison to men in our project's farming communities? Combined, these questions allow us to ascertain if gender may impact the adoption of ICSTs by key stakeholders in the maize value chain and women's empowerment in agriculture in the PHLIL study.

TABLE 1 The domains, indicators, and weights in the WEAI.

Domain	Indicator	Weight
Production	Input in productive decisions	1/10
	Autonomy in production	1/10
Resources	Ownership of assets	1/15
	Purchase, sale, or transfer of assets	1/15
	Access to and decisions about credit	1/15
Income	Control over the use of income	1/5
Leadership (in the community)	Group member	1/10
	Speaking in public	1/10
Time	Workload	1/10
	Leisure	1/10

Abbreviation: WEAI, women's empowerment in agriculture index.

Study participants and methods of data collection

In this study, we target maize value chain actors for FGDs, surveys, and key informant interviews in maize-producing communities in four regions of Ghana (Table 2).

The regions of Ashanti and Brong-Ahafo are in the more humid forest–savannah transition zone, and the Northern and Upper West are in the more arid–savannah zone. In the first two regions, ethnic Akan groups who engage in a matrilineal inheritance system that passes property through mothers to children dominate; in the last two regions, Dagbani-Dagaaba ethnic groups who engage in a patrilineal inheritance system (i.e., the property passes from fathers to children) dominate. Matrilineal and patrilineal descent has determined social and political relationships and structures (Fortes, 1984), and one may expect women to be more empowered in the matrilineal regions than in the patrilineal regions.

In 2015, FGDs were held with same- and mixed-sex groups (10 people per group) in maize-producing communities in the four regions. Each group included farmers, traders, and community leaders, as it was important to include farmers, traders, and community leaders to learn from different stakeholders with local knowledge to contribute to our research of the study sites. Traders include a significant number of women in our study sites, and so the traders were important to invite to the FGDs alongside farmers and local community leaders to better assess women's empowerment in different locations. During the FGDs, the differences between men and women with respect to awareness of the maize ICSTs were

TABLE 2 Sources of data and sample size.

Source	Region				Total
	Ashanti	Brong-Ahafo	Northern	Upper West	
Focus group discussions (FGDs)					(100)
Men's group	10	10			20
Women's group	10	10	10		30
Mixed group[a]		20 [10; 10]	10	20 [10; 10]	50
Individual surveys					(281)
Maize farmers	35	35	40	35	145
Warehouse operators	5	5	5	5	20
Input dealers	5	5	5	5	20
Maize traders	15	15	10	16	56
Maize aggregators	10	10	15	5	40
Key informant interviews					(36)
District Director of Agriculture	1	2	2	1	6
Cooperative/Community Development Officer	1	2	2	2	6
NGO Director/Project Leader	2	2	2	2	8
Agriculture Project Officers	2	2	2	2	8
Community leaders (Chiefs and Chief farmers)	2	2	2	2	8
Total	98	120	105	95	418

[a]Mixed groups were 50% men and 50% women (25 men + 25 women = 50 total participants).

sought. The guided interview script included questions on gender dynamics at home and in the community with attention to the five domains of the WEAI along the maize value chain. The closed-ended survey questions of the original WEAI (IFPRI, 2012) were rephrased and posed as open-ended or dichotomous questions.

In addition, a semistructured survey was designed to ascertain men's and women's awareness and use of the 10 aforementioned ICSTs as well as motivating factors for and benefits of technology adoption. In 2016, a total of 281 key actors in the maize value chain were surveyed: 145 maize farmers (61% men; 39% women) and 136 service providers. The service providers included: 56 maize traders (23% men; 77% women); 40 maize aggregators (60% men; 40% women); 20 input dealers (19 men; 1 woman); and 20 warehouse operators (18 men; 2 women). (Aggregators are wholesalers who travel to the cottages and hamlets to assemble grains for bulk distribution.) Since no database was available on any of the actor groups at the time of selection, surveyed farmers were selected in communities where the PICS bag had been introduced and distributed in the last decade by Adventist Development and Relief Agency, a nongovernmental organization. Service providers were selected based on a snowball and nonprobability sampling in towns and markets close to the farming communities.

To better understand the adoption of postharvest technologies, survey responses on the following factors of ICST adoption were analyzed: awareness and use of ICSTs, motivation to adopt ICSTs, (perceived) constraints, and (perceived) gains. The awareness and use levels of ICSTs were determined through relative frequency analysis for the five maize value chain actors: farmers, input dealers, warehouse operators, aggregators, and traders. Awareness is defined as knowledge of the technology and its usefulness. Adopters of ICST (s) are those actors who have used the specific input or practice for more than 1 year. Eight motivating factors to adopt ICSTs were identified and ranked by survey participants: (1) interest is shown by other actors, (2) capital to invest is available at a low-interest rate, (3) low level of capital investment is required, (4) there are no negative environmental consequences, (5) there is minimal demand on time (to use the technology), (6) technology is readily available in the community, (7) my peers are using it or doing business in it, and (8) my spouse agrees to the suggestion to use it. Kendall's coefficient of concordance was used to test agreement among the rankers of the eight factors. The null hypothesis is that there is no agreement among the rankers of the rankings. The alternate hypothesis is that there is agreement among the rankers of the rankings. The differences in the rankings of men and women value chain actors were analyzed.

The perceived constraints to ICST adoption listed by researchers and selected by individual survey respondents were ranked using relative frequency analysis. The differences between women's and men's responses were compared. We expected that more women would register higher levels of constraints to using ICSTs than men. The perceived gains of ICST adoption were similarly measured using survey responses on experiences or perceptions of: (1) changes in the number of months that maize is stored after using a technology, (2) whether technology better protected maize from pest attack, (3) whether higher prices were obtained for the commodity stored with a technology, and (4) whether food security status changed from poor to improved after using a technology.

In 2016, interviews on the role of the private sector, NGOs, and civil society in providing support for farmers were obtained from 36 key informants, including community leaders (e.g., Chiefs and Chief farmers), coordinators of food security projects, and monitoring officers at the local government departments (Table 2). Purposively including key informants who are leaders and technical experts was to validate the information and fill any gaps in information. Researchers also made observations at agribusiness service centers and socioeconomic facilities to gather data on institutional support for farmers.

We note that the survey participants differ from the FGD participants. Including different participants across the survey and the FGDs increased the diversity and number of study participants who could inform the project. In addition, it was not possible for all participants, especially farmers, to attend to both the survey and the FGD due to their time constraints and study logistics in Ghana. Requiring participants to do both the survey and the FGD to share their perceptions and experiences and respond to questions of importance for the project would have gone against the ethics of our study. We also did not want to risk influencing individual survey answers if someone had participated in an FGD, which was held before the survey. Finally, as explained in the next section, quantified WEAI-related FGD questions and WEAI-related survey questions' responses were combined to calculate our study's Q-WEAI scores. Having different participant samples for the FGDs and the survey ensured that we did not double-count participants' responses for our Q-WEAI analysis.

Method of Q-WEAI data analysis

Responses to WEAI-related FGD questions were transformed into numerical scores toward their relevant WEAI domains (Table 1). During the FGDs, men and women provided scores on both men's and women's empowerment in each domain. Additionally, WEAI-related survey questions' responses were converted (using relative frequency calculation) into numerical scores toward their relevant WEAI domains. These quantified FGD and survey responses were combined to calculate our study's Q-WEAI scores. The mean scores for each domain indicator are compared for men and women. Disempowerment for a gender group is reflected in an overall Q-WEAI score (for men or women) of less than 80%, and this is based on the WEAI's weight allocation for the domain indicators (Table 1). Alkire et al. (2013, pp. 75, 77) explain WEAI's 80% rationale:

> "[A] woman or man is defined as empowered in 5DE [five domains] if she or he has adequate achievements in four of the five domains or is empowered in some combination of the weighted indicators that reflect 80% total adequacy or more … An individual is disempowered if his or her inadequacy score is greater than 20%. This is the same as saying that an individual is identified as empowered in 5DE if he or she has adequate achievements in four of the five domains, enjoys adequacy in some combination of the weighted indicators that sum to 80% or more, or has an adequacy score of 80 or greater."

Similar to the WEAI, through our Q-WEAI, we analyze disempowerment to "identify the critical indicators that must be addressed to increase empowerment" (Alkire et al., 2013). The lower the score, the more disempowerment is indicated.

RESULTS

Adoption of technology

Our survey findings confirm that ICSTs help decrease postharvest losses and improve food security, and food security (for home consumption and sale) is the motive for crop cultivation for the majority (85%) surveyed. Before using any ICST, only 1% of farmers surveyed stored grains beyond 12 months due to pest attack and about 60% could afford three meals a day. Notably, after technology use, 36% of farmers stored grains beyond 12 months and 66%

TABLE 3 Use of ICSTs by gender.

	Farmers % Use		Warehouse managers % Use		Input dealers % Use		Traders % Use		Aggregators % Use	
ICSTs	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Simple tools to detect fungus	31	14	22	100	21	0	0	23	17	69
ZeroFly® bag	6	0	0	50	11	0	0	0	0	0
PICS bags	75	84	61	100	74	0	39	16	29	75
Super grain bags	81	74	83	100	74	0	100	95	96	94
Commercial plastic silos	2	4	0	0	11	0	0	2	0	0
Steel silos	3	2	0	0	11	0	0	0	0	0
Solar dryers	0	0	0	0	0	100	0	0	0	0
Moisture meter	0	0	17	50	5	0	0	0	0	0
AflaSafe	0	0	11	50	11	0	0	0	0	0
Baited traps	0	0	39	0	26	100	0	28	4	19

Abbreviation: ICST, improved crop storage technology.

could afford three meals a day. Table 3 shows the percentage of survey participants who use the 10 ICSTs.

Our survey results show use levels of the PICS and Super Grain bags as generally high for women and men in the maize value chain. Over 65% of women and 70% of men said they know how and when to use the bags as well as their benefits. The awareness level for the nonbag storage technologies was generally low among men and women. Ownership and access to silos, moisture meters, and solar dryers were low for men and women farmers, traders, and aggregators. Among the survey participants, men dominate input dealerships (19 men to 1 woman) and warehouse managers (18 men to 2 women). The one female input dealer had access to a solar dryer and sold baited traps. No warehouse managers used silos or solar dryers.

Men and women surveyed perceive the following gains from using ICSTs: grain protection, increase in the number of months for storing maize, higher quality grain, higher prices for commodities in the market, and improvement in household food security status.

Survey results reveal cost as the main constraint to ICST use for men and women, followed by the durability of material and local availability. Contrary to our expectation, women did not register more constraints or restrictions than men for using ICSTs. Neither men nor women consider their spouse's agreement to be an important constraint or motivating factor for technology adoption.

The four main motivating factors for adopting ICSTs in order of importance are: (1) minimal demand on time (to use technology), (2) no negative environmental consequences, (3) interest shown by other actors, and (4) peers using/doing business with the technology. There were a few slight differences in men's and women's rankings for motivation factors. For women aggregators, issues of capital (i.e., low level of capital investment is required and capital to invest is available at a low interest rate) were the most important motivating factors for ICST adoption. Also, the one female input dealer was highly motivated by technology availability in the community.

Regarding men's and women's access to information on ICSTs, our survey results show that both men and women rely on varied sources for obtaining technical information on ICSTs, although more women than men depend on relatives than the formal sector for such information. Unexpectedly, although more women than men had been trained in the use of simple tools for detecting fungus, women farmers use these tools less than men farmers (Table 3). The FGDs and interviews confirm women's training in simple fungus-detecting tools through women's groups.

State of (dis)empowerment for women and men

Our Q-WEAI was estimated based on the WEAI-related survey and FGD questions to measure the extent that maize producers in our study sites are (dis)empowered in the five domains: production, access to resources, control over income, leadership, and time allocation (Table 1). Our Q-WEAI results show that both women and men in our study sites are disempowered (with an overall Q-WEAI score of less than the 80% threshold), but women are more disempowered than men. Our Q-WEAI results for the domain indicators are shown in Figure 1 (see Table 1 for corresponding domains).

The lowest scoring Q-WEAI indicators are critical indicators that should be addressed to increase empowerment for women or men in the study sites. Figure 1 shows the top contributors to women's disempowerment in the study are: input in productive decisions, control over the use of income, and leisure, respectively, indicators of the production, income, and time domains. The Q-WEAI results show women as most disempowered and men as most empowered in "input in productive decisions," an indicator of the production domain. While women are disempowered compared to men in the overall Q-WEAI results, men are insufficiently empowered in agriculture in our study. The top contributors to men's disempowerment are the three indicators of the resource domain: purchase, sale, or transfer of assets; access to and decisions about credit; and ownership of assets (Figure 1).

Q-WEAI results suggest that men are less empowered than women in the resource domain, especially regarding the transfer of assets and access to credit. The "purchase, sale, or transfer of assets" is the Q-WEAI indicator of most empowerment for women, and it is the only indicator for which either gender is empowered above the 80% threshold.

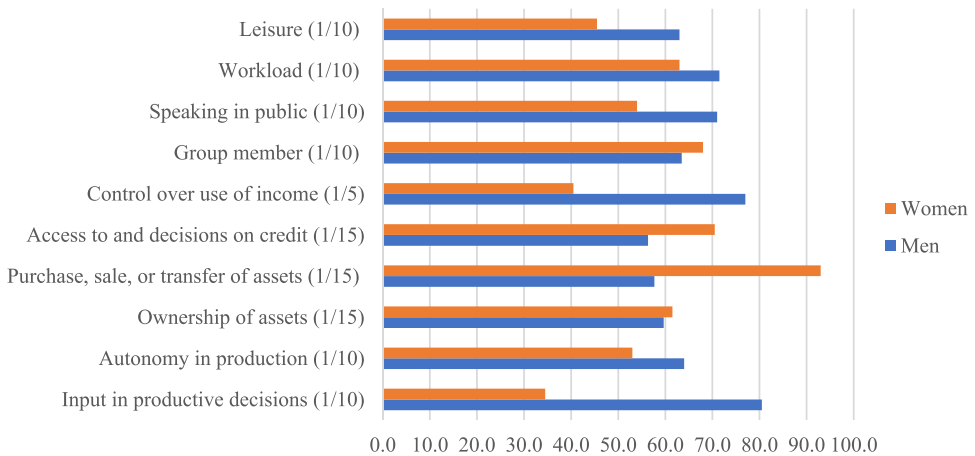

FIGURE 1 Results of quasi-women's empowerment in agriculture index (Q-WEAI) showing the extent of (dis) empowerment in the various domains.

However, it is one of the indicators of most disempowerment for men (Figure 1). Explaining men's disempowerment, FGD participants say that, in many instances and especially in households where men are not indigenes of the hometown of their wives, assets are jointly owned and men are *obliged to consult* with their wives before debts are accrued and assets are transferred. Interestingly, FGD participants also say that married women *always act in consultation* with their husbands.

Regarding men's disempowerment in "access to and decisions about credit," FGD participants express that women's groups have been targeted for trainings and opportunities for credit. According to both the FGDs and survey, husbands do not usually question wives' needs for small amounts of credit to expand business or support household consumption.

The third contributor to men's disempowerment—the resource domain's ownership of assets—is also the indicator for which women and men share their most similar level of disempowerment. Study participants' agricultural assets for supporting postharvest management of maize include machines for shelling, drying, winnowing, bagging, and weighing; pans; silos; warehouses/storerooms; mobile phones; and "vehicles." The major postharvest assets of both women and men surveyed are pans and storerooms. Warehouses and silos tend to be commercial facilities in town or are community-based and accessible to both men and women, but our survey results show its management tends to be dominated by men (see also Ministry of Finance [MoF], 2016). "Vehicles" owned by farmers and other service providers include bicycles, tricycles, tractors, and motorcars. Most of these "vehicles" are owned by men and hired out to both men and women.

Regarding decision making in multiple areas, more than 75% of both male and female farmer survey respondents say that women participate (at least occasionally) in decision making on sourcing of credit, land use, and purchase of farm and postharvest inputs (Table 4).

The income domain's indicator (control over the use of income) is one of the lowest Q-WEAI scores for women; women score 40%, while men score 79% (Figure 1). Regarding control over income from the sale of maize produced by farmers, the survey shows that 70% of women farmers compared to 85% of men farmers control how to save part of the income and what to spend the money on. FGD participants say that women have partial control over the use of income.

In both the FGDs and survey, the freedom of men and women to spend as individuals or in consultation with each other was household-specific. FGD and survey participants listed these necessities for household expenditures: food, school fees, utility bills, medicare, mobile phone credit, vehicles, and housing construction. The survey results indicate that among this list, women spend more on food, children's education, and medicare than men.

In the leadership domain, the Q-WEAI results show women as more empowered than men in group membership. Both the FGD and interview participants note the external support services that organize women-only groups to explain women's empowerment in group membership. Kapitsa (2008) confirms the organization of women-only groups. When asked in the survey, "Can women be executive members of mixed-sex groups?," 94% of men and 96% of women say "yes." However, we find barriers for women's empowerment in mixed-sex groups, as the FGDs offer a more nuanced view of executive members (i.e., leaders) and public speaking. Overwhelmingly, the FGDs confirm that all women can be leaders in women-only groups, but participants stress that "well-educated and courageous" women can be leaders in mixed-sex groups. FGD participants agree that when women join mixed-sex groups, there is a social norm of masculinity for which "men direct and lead," and they say that this interferes with women's choices and so women opt for executive positions *other than* president or chairperson. Some participants explain away the lack of women in leadership roles by saying that women shy away from public speaking. FGD participants

TABLE 4 Perception of women's participation in decision-making areas of production and postharvest.

Perceived extent of women's participation	Decision-making area							
	Type of land to use		Purchase of farm		Purchase of postharvest inputs		Sourcing of credit	
	Men (%)	Women (%)	Men (%)	Women (%)	Men (%)	Women (%)	Men (%)	Women (%)
All the time	7	19	13	22	17	23	12	27
Most of the time	53	28	33	24	39	23	40	33
Occasionally	21	27	30	30	18	16	39	31
Never	20	26	24	24	25	38	9	9

Source: Survey results of men and women farmers.

agreed to such participant statements as this one: “Men are better empowered in public speaking not due to their sex, but more due to higher exposure and higher participation in formal schooling.” The latter part of this statement on schooling is reflected in the lower level of literacy among women compared to men in our study (Appendix A).

An important empowerment factor for women in agriculture, including technology adoption, is local institutional (government and nongovernment) support of women farmers that was observed during community visits and confirmed through the key informant interviews and FGDs. There are local government services in agricultural extension, business advisory, information, cooperative organization, community development, and social welfare in each of the 216 district assemblies of Ghana. The extension officer to farmer ratio is 1:500 households with an average of only two officers in each district (of up to 1 million average population) for the other services (Ministry of Food and Agriculture, 2012). Interview and FGD participants note that in the last decade rural women have become the greatest beneficiaries of the government's business advisory and extension services, because they have been targeted and organized into community groups for sensitization and capacity building, including on technology adoption.

According to the key informant interviews, the private sector (including not-for-profit organizations) is also a significant participant in women's empowerment. The inclusive business models adopted by private businesses and out-grower and contract farming schemes have allowed women to be trained to participate in all nodes of the agricultural commodity value chain. In all four regions visited by the study team, there was at least one project organizing women in maize, soy beans, and rice, and training women to obtain credit and use improved technology for enhancing crop productivity. Such trainings aim to improve women's participation in productive decision making during the organization of inputs and credit for completing cereal production and postharvest activities.

Based on the literature on different descent regions (e.g., Fortes, 1984), the expectation was that women in patrilineal regions are likely to be more disempowered than in matrilineal regions, where women inherit property. However, we find only a slight difference in women's (dis)empowerment in agriculture between our study's patrilineal and matrilineal regions. Specifically, survey participants' perception of women's participation in decision making concerning land use, purchases, and credit show mixed results for the two regions. Women in the Upper West (a patrilineal region) are the most disempowered, yet women in the Northern region (also patrilineal) are more empowered than women in the Ashanti and Brong-Ahafo (matrilineal) regions. In both the matrilineal and patrilineal regions, we find that men may dictate women's engagement in agriculture regarding commodities, scale of operation, location of business, use of income, investment in assets, business association, and use of time.

Gender division of labor

The time domain includes two indicators (leisure and workload), and these are related to a gender division of labor. Leisure is one of the top contributors to women's disempowerment in our Q-WEAI study, with women more disempowered (score = 45%) than men (score = 63%) (Figure 1). This does not mean that women find no time for relaxing or other leisure activities, but leisure is one of the most critical indicators for addressing women's empowerment as per the Q-WEAI results. As previously noted, women are also critically disempowered in “control over use of income,” and we find that this overlaps with the leisure indicator in terms of spending income on leisure. FGD participants (men and women) say men spend more time on leisure as well as more money on “entertainment” and “past-times” than women. Regarding workload, women are also more disempowered than men

(Figure 1), and the FGDs show that women's workload at home and on-farm is heavy. Our findings on women's disempowerment in leisure and workload confirm the "time poverty" that women face in relation to gender division of labor, which places responsibility for housework and childcare on women and girls, regardless of women's farming or other work (Chant, 2006; Folbre, 2006).

During the FGDs and in the surveys, participants were asked about gender roles and activities performed at home, on the farm, and off the farm. We find that despite an increased acceptance of males—particularly boys—assisting with housework and childcare, the bulk of such work is still placed on females in the study sites. Regarding gender roles, FGD participants perceive that activities are not as rigidly divided between male- and female-only activities as in the past; today in their communities, girls may engage in work that the FGD participants label "difficult" (e.g., construction, repairs, and large animal rearing) and boys may engage in work that FGD participants consider "soft and for females" (e.g., fetching water, cooking, and caring for babies). FGD participants perceive that among household work, childcare is one of men's most common activities with this caveat: *when men are at home* and there are children, they prefer to care for them by watching them play, playing with them, or putting them to sleep *rather than* doing any other activity besides construction.

When probed about the intensity of work, both FGD and survey results show that girls and women maintain the greatest involvement in housework and childcare. Participants say: girls are raised to stay at home with their mothers, and boys to follow fathers to farms when they are not in school; girls do more housework than boys. During an FGD, a man from Akrobi states, "Boys do not stay at home. They like playing with friends in the community so you will hardly get them to sweep." A man in Babasso summarizes the local gender roles in agreement with participants: "When there are both boys and girls, there is division of labor. But nothing stops any of them from doing work at home." A woman in Konbiahi clarifies, "If you have only boys, they will definitely do what people call ladies work." A woman in Sekyedumase confirms this, "I had no girls, so all the home chores were done by my boys."

Regarding the intensity of men's contributions to housework, women in Nkonsia agreed with this FGD participant statement: "Our men only work on the farms. They think they should not bring themselves down to doing jobs at home which are for women and children." Mangoase women agreed to a similar statement. In a mixed-sex group in Zuo, a man states, "We [men] do little of the day-to-day housework, but when it comes to fixing leaked roofs and bulbs and other things that are very physically challenging, we are not found wanting." A woman in Mangoese says, "The fact is most of the time, during the day, men are not at home; they are in the farm or at the common sitting place for men in the community, so you cannot call them to assist in anything." Women in Mangoese and Tuobodom echoed that statement. A Gbabshei woman adds, "Some of the men are good, so they wash their own clothes and start cooking when you [i.e. women] are late in coming home from the market."

In sum, as expected from the scholarly research (e.g., Gillies, 2003), we find that gender roles place a heavier housework and childcare workload onto females in comparison to males. In addition to these activities, women farm with their husbands or as heads of household. A woman in Nkonsia says the farm workload is high because the input cost is too high: "We cannot hire labor and pay for fertilizer and the herbicides, so we do everything ourselves [without technologies]. Farming is too physically challenging." Study participants also say that women's participation in agricultural marketing on their own behalf and for family farms has been less restricted to women than other activities in the agricultural value chain (see also Doss, 2011). In this study, the majority of men work mostly on their farms. Only a few husbands take care of livestock outside the home, and occasionally husbands work as paid laborers on other people's farms within or outside the community.

DISCUSSION

The survey results on technology awareness, use, motivation, and perceptions of constraints and gains show that the ICST capacity of both men and women is being built in Ghana. The Ghanaian Government's response to improving smallholder participation in its agricultural modernization agenda has been to provide subsidies and development projects to increase the adoption of new and improved technologies (Buah et al., 2011). In Ghana, most agricultural technology transfer programs of the last two decades have targeted women, especially those who belong to recognized farmer-based organizations or out-grower/contract farming schemes. This is in response to the recognition that developing women's technical and entrepreneurial skills is critical given the increasing food demands, the changing context of agricultural trade, and the unpredictable long-term effects of climate change; technology development and transfer in Ghana have been largely driven by capacity building with women's empowerment as a key strategy (Njobe, 2015).

This government strategy, particularly the targeting of women's groups for trainings and access to credit, appears to have had a positive (although insufficient) effect on women's empowerment in our study sites. As noted in our results, institutional support through government and nongovernment programs is touted for improving women's empowerment, particularly through women's groups that receive trainings to participate throughout the agricultural value chain. Trainings for women that study participants largely referenced were for obtaining credit, and this is also reflected in the Q-WEAI results, which reveal women are more empowered than men in access to credit. This appears related to the sprawl of microcredits and "savings and loans" that target women and is located closer to rural communities, as observed by team researchers in our study sites and as documented elsewhere (Global Forum for Rural Advisory Services [GFRAS], 2013). In rural Ghanaian communities, governmental and nongovernmental organizations organize women in groups, provide financial literacy trainings, and link them to financial institutions (rural and community banks, savings and loans companies, and microfinance schemes). GFRAS (2013) notes that over the past two decades, there have been several efforts to overcome gender biases in advisory services that have had positive outcomes in rural Ghana.

While women's growing capabilities as a result of these programs that target women have been touted, some researchers suggest that many of the property rights and technology-related projects have been implemented with only modest achievements for women's empowerment (Domingo et al., 2015; Huyer & Mitter, 2003). For example, community leaders are sometimes engaged and convinced to change their stance so that women will have greater access to and control over resources, but this often lasts only for the life of the project. At the end of the project, women revert to prior positions; only in a few cases have women kept their new positions, such as to be able to use the land for a different crop, rent land out to a new user, invest in livestock, maintain savings accounts, and use funds at will (Domingo et al., 2015).

In this study's PHLIL Ghana sites, the importance of participating in groups for social and economic benefit is not lost on farmers regarding the postharvest of maize, but barriers to women's leadership reflect gender norms that are biased in favor of men as given leaders in mixed-sex groups. Other studies find similar barriers to women's empowerment in the leadership domain (Baden, 2013). Gotschi et al. (2008, p. 650) find that, despite women's participation in groups, it is "difficult to transform social relations into improved access to information, access to markets, or help in case of need" for women; they add: "While there were no significant differences in the investment patterns of men and women in terms of participation in group activities and contribution of communal work, access to leadership

positions and benefits from social capital were unequally distributed" in favor of men. Domingo et al. (2015, pp. 79–80) discuss gender norms in and beyond group settings that perpetuate gender inequalities:

> "[I]mportant constraints to women's participation in organised groups remain and there is only so far that collective action can go in addressing deep-rooted inequalities … [R]estrictions on women's mobility or the burden of care work can create barriers to women's participation in meetings and prevent women from assuming leadership roles … [W]omen are often excluded from formal or informal networks in the private sector, with gender-based stereotypes and a lack of role models often blocking women's professional advancement and limiting their voices in business communities and policymaking."

Thus, group participation and access to credit, while important steps for empowerment, do not sufficiently address gender norms that foster inequalities along value chains. Indeed, our Q-WEAI results show women are more disempowered than men in agriculture regardless of the years of programs targeting women as beneficiaries through groups and access to credit.

A more meaningful approach to achieving significant change in women's empowerment beyond the life of a project would be to challenge deep-seated gender norms (e.g., a gender division of labor) that perpetuate inequalities and restrict women's empowerment in multiple domains. A major finding from our study is the inequitable division of unpaid household and care work. Gender inequalities reinforced by a gender division of labor have stalled women's empowerment in agriculture and other sectors.

How might gender inequalities impact the adoption of ICSTs in our project sites? While women's empowerment may impact women's technology uptake, this study is not able to report on a conclusive relationship between uptake/nonuptake of ICSTs and (dis) empowerment. Nonetheless, we find that although more women farmers than men farmers had been trained in the use of simple tools for detecting fungus, women farmers use these tools less than men farmers. This survey finding provides one example of how women's overall disempowerment in our study may potentially limit the adoption, transfer, and scale-up of ICSTs, and the ultimate impact of ICSTs on food security for smallholder farmers. In this study, cost is the main constraint of ICST use, and minimal demand on time (to use technology) is the main motivating factor for ICST adoption. The cost (constraint) of technology adoption particularly relates to the income domain, and the minimal time demand (or motivating factor) of technology use fits with the time domain. Two Q-WEAI critical indicators (i.e., low Q-WEAI scores) for women are control over the use of income and leisure, respectively, of the income and time domains. These critical indicators reflect gender norms that also relate to women's disempowerment in other domains (e.g., leadership). The combination of cost and time factors for ICST adoption and women's disempowerment in income and time suggests that women's group trainings and access to credit for women are not enough to scale up technology adoption among women.

Given our finding of the importance of cost and time for the adoption of ICSTs, women's disempowerment in the income and time domains may likely impact the adoption of ICSTs by women in the maize value chain. Again, however, we stress that we do not find a conclusive relationship between uptake/nonuptake of ICSTs and (dis)empowerment. Following a discussion of these critical indicators for women in our study, we propose policy recommendations to address these indicators to increase women's empowerment and technology adoption to improve food security.

Critical indicator: Control over the use of income

Women in our study sites are critically disempowered in their control over the use of income, and disempowerment in the income domain likely impacts women's adoption of technologies, as our study finds cost is a top constraint in the adoption of ICSTs. Women's empowerment in the income domain is also important for children's health and education because women and men often spend income differently due to the gender role of women as primary caregivers (e.g., Adeyemi, 2010; Koopman, 2009; Manda & Mvumi, 2010; Quisumbing & McClafferty, 2006; Sherah & Theuri, 2015; World Bank, 2007). Studying Ghana, Maxwell et al. (2000) find that, holding household structure constant, having a woman as head of household positively impacts calorie availability, reflecting differences in spending priorities between male- and female-headed households. Also conducting research in Ghana, Levin et al. (1999) observe that women earn lower incomes than men, but tend to allocate more of their budget to basic goods for themselves and their children, while men spend more on entertainment for themselves only. Our study results echo these earlier findings that women spend more on food, children's education, and medical care than men, and men spend more on leisure activities for themselves.

Women's disempowerment in their control over the use of income potentially creates barriers to ICST adoption, and this disempowerment is related to gender norms that perpetuate gender inequalities and impact women's control over income use in at least three ways. First, across our study sites, FGD participants say that married women always act in consultation with husbands. In male-headed households, this may create a barrier to ICST adoption if the husband prioritizes other expenditures. Given men's empowerment in production decision making in this study, men may, for example, prioritize spending on production technologies over postharvest technologies.

Second, gender norms limit women's income-earning potential. For instance, our study finds that men dominate management positions as well as mixed-sex group leadership positions, which builds one's skills and reputation as a leader and that, in turn, could open more opportunities for higher paying positions (e.g., management) (Mukhopadhyay et al., 2006). Other studies confirm that women in Ghana and elsewhere do not have the same opportunities as men to earn income, gain skills, and participate along the value chain; women face greater difficulties in transforming their labor into more productive employment activities (Dolan & Sutherland, 2002). In our study, women's income is less than men's, as expected from the scholarly research. Women's lower income due to gender norms likely hinders women's ability to spend on technologies, as cost is the main constraint to technology adoption in our study.

Third, gender norms include a “feminization” of responsibility for housework and childcare or a “care economy” that perpetuates unequal responsibilities and spending between men and women, particularly for children (Chant, 2006; Folbre, 2006). As such, women's ability to spend (their already limited) income on postharvest technologies is further limited by gender norms for which women spend more on food, children's education, and medical care than men. Of course, this type of women's spending is an important household contribution. However, regarding spending on food, increased calorie availability does not necessarily mean improved food safety and nutrition due to toxins related to improper postharvest drying and storage. Postharvest technologies increase food security (i.e., calorie availability and nutrition) and food safety, thus making ICSTs important for farmers involved in postharvest activities to access. Women's spending to improve household food security could go further by countering postharvest loss food insecurities with the purchase and adoption of ICSTs. The unequal responsibilities and spending between men and women are also evidenced in our finding that men spend more than women on leisure activities for themselves. Given the interaction of the empowerment domains, our findings

on women's disempowerment in their control over the use of income dovetails with the next critical indicator: leisure.

Critical indicator: Leisure

In our study, men and women participants agree that women are more disempowered than men in leisure and workload (both indicators of the time domain), and our Q-WEAI results reveal leisure as a critical indicator. Similar to women's disempowerment in their control over the use of income, gender norms related to time use hinder women's participation, and productivity along the agricultural value chain. Women's critical disempowerment in leisure reflects a gender division of labor, namely, women's unpaid labor in the form of housework and childcare that limits women's time for leisure as well as off-farm income opportunities.

Other studies confirm that women face time poverty due to a gender division of labor that normalizes the "feminization" of reproductive labor (housework and childcare) and a "care economy" based on women's unpaid labor; in other words, women's time poverty results from placing responsibility for housework and childcare on women in addition to farming or other work instead of a more equitable division of labor in the household (Chant, 2006; Doss, 2011; Folbre, 2006). Time poverty and a gender division of labor that impacts women's empowerment are observed in most agricultural value chains in Ghana (Kitalyi, 1998). Elsewhere, Dolan and Sutherland (2002, p. 28) find in Kenya's horticulture value chain that married women "faced the greatest time poverty, as they had to care for their husband and children, as well as fulfill their responsibilities at the packhouse and/or on farm." In our study, women face a heavier workload and less leisure time than men due to a gender division of labor. Women's disempowerment in time use has implications for ICST adoption, as the most important motivating factor for adopting ICSTs (for men and women) is minimal demand on time to use the technology.

RECOMMENDATIONS

Although women's participation in the activities that move harvested grain from the farm to the final consumer is significant, our study finds that women in the maize value chain are less empowered than men in the PHLIL Ghana study sites. This study speaks to concerns about food security and postharvest losses, as women's disempowerment constrains women's adoption of technologies (Morris et al., 2002; Okorley et al., 2001). The findings of this study suggest that gender equality programs, led by a range of development actors, need to more sustainably challenge rigid gender norms, especially a gender division of labor that disempowers women and girls (in comparison to men and boys) and potentially impacts multiple empowerment domains.

Despite the benefits of projects that target women's groups for access to credit and other trainings, both of which can increase women's empowerment, women's workload and related time poverty may not be lightened by projects aiming to address gender inequalities. This is problematic as studies find a link between gender division of labor and poverty in SSA (Kes & Swaminathan, 2006). Baden (2013, p. 304) finds in Ethiopia, Mali, and Tanzania:

> "[W]omen's lack of time and restricted mobility due to family responsibilities remains a barrier to many women engaging in markets as well as in marketing groups. Women's groups accommodate this more, for example timing their meetings to suit members' needs including caring responsibilities, since they are

> more flexible and responsive to women's needs, but efforts to reduce women's workload or address social attitudes to enable their effective participation in markets were not, in general, factored into the design of the interventions studied."

Projects that support gender equality but do not address the need to reduce women's workload or change social attitudes about care work or housework fail to ameliorate a major barrier to women's participation along value chains. Women and men may not equally benefit from the introduction of postharvest (and other) technologies if women are unable to adequately engage with technologies due to a gender division of labor that disempowers women as a social group across social, economic, and political arenas (Domingo et al., 2015, 95; Leonard & Tronto, 2007).

While acknowledging the complex and deep-seated inequalities associated with gender norms, we provide recommendations to move toward a more sustainable empowerment of women *beyond* the life of specific projects. Our study findings support the call for a more comprehensive approach to combatting gender inequalities, including a gender division of labor that impacts multiple domains of women's empowerment (Baden, 2013, pp. 306–307). Specifically, to better address this study's critical indicators (i.e., the related income and time domains), we recommend the following strategies for governments and nongovernmental actors working on food security and other development projects.

a. *Engage men, women, and community leaders in transformative gender norms education*:

Sociocultural institutions, including gender norms, create conditions that facilitate or undermine the possibilities for empowerment (Hill & Khan, 2008; Jacobs, 2011). We recommend that projects addressing women's empowerment in agriculture (and other areas) incorporate transformative gender trainings and workshops with men, women, boys, and girls to address gender norms for a more sustainable impact on gender equality at the local level. To reduce gender inequalities and better empower women—and in turn empower men and rural communities as a whole—transformative gender norms education would engage men and women across households and community leaders. Domingo et al. (2015) echo the need to engage a wide range of actors to alter gender attitudes and behaviors that hinder women's voice and agency along value chains.

Transformative gender norms education challenges rigid gender norms,including a gender division of labor that disempowers women and girls. Mukhopadhyay et al. (2006) provide examples of culturally appropriate transformative gender norms education (e.g., trainings and workshops) in developing nations with farmers and others. As part of our PHLIL project, we have included gender sensitization workshops for women and men that have included discussion and guidance for: husbands to support wives in their participation in leadership and capacity-building activities; men and women to improve workload sharing to reduce women's time poverty and more equitably distribute household and carework; community leaders to support gender equality and challenge rigid gender norms that have particularly disadvantaged girls and women in the areas of education, leadership, and entrepreneurship along the agricultural value chain. Among community leaders, for example, extension workers should move away from the traditional focus on household heads to ensure that women farmers are also included in trainings; in addition, extension services should be inclusive of women who face time poverty and limited mobility (O'Brien et al., 2016).

While we acknowledge the complementary work that men and women household members often do as well as women's unique role in the birthing and breastfeeding of

children, both men and women are providers for children and the responsibilities of caregiving and housework should not be assumed to be "women's work"; we also note that men and women's "responsibilities" have varied over time and place (Leonard & Tronto, 2007). In the agricultural value chain, for instance, men should be invited and trained in nutrition and processing alongside women, so that husbands may be as likely as wives to engage in feeding nutritious meals to their children. In our study, a woman in Tuobodom asserts, "A husband participating in any activity at home depends on his level of education or how enlightened he is; the enlightened men like to support [in housework and childcare] without fear of public criticism." By engaging men in addition to women, transformative gender norms education can help decrease women's time poverty and improve women's participation throughout value chains in Ghana and elsewhere.

b. *Increase funding to improve girls and women's levels of education*:

The education of females should be improved to contribute toward a more comprehensive approach against gender inequalities as well as to address our study's critical indicators (in the income and time domains). Female education levels are related to the need for transformative gender norms education, as our study finds that girls are more likely than boys to be pulled from school to assist with housework and childcare in our study locations. We find that a gender division of labor has limited females in comparison to males in terms of time to attend school and study at home, and education is linked with women's income and leadership.

Women's lower level of literacy and higher education compared to men in our study is concerning for various points in the agricultural value chain. In this study's survey, female farmers, traders, and aggregators have less education and wealth than their male counterparts (Appendix A), and our study finds that women's lower level of literacy compared to men appears to impact women's empowerment in the leadership domain. Not only is women's lower education level implicated in women's lack of leadership positions in mixed-sex groups as well as disempowerment in public speaking, according to our FGDs, but illiteracy may also impact women's ability to effectively use ICSTs (Njobe, 2015). Our survey shows that more women than men depend on relatives than the formal sector for technical information on ICSTs and that women are expected to depend on husbands and other adult men for agricultural information due to low levels of literacy (see also Kapitsa, 2008). However, previous studies reveal that it is problematic for women farmers to rely on husbands to disseminate agricultural technology information (O'Brien et al., 2016). Since improvement in women's empowerment is related to adult literacy, Ghana's community development and functional literacy offices of the local government should continue women's adult literacy classes. When women can read and write, women's empowerment and self-confidence in negotiating rights in the home, in mixed-sex groups, and in the market should increase, and this could reduce the negative impact of gender inequalities on technology adoption and food security.

State and nongovernmental budgets supporting education should be increased and incentive packages developed to further boost women's enrollment in literacy classes as well as girls' enrollment in secondary/higher education. Along the agricultural value chain, women's education level is related to child nutrition. Smith and Haddad (2000, p. 2) find women's education "relative to men's to be strongly associated with child malnutrition in developing countries. Improvements in female secondary school enrollment rates are estimated to be responsible for 43 percent of the total 15.5 percent reduction in the child underweight rate of developing countries during the period 1970-95." Consequently, supporting the education of girls through secondary school, especially in rural communities, is important for improving both women's empowerment in agriculture and child nutrition. In

addition, our survey finds that women are more likely than men to work in processing (Appendix A). This indicates that women should be key targets for interventions to improve nutrition through the processing of maize. However, as previously noted, we stress that men should also be involved in interventions to improve nutrition to challenge rigid gender norms and increase men's participation in the feeding of nutritious meals to children. Our recommendation to improve girl's and women's education does not negate the importance of boy's and men's education.

c. *Increase mixed-methods research to better address data gaps, and to develop and evaluate women's empowerment measurements and projects*:

Although development projects have targeted women with interventions that can impact food security, women's empowerment (e.g., in leadership) related to gender equality agendas "remains fundamentally under-explored" (Domingo et al., 2015, p. 85). To ensure that agricultural technology programs contribute toward gender equality, Kes and Swaminathan (2006, p. 24) stress the research "need to identify the community specific causes of why women are unable to access these technologies and subsequently address these in their design to make sure women benefit equally [with men] from their interventions." Responding to these research gaps, we recommend mixed-methods (qualitative and quantitative) research and the development and evaluation of women's empowerment measurements and projects.

Specifically, more time-use analysis is needed to address data gaps, especially regarding the intensity of workloads that impact income and time in developing nations (Bardasi & Wodon, 2006, p. 76). Advocating both qualitative and quantitative methods to analyze local social norms and time use patterns, Kes and Swaminathan (2006, p. 27) write, "Time use analysis can strengthen the policies in sectors that are identified as key to reducing poverty and improving living and working conditions of women, including agricultural modernization and commercialization…" For evaluating policies and interventions, time-use analysis tools should be designed for local contexts and local perceptions of time, and they should "capture individuals' work intensity and the tradeoffs they face" to avoid omitting women's household and "care activities" as work (Kes & Swaminathan, 2006, pp. 24–25). Additionally, "agriculture is the dominant sector in SSA and there are distinct seasonal variations in the workloads of women and men. Therefore, it is important to undertake the surveys over a year at different points in time to capture the impact of seasonality" (Kes & Swaminathan, 2006, p. 25).

In the design of development projects, measuring gender division of labor in housework and childcare should be incorporated to provide insights into women's empowerment. Folbre (2006) "suggests developing measures of individual disposable income and individual disposable time that would be net of financial and time responsibilities associated with care. In addition, she suggest[s] measures that would particularly incorporate gender gaps in disposable time and income as well as care responsibilities" (cited by Klasen, 2006, p. 146). Discussing gender-related human development measures, Chant (2006) calls us to "improve the quality and coverage of sex-disaggregated data on material poverty, on the economic returns of male and female labor, and on gender differences in expenditures in work time and time use" (cited by Klasen, 2006, p. 147). As adapted for our study, the WEAI is one tool that can assist in this research area.

Researchers should evaluate tools that measure women's empowerment in comparison to men's. In particular, our Q-WEAI study raises questions for further research and evaluation of perceived versus actual levels of empowerment between men and women. Future studies should evaluate the measurement of empowerment with qualitative and quantitative data to determine if local gender norms impact the study participants' perceptions

of empowerment in comparison to the actual practices that the WEAI domains seek to measure. For instance, when inquiring about empowerment in the leadership domain, researchers should dig deep into the extent of women's participation in decision-making roles at the community level, as the perception of women's empowerment in comparison to men may contrast with women's actual leadership roles in community groups. Studies should also disaggregate data on the women who are in leadership roles in single- and mixed-sex community groups. Our study's focus groups suggest that more educated or formally employed women, if any, may serve in some leadership roles (although not in the top positions) in mixed-sex groups. This echoes findings from Kabeer (2011), whose studies from Ghana, Egypt, and Bangladesh, show that "women in formal employment were more likely to be treated with respect within their community and consulted by others for advice and information" (cited by Domingo et al., 2015, p. 77).

Assessing empowerment within and across the WEAI domains requires qualitative and quantitative methods to illuminate differences between perceptions and the actual extent of gender inequalities. For example, our Q-WEAI results on asset ownership show women as slightly more empowered than men, but men were much more likely than women to own "vehicles" and enterprises, and women's engagement as owners of livestock enterprises was lower than men's. (Some women raise small ruminants and local poultry on a subsistence basis, but not as an enterprise.) Costlier assets in our study are owned or managed by men, yet men's perceptions in our study suggest that they, nevertheless, feel disempowered compared to women in asset ownership. Similarly, Rustad (2016) finds a disconnect between perceived and actual inequalities among social groups, but that study did not examine gender inequalities or empowerment.

Regarding access to credit, even if women are found to be empowered in this area, future research should ask, "Do married women have equitable control or decision-making power over the use of that credit?" In our study, women in FGDs report that they "consult with" their husbands. Does such consultation mean equitable household bargaining power for men and women? In one study of Ethiopian farmers, consultation means that the husband tells the wife what is being done, and this does not reflect the WEAI vision of actual empowerment for women in decision making (O'Brien et al., 2016).

Mixed-methods studies should be designed to evaluate male and female perceptions versus actual extents of (dis)empowerment across WEAI domains. Our findings on men's perceptions of their disempowerment in comparison to women lead us to ask: Do some men view women's empowerment as a win-lose proposition rather than a mutual benefit for households and communities? Do local social norms on masculinities and femininities, gender roles, and gender relations impact participants' perceptions of (dis)empowerment, especially in programs that explicitly include women's empowerment as a goal? Thus, future studies on empowerment and gender equality projects should also incorporate questions to evaluate the impact of measuring and promoting women's empowerment on men's perceptions of gender inequalities and their own empowerment in comparison to women. If local men's perceptions of their disempowerment outweigh their actual disempowerment compared to local women, then development projects should improve the translation of gender equality goals in that locality.

Further, more research is needed to evaluate gender equality agendas, including programs promoting ICSTs, as gender norms can impact the adoption of storage technologies for food security. For instance, income is an important domain for entrepreneurship and investment in postharvest activities, including the adoption of ICSTs, and gender equality programs would ideally improve married women's household bargaining power toward more equitable control over income. However, more research is needed to evaluate programs' impact on developing capacities and social norms that foster equitable male and female relationships at the household and community levels. Are gender

equality agendas and their related programs contributing to more equitable relationships between males and females in households and communities? Have men's views shifted from patriarchal norms toward an understanding of the importance of gender equality for the household and community? In addition, more mixed-methods research is needed to assess the effect of targeting women during technology transfer processes on gender relations and inequalities as well as to assess the design, introduction, and monitoring of technologies for women's empowerment. What is the relationship between the transfer of maize storage technology and gender disparities in Ghana?

More specifically for Ghana's gender equality agenda, future studies should evaluate the impact of Ghana's Gender and Agricultural Development Strategy (which began in 2016) and its national Gender Policy (launched in 2013) on women's participation in agricultural value chains, as both of these policies prioritize women's empowerment. Have Ghana's gender equality policies effectively challenged patriarchal social norms and improved women's participation in the food system? What is the state of women's empowerment in agriculture in relation to Ghana's gender equality policies? Such questions could also be applied to evaluate gender equality agendas beyond Ghana.

d. *Reduce time poverty, especially for women and girls, through improved access to basic infrastructure services (e.g., water and electricity) and time-saving technologies*:

Governments and partners should invest more in infrastructure and technologies to decrease time poverty related to household and care work duties (Domingo et al., 2015, p. 95). A "constraint to development in Sub-Saharan Africa," women's time poverty is due in part to "a lack of access to basic infrastructure services such as water and electricity" and "care economy" demands (Bardasi & Wodon, 2006, pp. 91–92). Beyond farming, rural women and girls in SSA: are primarily responsible for traveling to fetch water and biomass fuel (e.g., wood) for cooking; experience higher "time poverty" than men and boys; and, after accounting for time spent working in paid and unpaid labor, women, and girls have less time for rest and leisure than men and boys (Bardasi & Wodon, 2006). Time poverty impacts monetary poverty, time spent by children working instead of being enrolled in school, and the nutritional status of children (Bardasi & Wodon, 2006, p. 92). Bardasi and Wodon (2006, p. 76) explain:

> "In Sub-Saharan Africa, the issue of time use is especially important because of the high workload carried by many and the relationship between time use and consumption poverty. Households have a high probability of being consumption poor, so that any opportunity to enable them to make a better livelihood, for example by shifting time from low- to high-productivity activities should be pursued."

Investments to decrease "household time overhead" and its related time poverty would "reduc[e] the tradeoffs among competing uses of scarce labor," and this would "have important multiplier effects on improving health, saving time, and enabling girls to go to (and stay) in school" (Kes & Swaminathan, 2006, pp. 27–29). Poverty reduction and nutrition strategies should, therefore, address women's time poverty.

In our study, women state that they want time-saving technologies, and we find that time and income are critical areas for women's adoption of ICSTs. Governments and partners should create and disseminate time-saving technologies to increase women's participation in formal labor, which itself improves household nutrition (Kes & Swaminathan, 2006, pp. 22–23, 27). Addressing women's immediate and practical concerns related to time-intensive

work, including domestic work, is important to achieve the long-term goals of women's empowerment in agriculture and other value chains.

LIMITATIONS AND FUTURE STUDIES

We call this a quasi-WEAI or Q-WEAI study to acknowledge the influence of the WEAI on our study and analysis. Barring the limitation of not employing the WEAI, the information collected from women and men actors in the value chain is useful and appropriate for our study. We included key informants who are leaders and technical experts to validate and fill any gaps in information. Interviewing spouses (as done in the WEAI) may have some value addition, but our lack of spouse interviews should not minimize this study's results. Future studies could employ the WEAI. This study did not administer the WEAI, which at the time of this study did not include all 10 of our context-specific technologies that we include in our survey.

One may view our inclusion of actors along the value chain as a study limitation. The two main findings from our Q-WEAI—that cost and minimal demand on time promote ICST uptake—were derived from a sample that included farmers, as well as warehouse operators, input dealers, maize traders, and maize aggregators. Given that the actors further along the maize value chain may be using more and different types of ICSTs that are more high-end and costly, their reasons for constraints on cost will likely be different than that for maize farmers. Actors further along the value chain have a different livelihood situation and agricultural enterprises than most maize farmers, and the stated factors affecting uptake may be for different reasons. For example, actors further up the value chain may have employees that use the technologies rather than actually using the technologies themselves, so their reference to minimal time demand could relate to the wages they pay employees, and hence impact on business profits, rather than the demand on their own time, which will rather likely be the case for maize farmers. Analyzing all actors in the value chain could risk confounding the Q-WEAI results, but our key gendered findings did not change when we separated the actors. This study focuses on women's empowerment in the value chain. We asked men about both men's and women's empowerment; we asked women about both men's and women's empowerment. Our study's inclusion of actors along the value chain is an important contribution to assessing perceptions of empowerment. Moreover, we stress that the relationship between the empowerment results and the technology uptake is suggestive, not conclusive. Next, we discuss how our survey results on ICST uptake relate to the livelihood situation and agricultural enterprise of each actor.

We asked Q-WEAI survey participants to describe their personal perceptions of and experiences with postharvest technologies and institutions (e.g., credit) for maize farming. The actors along the value chain are all involved with maize farming, and the majority of survey participants are maize farmers and not further along the value chain, even though those actors may also farm. For example, we surveyed only 20 warehouse operators and 20 input dealers compared to 145 maize farmers (Table 2). We asked Q-WEAI survey participants to rank factors that would motivate them to continue to use or start using the maize farming technology, and their rankings support our general findings if we pool or separate actors (Supporting Information: Annex 1). Farmers harvest maize for home consumption and surplus sale to aggregators and traders. Famers' livelihood concern is food security, and they highly rank time-saving technologies with little or no negative consequences on health. Input dealers are enterprise operator/owners whose livelihood concern is increased income. The key consideration for both male and female input dealers from our survey is whether the time spent in applying technology is long or short. Warehouse operators are enterprise operator/owners who receive fresh grain for medium- to long-term

storage, and their livelihood concern includes increased income and environmental soundness. Both male and female operators are motivated by the time-saving and minimum negative consequence character of technology. In our context-specific Q-WEAI survey, all 10 technologies, except the plastic and steel silos, can be time-consuming for warehouse operators; they prefer bagging in 50–100 kg bags and stacking packaged grain to storing in small containers (less than 7 Mt). Men and women warehouse operators and input dealers stressed their preference for less time-consuming technologies, but the women also ranked a low level of capital investment as important for increasing their use of a technology.

In our survey, male and female traders and aggregators appreciate technologies with a minimum demand on time and a low level of capital required. Traders are merchants who buy bulk and operate as wholesalers or buy from wholesalers and operate as retailers of grain to consumers (to prepare human food or animal feed). They hold inventory to assure regular supply. Traders' key livelihood concern is increased income. Any technology that assures food safety, is patronized by other actors in the value chain, and can easily be financed will interest traders. These maize retailers hold small volumes, and they are more likely to adopt the food and pheromone-baited traps for monitoring insects, and the hermitic bags and silos. Aggregators are merchants who buy for traders and agro-processors in the industry (manufacturing animal feed or human food); they travel to the cottages and hamlets to assemble grains for bulk distribution. They hold inventory to assure regular supply and occasionally speculate on price. Aggregators' key livelihood concern is increased income. Any technology that assures food safety, is patronized by other actors in the value chain, and requires low investment will interest aggregators. Such technologies are applied at the least cost. Maize aggregators usually buy and hold bulk stocks for distribution; they are more likely to adopt the food and pheromone-baited traps for monitoring insects than any of the nine other technologies. In sum, less time-consuming and labor-demanding technology tends to have demand from farmers, traders, and other actors in the value chain. Perhaps, doing business in technologies that save time can result in a higher return on investment due to more rapid sales. Future studies could assess more nuanced differences in technology uptake factors across the value chain actors that go beyond the scope of this study.

While our study finds that women are more disempowered than men, both men and women need to be more empowered in agricultural value chains. However, we emphasize that more research is needed to evaluate men's and women's perceived empowerment versus actual empowerment in agricultural value chains. As discussed, a word of caution in the Q-WEAI results on men's disempowerment, in particular, is in order due to what appears to be discrepancies between perceived versus actual disempowerment of men in comparison to women (e.g., in assets). In this vein, there may be differing ideas of (dis) empowerment by study participants. For example, one idea of disempowerment may reflect rigid gender norms that assume men should have some power over women in contrast to shared power with women in a household; male participants may ascribe to a rigid view of masculinity rather than accepting a wider range of possibilities or masculinities. Rigid gender norms, which favor a patriarchal view of men and women, contrast with the Q-WEAI (and WEAI) vision of women's empowerment. As such, if a male study participant adheres to a rigid gender norm, then he may perceive that he is disempowered if his wife gains access to credit through a women's group (and he does not gain access through his men's group) even if she does not have full control over the use of that credit due to her husband's decision-making power. Regarding decision-making power, study participants may have different definitions of consultation, as another study (O'Brien et al., 2016) finds that “consultation” may mean that husbands inform wives about decisions rather than seeking their input. In our study, it appears that (some) men who feel “obliged” to consult with wives about decisions feel disempowered by this, despite the finding that women “always” consult with husbands—this is an example of discrepancies between perceived and actual

disempowerment in comparing men and women. Thus, future studies should analyze perceived versus actual (dis)empowerment from the researcher's standpoint.

Future studies should investigate men's and women's perceptions of their own empowerment in relation to development projects. One such example of a study on women's empowerment in an agricultural development project is O'Brien et al. (2022), which employs qualitative methods like participatory research activities to understand context-specific interpretations of empowerment. Since quantitative measures of empowerment (like a survey) applied across contexts can miss localized meanings, we recommend qualitative methods to gather nuanced explanations of perceived empowerment from study participants themselves. Qualitative methods can help us to better understand men's and women's different perceptions of empowerment and gender-based constraints/opportunities within the same context, as perceptions of empowerment may not match with less expressive quantitative measures of empowerment. It would be useful, for example, to determine if men perceive any increase in women's empowerment as a decrease in men's empowerment. Some men in Ghana and elsewhere in Africa have reported to at least one coauthor of this paper that women's empowerment must disempower men because they view women's empowerment as a zero-sum game. However, studies show that women's empowerment can improve household income, nutrition, and other areas of well-being for men and communities too (O'Brien et al., 2022). Thus, we further encourage development projects seeking to empower women to educate study participants, households, and communities about the benefits of women's empowerment for men, families, and communities, and to educate that both men's and women's empowerment are not mutually exclusive.

CONCLUSION

In this PHLIL Ghana project study, we collected data from more than 400 stakeholders, primarily farmers, in the maize value chain. Our findings confirm that ICSTs help decrease postharvest losses and improve food security by increasing the time that grains can be safely stored and the number of families who could afford three meals a day after the use of an ICST. However, women as a social group are disempowered compared to men working in the maize value chain, and this likely hinders the impact of ICST contributions to improve household food security. Future studies should determine if there is a conclusive, known relationship between the uptake/nonuptake of ICSTs and (dis)empowerment.

Drawing from the pioneering methodology of the WEAI and conducting a Q-WEAI analysis, we find that cost and time poverty are the most important factors influencing the adoption of ICSTs, and relatedly, women are critically disempowered in the income and time domains. Despite international partnerships with state and non-state agencies in multiple African countries to address food security (Cotula et al., 2011), our findings highlight the need for governments and development partners to implement more substantive gender equality agendas to empower women in agricultural (and other) value chains. In particular, women's time poverty related to rigid gender norms hinders women's participation in agricultural (and other) value chains. Women's empowerment will likely be a continuous struggle over time, as regression in gender equality has been evidenced historically and globally, especially if community leaders return to or maintain rigid gender norms at the local level. Thus, we recommend a multidimensional approach to achieve women's empowerment across the domains with special attention to reducing women's time poverty through: (1) transformative gender norms education that engages men, women, and community leaders; (2) investment in improving levels of female literacy and secondary/higher education; (3) mixed-methods research to address data gaps and evaluate women's empowerment measures and projects;

and (4) investment in infrastructure and time-saving technologies that address women's practical needs and gender role constraints.

Incorporating gender equality agendas in a sustainable manner beyond the life of a project is of utmost importance for decreasing poverty and improving household food security. This requires challenging social norms that perpetuate gender inequalities, which our study confirms disadvantages women as a social group. Perhaps, most importantly for researchers, our study reveals the need to measure perceived versus actual gender inequalities, as gender forms a part of sociocultural norms that may reflect a patriarchal perspective that disavows the importance of women's empowerment. In research on poverty alleviation, food security, and the promotion of gender equality in rural Africa, Guèye (2000) stresses the importance of taking sociocultural issues into account when designing, implementing, monitoring, and evaluating development projects. Our PHLIL Ghana project heeds this call through ongoing gender analysis of local maize value chain sites. Informed by an in-depth gender analysis, this study's recommendations can be applied to other agricultural technology projects as well as other economic sectors that interest policy-makers, researchers, and development partners.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A

Table A1.

TABLE A1 Sociodemographic characteristics of respondents—farmers.

Characteristic	Men	Women
Age (years)		
Range	21–73	26–74
Mean	42	44
SD	11.7	11.0
Education		
% Literate	56	26
% Illiterate	44	74
Religion		
Christian	43	46
Muslim	53	54
Traditional	4	0
Marital status		
Married	84	90
Single	16	10
Other occupation		
Trading	61	83
Processing	0	6
Wage work	5	6
Artisanship	34	5
Crops other than maize[a]		
Cereals	64	23
Legumes	84	74
Roots and tuber	30	40
Vegetables	39	47
Fruits	9	7
Wealth rank (GHS total earnings)		
≤5000	75	93
>5000	25	7
Location		
Ashanti	20	30
Brong-Ahafo	18	33

TABLE A1 (Continued)

Characteristic	Men	Women
Northern	31	23
Upper West	31	14
Perception of quality of life		
Child education	92	98
Medicare	90	77
Water/sanitation	93	95
Asset (mobile phone)	85	86
Concrete wall/aluminum roofing	33	32
Transport	87	90

Abbreviation: GHS, Ghana currency code.

[a]Maize is a seasonal crop grown as monoculture or polyculture. Maize farmers also grow root and tuber crops, such as yam, cassava, and cocoyam; other cereals, such as millet, rice, and sorghum; nuts and pulses, such as beans, cowpea, soya beans, ground nut; vegetables, such as okro and pepper. About 50% of maize harvested by households is sold. For households that harvest large volumes, higher proportions are sold. In households where maize is cultivated for both cash and food, when maize is in season, income from maize may form a larger proportion of household income.

Source: Survey data, July 2016.

APPENDIX B

Table B1.

TABLE B1 Proportion of respondents confirming participation in maize production activity all of the time.

Activity	Male (%)	Female (%)
Land preparation	83	81
Planting	96	97
Taking care of field (weeding, pesticide, and fertilizer application)	84	79
Group farm labor	81	68
Harvesting	97	98
Transport from field	99	95
Shelling	94	93
Drying at home	97	98
Bagging	98	97
Application of chemicals to harvested maize	34	21
Storage	83	81

Source: Survey data, July 2016.

APPENDIX C

Table C1.

TABLE C1 Factors that will motivate respondents to continue to use or start using the technology (mean rank results from individual sample survey).

Factors	Warehouse operators		Input dealers		Traders		Aggregators		Farmers	
	M	F	M	F	M	F	M	F	M	F
Interest is shown by other actors	3.83	7	4	6	3.46	4.34	4.08	6.44	3.93	3.93
Capital to invest is available at low interest rate	4.83	4.5	4.63	4	4.23	4.05	4.63	5.5	5.6	4.65
Low level of capital investment is required	5.28	4.5	4.42	3	5.08	4.6	4.13	2.5	5.55	5.53
There are no negative environmental consequences	2.78	1	3	7	3.15	4.35	3.69	4.31	3.14	3.66
There is minimum demand on time to use technology	2.33	2	2.68	2	4.46	4.07	3.73	4.75	3.82	3.83
Technology is readily available in the community	6.89	3	6.42	1	5.38	4.84	5.29	5.13	5.5	5.51
My peers are using/ doing business in it	5.39	6.5	5.37	5	4.62	4.05	4.54	3.06	3.81	3.2
My spouse agrees to the suggestion to use it	4.67	7.5	5.47	8	5.62	5.71	5.92	4.31	4.65	5.69
Test statistics										
Male	Warehouse	*N*	18							
		Kendall's *W*[a]	0.365							
		χ^2	46.037							
		df	7							
		Asymp. sig.	0							
	Input dealer	*N*	19							
		Kendall's *W*[a]	0.267							
		χ^2	35.509							
		df	7							
		Asymp. sig.	0							
	Trader	*N*	13							
		Kendall's *W*[a]	0.127							

TABLE C1 (Continued)

Factors	Warehouse operators		Input dealers		Traders		Aggregators		Farmers	
	M	F	M	F	M	F	M	F	M	F
		χ^2	11.564							
		df	7							
		Asymp. sig.	0.116							
	Aggregator	*N*	24							
		Kendall's *W*[a]	0.101							
		χ^2	16.895							
		df	7							
		Asymp. sig.	0.018							
	Farmers	N	88							
		Kendall's *W*[a]	0.154							
		χ^2	94.704							
		df	7							
		Asymp. Sig.	0							
Female	Warehouse	*N*	2							
		Kendall's *W*[a]	0.952							
		χ^2	13.333							
		df	7							
		Asymp. sig.	0.064							
	Trader	*N*	43							
		Kendall's *W*[a]	0.053							
		χ^2	16.006							
		df	7							
		Asymp. sig.	0.025							
	Aggregator	*N*	16							
		Kendall's W[a]	0.27							
		χ^2	30.25							
		df	7							
		Asymp. sig.	0							
	Farmers	*N*	57							
		Kendall's *W*[a]	0.159							
		χ^2	63.624							
		df	7							
		Asymp. sig.	0							

Abbreviations: Asymp. sig., asymptotic significance; F, female; M, male.

Source: Survey data, July 2016.

[a]Kendall's coefficient of concordance.

APPENDIX D

Table D1.

TABLE D1 Farmers' ranking of activities that males and females engage in at home.

Activity	Rank[a]			
	Boys	Girls	Men	Women
Sweeping/cleaning of the house	5	1	8	5
Water fetching	2	5	3	4
Washing (clothes)	4	4	4	3
Cooking meals	9	3	9	2
Child care	5	2	2	1
Animal care	1	6	5	8
Petty trading	6	7	6	6
Agro processing	7	8	7	7
Building construction	3	9	1	9
Molding of bricks				
Support process				

[a]1 = *most done activity*; 9 = *least done activity*.

Source: Survey data (and cross-checked with Focus Group Discussion data).

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