The influence of women's empowerment on poverty reduction: A case of smallholder sugarcane farmers in western Kenya

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Abstract

This study uses primary data from smallholder sugarcane farmers in Kenya to investigate how women's empowerment affects household poverty. Instrumental-variable tobit (IV tobit) was used to determine the causality between women's empowerment and household poverty. The results reveal that poverty levels in households with empowered women are low compared to households without such women. Besides, education level, credit access, market access, land size, and crop and income diversification contributed positively to women's empowerment and to the reduction in household poverty. The domains that contribute significantly to women's disempowerment in sugarcane farming are income, work balance and leadership. These results suggest that strengthening women's control over income and their leadership position in society are vital domains that should be targeted by rural development interventions to improve the livelihoods of smallholder women sugarcane farmers. In addition, there is a need to intensify crop diversification and increase women's access to markets.

Key words: women's empowerment, sugarcane, instrumental variable, Kenya

1. Introduction

Empirical evidence shows that empowering women in agriculture contributes to improving households' food and nutrition security and reducing poverty in low- and middle-income countries (LMICs) (Sharaunga *et al*. 2015; Clement *et al*. 2019; Galiè *et al*. 2019; Jones *et al*. 2020; Anderson *et al*. 2021). Although empowering women is an end goal in itself for most agricultural research for development (AR4D) initiatives, many interventions currently consider it as a strategy to enhance household welfare through aspects such as food security, poverty reduction and nutrition. In the

context of empowerment and nutrition, empirical evidence shows that, when income is under women's control, child and household nutrition is more likely to improve, as women tend to allocate their income to household needs such as purchasing nutritious food (Sraboni *et al.* 2014; Malapit & Quisumbing 2015; Malapit *et al.* 2015). A macro-level study done in Tanzania, Uganda and Malawi shows that empowering women in agriculture reduces the incidence of undernourishment, with an additional 80 000 people being nourished sufficiently annually (UN Women et al., 2015). Women's empowerment is the process by which women gain the ability to access and make decisions on production resources, have control over household income, and have the ability to participate in communal leadership (Kabeer 1999).

Despite women's indispensable role in household well-being in LMICs, they face persistent obstacles and economic constraints that limit their empowerment and agricultural productivity (Mwololo *et al.* 2021). Recent studies have shown that farm plots owned or managed by women are less productive than those managed by men (Oseni *et al.* 2015; Slavchevska 2015; UN Women *et al.* 2015; Diiro *et al.* 2018). Gender inequalities arise due to the gender gap in access to crucial productive resources, in terms of which women lag in access to resources such as land, information and capital, despite them being the key contributors to agricultural development (Quisumbing & Pandolfelli 2010; Maher *et al.* 2015; Huyer 2016). Women are discriminated against the most in society, mainly due to negative cultural norms; and they have limited rights over participation in intra-household decisions such as farm management, or control over income (Fabiyi & Akande 2015; Dohmwirth & Liu 2020). Studies have shown that women have limited decision-making power over decisions concerning the purchase and sale of assets, and the type of crop to be planted (Damisa & Yohanna 2007). This undermines women's position in both agricultural production and purchasing power, hence resulting in an increase in the household's vulnerability to poverty.

Poverty is a multifaceted phenomenon that entails the inability of an individual or household to access basic needs, for instance not having access to enough and quality food, limited access to quality education, along with insecurity and exclusion (Alkire & Foster 2011). Therefore, the incidence of poverty not only negatively affects households' ability to buy goods, but also increases vulnerability to various risks and shocks that may prohibit a household or individual from having a quality life (Alkire & Foster 2011), and may even lead to the disempowerment of women. Against this backdrop, it can be argued that poverty and women's empowerment are interconnected. Despite many empirical studies showing a positive link between women's empowerment in agricultural systems and key development indicators (e.g. child and household nutrition, poverty alleviation, education and the development of human capital) (Fabiyi & Akande 2015; Diiro *et al.* 2018; Tsiboe *et al.* 2018; Galiè *et al.* 2019; Meinzen-Dick *et al.* 2019, among many others), it remains unclear what the association is between women's empowerment and household poverty for cash crop farming, in which women are the main labourers. Yet women are the major players in the agriculture sector in developing nations, comprising many farmers and farm labourers (OECD 2012). Only a few peer-reviewed studies have looked at drivers of women's empowerment in cash crop farming (Achandi *et al.* 2019). To our knowledge, no study has looked at women's empowerment and sugarcane farming in Kenya.

In Kenya, poverty alleviation is a major concern of the national government and non-governmental organisations (NGOs). Since independence, Kenya's development efforts have been geared toward alleviating poverty. However, to date, poverty levels remain pervasive, in particular in the rural parts of the country, with major sugarcane-growing zones like Kakamega county being among the poorest counties (Elezaj *et al.* 2020). The high incidence of poverty in sugarcane-growing zones in Kenya creates a need for empirical studies and the generation of new knowledge to inform poverty-reduction strategies. This study aimed to address this research gap by answering the following research questions: i) How does women's empowerment affect household poverty among smallholder sugarcane farmers in Kenya? and ii) apart from women's empowerment, what are other factors that

influence household poverty levels among smallholder sugarcane farmers in Kenya? The findings of the study will help to understand what is needed to change the conditions of poor, vulnerable and powerless women.

The rest of the article is organised as follows. The next section presents the methods used to collect the data and undertake the analysis. The third section presents the results and discussion. Conclusions and recommendations are presented in the fourth section.

2. Methodology and study area

2.1 Study area

The study was conducted in Kenya's sugarcane-growing zones, focusing on smallholder sugarcane farmers. We considered smallholder sugarcane farmers to be households that farm sugarcane on less than 20 hectares of land, and they also practise mixed farming, in which they grow crops and keep livestock. However, they depend more on sugarcane as their primary source of livelihood. Some households' heads supplement their income by engaging in off-farm income-generating activities, such as doing business or being employed as casual workers (Netondo *et al*. 2010).

2.2 Sample size and sampling method

The population of the study consisted of all dyad (both husband and wife present) households engaged in sugarcane-growing activities within the study region. A multi-stage sampling technique was used to identify the study respondents. The first stage involved a purposive selection of Kakamega county because it is a major sugarcane-farming region in Kenya, and most rural poor people depend on sugarcane farming as the primary source of income. Kakamega county is characterised by high levels of poverty; current statistics show that the poverty index stands at 49%, compared to the overall country index of 36% (Elezaj *et al*. 2020). Furthermore, there are gender inequalities that persist regarding resource ownership and labour allocation to sugarcane farming. The second stage entailed a random selection of three wards. This led to the selection of Etenje, Mumias West and Mumias Central (see Table 1). Finally, we used a simple random sampling technique to select 381 dyad households engaged in sugarcane farming. A complete household listing was developed for each selected ward, and simple random sampling, based on a proportion-to-size sampling technique (Kothari 2004), was used to identify households to be interviewed.

The data was obtained by using pre-tested semi-structured questionnaires. Five enumerators were used to collect data from female spouses of the selected 384 dyad households with the aid of Open Data Kit ([ODK] 2021). The questions focus on household demographic characteristics, poverty status, and indicators of women's empowerment. The survey collected data for the 2013/2014 and 2014/2015 sugarcane growing seasons, and data collection was conducted from February to March 2016. Two seasons were considered because sugarcane is a perennial crop, taking about 12 to 18 months to mature.

Table 1: Distribution of respondents per award

Wards	Number of respondents	Percentage
Etenje	125	32.81
Mumias Central	174	45.67
Mumias West	82	21.52
Total	381	100

2.4 Tools for data collection and analysis

2.4.1 Women's Empowerment in Agriculture Index (WEAI)

We used the women's empowerment in agriculture index (WEAI) to measure the level of empowerment of women who are actively engaged in sugarcane farming. The WEAI is based on five domains (5DEs), which include control over productive resources, input in agricultural production, income control, leadership ability, and time allocation (Alkire *et al*. 2013). The resource domain represents the woman's ability to decide on how to allocate and use productive agricultural assets within the household. The control over the income domain represents the ability of the female spouse to exercise her right of choice when it comes to control over income. The leadership domain captures most of the aspects that indicate the inclusion of women in community development activities, and the respect they get regarding the maintenance of accountability and credibility in managing community resources. In the WEAI, each domain is assigned an equal weight of 20%, which is further distributed based on the number of indicators per domain (see Table 2). Indicators are designed to measure whether a woman achieves the minimum required threshold to be considered as empowered or not. In each indicator, for a woman to be considered adequately empowered, she is supposed to be involved in decision making either solely or jointly with somebody else in the household. The total score of the WEAI is 100%, with individual empowerment ranging from 0 to 100, where zero indicates disempowerment in all the 5DEs of empowerment, while 100 indicates empowerment in all the five domains (Alkire *et al*. 2013).

Table 2: Domains, indicators and weights of the WEAI

Domain	Indicator	Weight
Production	Input in production decision	1/5
Resource	Ownership of assets	1/15
	Purchase, sale or transfer of assets	1/15
	Access to and decision over credit	1/15
Income	Control over household income	1/5
Leadership	Group membership	1/10
	Speaking in public	1/10
Time	Workload	1/10
	Leisure	1/10

Source: Alkire *et al*. (2013)

2.4.2 Multidimensional Poverty Index (MPI)

This study used the Multidimensional Poverty Index (MPI) to measure the poverty level among smallholder sugarcane farmers. The MPI includes three dimensions, namely health, education, and standard of living (Alkire & Santos 2014). As recommended by Alkire and Foster (2011) and Alkire and Santos (2014), the domains are assigned weights that are used to compute the overall poverty score. The three dimensions are further divided into ten indicators, as shown in Table 3. The index uses a dual cut-off procedure for poverty identification, as illustrated by Alkire and Santos (2014), by which, for each indicator, a household takes a value of 0 if deprived and 1 otherwise. The health domain is represented by child malnutrition, or even mortality that results from malnutrition. In this domain, a household is considered deprived if a child has died due to malnutrition in the 12 months preceding the data being collected. Similarly, a household is deprived of nutrition if there is at least one or more undernourished person in the household. Education is represented by the parents' or child's schooling years. A household is deprived in education level if the parents lack formal education, or if children who have reached school-going age are not going to school. Hence, a household passes a deprivation point if one of the household members is educated (at least having attained five years of formal education) (Alkire & Santos 2014). The living standard of the household

is represented by access to electricity, which is used either for cooking or lighting, improved sanitation, access to clean drinking water, suitable flooring, and other vital household assets.

The MPI applies equal weights across dimensions, where each indicator is given the same weight of 1/3 (refer to Table 3). The weights are summed and, finally, the poverty cut-off point is determined. A household is considered multidimensionally poor if its weighted deprivations sum to one third and higher.

According to Alkire and Santos (2014), the MPI achievement in dimension, d, across small-scale sugarcane farmers, n, is denoted by $y = (y_{ab})$ and is represented by a matrix, $n \times d$. Therefore, the ath household poverty attainment in dimension b is represented by $y = (y_{ab} \geq 0)$, where $a = 1,2,3,\ldots\ldots n$, while $b = 1,2\ldots\ldots d$. The MPI reflects the intensity of poverty, with the sum of weighted deprivations ranging from zero to one. According to the MPI, each dimension is weighed differently using the 'nested weights', defined as weighted vector w, given by $w_j(1j = d)$. The w_{ab} represents the weight that is applied to dimension b and the set $w_j^d = 1w_j = d$, implying that the dimensional weights sum to the number of dimensions used in measuring multidimensional poverty (Alkire & Santos 2014).

Table 3: Dimensions, indicators, cut-offs and weights of the MPI

Dimension and indicators	Deprivation points	Weights
Education		
Educational achievement	Deprived if the household spouses have not completed primary education	1/6
	Deprived if household has school-aged children not going to school	1/6
Living standard		
Electricity	Deprived if no electricity	1/18
Drinking water	Deprived if lack of access to safe and clean water	1/18
Sanitation	Deprived if lack of decent latrine/toilet	1/18
Flooring	Deprived if the household floor is earthen	1/18
Assets		
Phone	Deprived if the household does not own a mobile phone	1/18
Radio/television (TV)	Deprived if the household does not own an information gadget, whether a radio or a TV	1/18
Vehicle	Deprived if household does not own at least a bicycle	1/18
Health		
Child mortality	Deprived if any child has died in the family in the last 12 months due to malnutrition	1/6
Nutrition 2	Deprived if the household relies on relief food or has experienced malnutrition in the past one year	1/6
Access	Deprived if household has difficulty in meeting basic public hospital bills	1/6

Source: Alkire and Santos (2014)

2.5 Model specification

We used an instrumental-variable (IV) tobit econometric regression model to evaluate the causality between the WEAI and the MPI among small-scale sugarcane farmers. The estimated IV tobit is as shown in Equation (1).

$$MPI_i = \beta_o + \beta_1 W_i + \beta_2 H_i + \beta_3 \pi_i + \varepsilon_i, \tag{1}$$

where MPI_i is the estimated poverty status of the ith household determined using the multidimensional poverty index, $MPI = 0$ if $MPI_i^* > 0$, but $MPI = 0$ when $MPI^* < 0$. Furthermore, w is a measure of WEAI, H is a vector of household characteristics, and π is a set of dummy variables

meant to capture community characteristics. β_o is a constant across all observations, and ε is an error term. The error term is assumed to be uncorrelated with all regressors except θ, which leads to an inconsistent estimator of β_1 (Moestue 2005).

In this study, instruments for women's empowerment are spousal age difference (δ) and the number of social groups in which a woman participates (η). The spousal age differences reflect differences in human capital between a woman and her spouse, and therefore reflect relative empowerment in decision-making. Active participation of a woman in social groups could indicate greater social capital within the community, which could influence a woman's decision to actively participate in social group activities. Group membership is determined using information on the number of group meetings a woman participated in during the study period. We hypothesised that a woman who has attended more social group meetings is more likely to be empowered. In addition, these instruments are unlikely to influence MPI directly, but can do so through the WEAI.

Formally, the empirical model is as illustrated in Equation (2) and Equation (3) below.

$$MPI_{1I}^* = \beta_0 + \beta_1 W_{2i} + \beta_{2i} Y + \beta_{3i} X + \varepsilon_i \tag{2}$$

$$W_{2i} = Z_{1i}\pi_1 + Z_{2i}\pi_2 + Z_{3i}\pi_3 + v_i \tag{3}$$

where $i = 1,2,\ldots\ldots n$ sugarcane households in the sample, vector MPI measures the level of household poverty, w captures WEIA, y is a vector of women's characteristics, and x is a vector of household characteristics. It is assumed that $(\varepsilon_i, v\ ) \approx N(0)$, y and β represent vectors of structural parameters, and $\pi_1, \pi_2 \pi_3$ indicate matrices of reduced-form parameters. The MPI_{1i}^* represents a latent variable that satisfies the classical linear model assumption, such as a normal, homoscedastic distribution with a linear conditional mean.

Therefore, we do not observe MPI_{1i}^*, but instead observe Equation (4) below.

$$MPI_{1i} = \begin{cases} 0 & MPI_{1i}^* < 0 \\ MPI & 0 \le MPI_{1i}^* \end{cases} \tag{4}$$

The empirical model is as estimated in Equation (5) below.

$$MPI_{1i} = \beta_0 + \beta_1 Z_i + \beta_2 Yi + \beta_{3i} X_i + \varepsilon_i, \tag{5}$$

where MPI_{1i} represents the household poverty level, z_i represent the instrumental variables, x represent household's characteristics and Y_i is the characteristics of the female spouse. The final equation is as specified in Equation (6).

$$MPI_{1i} = \beta_0 + \beta_1(\delta, \eta) + \beta_2 Yi + \beta_{3i} X_i + \varepsilon_i \tag{6}$$

A Wald test was used to check for the exogeneity of the instrument used in the regression. The results for the Anderson canon and Hansen J statistical tests for the endogeneity imply that the endogenous variables used in modelling are valid instruments. STATA was used to manage the data during analysis.

3. Results and discussion

3.1 Socio-demographic characteristics

Table 4 presents the summary statistics of the 381 sampled households. The average age of the sampled women and their spouses was 39 and 44 years respectively, with an average spousal age gap of five years. The sampled women had an average of 14 years of experience in sugarcane farming. The polygamous type of marriage arrangement was reported by 25% of the sampled households. The sampled women and their male spouses had an average of 10 years of formal education. The sampled households had an active labour force of three people, with an average dependency ratio of 0.92. The results show that 41% of the household heads (husbands) engaged in off-farm income as a primary source of livelihood. In comparison, only 9% of women reported engaging in off-farm income-generation activities. The average annual income from agricultural and non-agricultural income-generating activities was USD 959.

Table 4: Summary statistics of sampled sugarcane farming households

Variable description	Mean (SD)	Proportions (SD)
Household socio-economic characteristics		
Age of the husband (years)	44.044 (10.508)	
Age spouse (years)	39.498 (9.937)	
Marital arrangement (1 = polygamy)		24.670 (0.431)
Education level of the husband	10.559 (2.747)	
Education level of the spouse	10.490 (2.533)	
Active labour force in the household (adult equivalent using modified OECD scale)	2.927 (1.504)	
Dependence ratio	0.923 (0.602)	
Female spouse primary occupation (1 = off-farm)		9.450 (0.292)
Husband primary occupation (1 = off-farm)		41.470 (0.493)
Experience of female spouse in sugarcane farming (years)	14.600 (13.002)	
Annual household income (from agriculture and non-agricultural sources)	959.530 (16.120)	
Farm and farming characteristics		
Size of the land under farming (hectares)	1.826 (1.812)	
Diversification of agricultural farming (1 = yes)		54.731 (0.362)
Tropical livestock equivalent units owned by the household	2.983 (3.570)	
Institutional characteristics		
Market access (walking time in minutes)	14.204 (10.673)	
Access to clean water (walking time in minutes)	2.718 (15.060)	
Female spouse access to extension (1 = yes)		26.510 (0.442)
Instrumental variables		
Spousal age gap (age difference between spouses)	4.545 (4.435)	
Number of groups of which a woman is an active member	1.593 (0.721)	

Note: n = 384, SD = standard deviation

The sampled households had an average of two hectares under farming, with 55% of the households practising crop diversification, in terms of which they grow sugarcane and other crop varieties. The sampled households had an average of three heads of livestock, measured in tropical livestock units (TLU). Considering institutional factors, it takes on average 14 minutes to walk to the nearest market and three minutes to walk to the nearest water source. Only 27% of the sampled women reported to have accessed credit within the study period. On average, women were active members of at least two social groups.
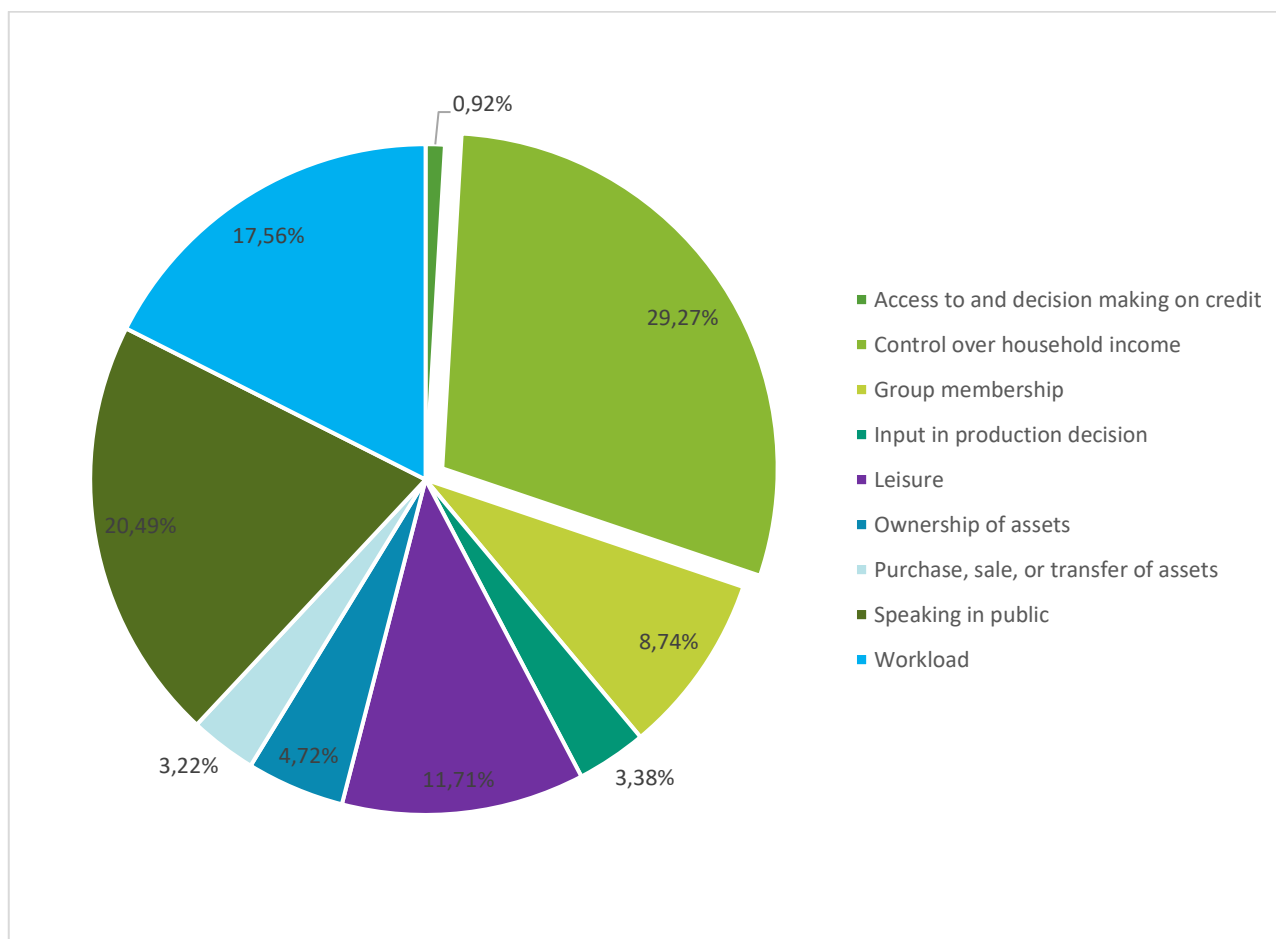
3.2 Women's empowerment in sugarcane farming

Descriptive statistics were used to explore the contributions of various domains and indicators to women's disempowerment in sugarcane farming. Figure 1 shows that the income (29.27%), time (29.27%) and leadership (29.23%) domains contributed most to disempowerment of women in sugarcane farming in western Kenya. These results imply that most of the women in sugarcane plantations are less involved in decisions regarding control over income from sugarcane or other agricultural enterprises of the household.
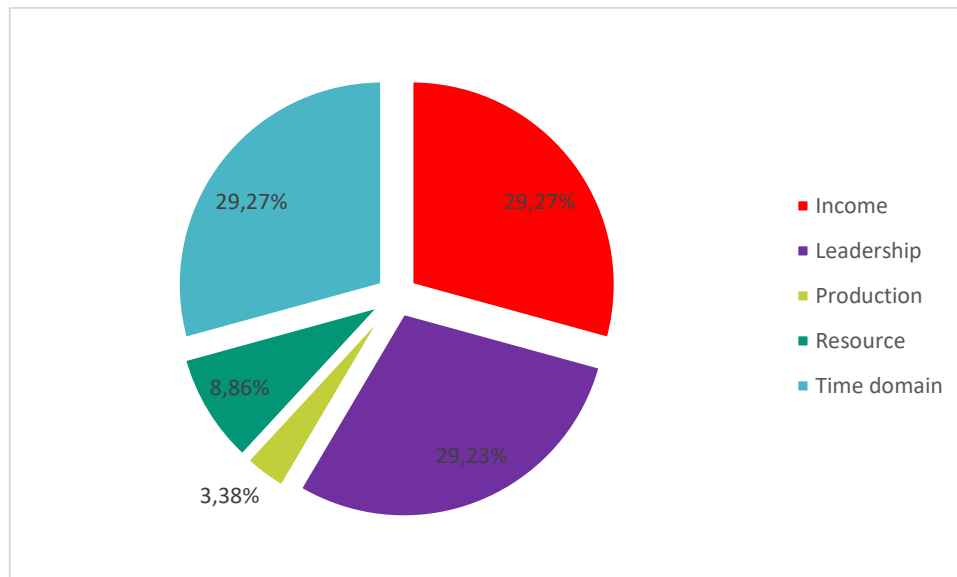
Figure 1: Domains contributing to women's disempowerment

Error! Reference source not found. shows the contribution of the indicator of each domain to women's disempowerment. Speaking in public is the major contributor to the disempowerment of women in the leadership domain. This result implies that women find it hard to express their views in social gathering. Workload is the major contributor to women's disempowerment in the time domain, implying that women might be the main labour providers regarding planting, weeding, and harvesting sugarcane.

Figure 2: Contribution of various indictors to women's disempowerment

3.3 Household poverty level in sugarcane farming

Table 5 presents the results of indicators influencing household poverty. Key MPI indicators contributing to household poverty were household access to clean water for cooking and drinking (7%), access to electricity for lighting and powering household electrical devices (8%), access to clean cooking fuel (7%), access to clean lighting energy (7%), and limited access to good flooring materials (11%). Fifty percent and 55% of the households were deprived in relation to the education and child mortality indicators respectively. All the households achieved in the asset ownership and sanitation indicator.

Table 5: Household poverty status

MPI indicators	Mean	Standard deviation
Education		
Education achievement (1 = not deprived, 0 = otherwise)	0.498	0.501
Living standard		
Electricity (1 = not deprived, 0 = otherwise)	0.086	0.282
Water source – drinking water (1 = not deprived, 0 = otherwise)	0.007	0.089
Sanitation (1 = not deprived, 0 = otherwise)	0.997	0.051
Cooking fuel (1 = not deprived, 0 = otherwise)	0.007	0.088
Flooring (1 = not deprived, 0 = otherwise)	0.118	0.323
Lighting energy (1 = not deprived, 0 = otherwise)	0.073	0.261
Assets ownership (1 = not deprived, 0 = otherwise)	100	0.000
Health		
Child mortality (1 = not deprived, 0 = otherwise)	0.559	0.497

3.3 Effect of women' empowerment in sugarcane farming on household poverty level

The results on the influence of women's empowerment in sugarcane farming on household MPI, and other factors influencing household MPI, are presented in Table 6. Focusing first on the core variable, the results show a negative and significant (5% level) association between the WEAI and household MPI; this was after checking for potential endogeneity. These results suggest that households with disempowered women are relatively poor compared to those with empowered women. In addition to overall women's empowerment, an active household labour force, annual household income, education level of the household head and the spouse, household head participation in off-farm income-generating activities, access to credit, land size under farming, and access to extension services also significantly and negatively affected households' MPI. Distance to the nearest market and the household's dependence ratio significantly and positively influenced household MPI.

Table 6: Women's empowerment in sugarcane farming and households' poverty levels

Dependent variable: MPI	Coefficient	Robust std error	t
WEAI	-0.023**	0.058	-0.400
Household socio-economic characteristics			
Marital arrangement (1 = polygamous)	0.014	0.016	0.850
Active labour force in the household (number of adult household members)	-0.012*	0.012	-0.418
Annual off-farm income (log)	-0.012***	0.000	-8.610
Husband's level of education (schooling years)	-0.031***	0.013	-4.270
Female spouse's level of education (schooling years)	-0.010***	0.048	-3.590
Female spouse's primary occupation (1 = off-farm)	-0.003	0.025	-0.120
Husband's primary occupation (1=off-farm)	-0.019**	0.015	-1.310
Female spouse farming experience in years	-0.021	0.042	-2.430
Dependence ratio	0.029*	0.012	1.570
Farm and farming characteristics			
Diversity in crop production (1 = yes)	-0.020	0.030	-0.660
Female spouse access to credit (1 = yes)	-0.034**	0.024	-1.400
Land size under farming in hectares	-0.022*	0.024	-0.420
Number of tropical livestock units	-0.014	0.033	-1.451
Institutional characteristics			
Female spouse access to extension (1 = yes)	-0.011*	0.076	-0.640
Distance to the nearest market (walking time in minutes)	0.014***	0.021	1.760
Distance to the nearest tarmac road (walking time in minutes)	0.001	0.001	0.580
Distance to the nearest water source (walking time in minutes)	0.021	0.021	0.170
Constant	0.575	0.171	3.510
Number of observations	384		
Adjusted R^2	36.970	Prob > F: 0.000	
Tests of endogeneity			
Anderson canon. corr. LR statistic (identification/IV relevance test)	42.756		
	Chi^2 (4) P-value	0.000	
Hansen J statistic (over-identification test of all instruments)	53.615		
	Chi^2 (3) P-value	0.000	

Note: *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively

3.4 Discussion

This study explored the influence of women's empowerment on household MPI among smallholder sugarcane farmers in Kenya. The results show that there is a negative association between women's empowerment and households' MPI, as shown in Table 6. These results were expected, since studies have shown that empowering women in agriculture tends to increase their ability to earn and control income from agricultural enterprises (Galab & Rao 2003). In addition, women have been shown to channel most of their income to improving household nutrition (buying nutritious food such as animal

source food) and general household development, such as buying clothes, constructing better shelters and educating their children (Greene 2003; Malapit & Quisumbing 2015; Tsiboe *et al*. 2018; Galiè *et al*. 2019; Jumba *et al*. 2020; Opata *et al*. 2020). A study in Nigeria shows that women's empowerment leads to an improvement in children's anthropometric scores (Aderemi 2021). In Ghana, empowered women had higher health status compared to non-empowered women, and their improvement in body mass index was mainly associated with a good diet (Tsiboe *et al*. 2018). Although women's empowerment contributes positively to household poverty levels, the income, time and leadership domains are the greatest contributors to women's disempowerment in sugarcane farming. A study done in the sugarcane growing regions in western Kenya showed that women in male-headed households are discriminated against when it comes to control over sugarcane income, and this is mainly due to patriarchal systems and norms and taboos that gave men more power over family assets (Kwenya *et al*. 2021). Empirical evidence shows that women are the main providers of labour in agricultural enterprises in sub-Saharan African (SSA) (Theis *et al*. 2018; Jumba *et al*. 2020), and this could be the reason why poor work balance is a major contributor to the disempowerment of women in sugarcane farming.

In addition to women's empowerment, the results also show that other household and institutional characteristics play a role in reducing household poverty. Annual off-farm household income has a negative and significant (1% level of significance) effect on a household's multidimensional poverty status. These results suggest that households with higher annual income from off-farm activities are less likely to be poor than those with low annual off-farm income. Off-farm income can be used to purchase basic household needs such as food and clothes, to settle medical bills, to educate children, connect households to clean water, and even to construct better shelter. These results agree with those of Imam *et al*. (2018) in Bangladesh, Eyasu (2020) in Ethiopia, Lekobane and Seleka (2017) in Botswana, and Oluwatayo and Babalola (2020) in South Africa. These authors found that households with higher off-farm income were less likely to be poor due to higher purchasing power.

The education level of the husband and the spouse (wife) negatively and significantly affect the multidimensional poverty index. These results suggest that households with more educated spouses are less likely to be poor; this can be attributed to the ability of the household spouses to diversify their income by engaging in non-farm jobs, and the ability to make informed decisions regarding the allocation of the income earned. Furthermore, formal education equips household spouses with skills that allow them to embrace good agricultural practices and technologies, such as better sugarcane farming techniques. This could include proper ways of applying fertiliser and adopting the best variety to be established, which increases yields. According to Adeoti (2009), literacy enhances an individual's ability to embrace innovations that aim to increase agricultural production and improve household income. Other studies also corroborate these findings (Wanka & Rena 2019; Adepoju 2020; Abaidoo 2021).

An active household labour force had a negative and significant effect on household MPI. This result agrees with that of Kamuzora (2005), who found that households with a large active labour force are less likely to be poor, as they generate income from various household members. However, some authors argue that, if the members of a household are not working or actively engaged in income generation activities, this could lead to a lowering of household welfare (Islam 2004). Land size under crop and livestock farming has a negative and significant effect on household MPI. These results suggest that an increase in land size under farming results in a decrease in household poverty levels. This could be attributed to the ability of a household with larger farm size to diversify its income by planting different crops or rearing different livestock species that boost their income. A study done in the rural areas of Kenya shows that access to land plays an important role in supporting household income and lowering household vulnerability to poverty (Karugia *et al*. 2006). In their study in Zambia, Jayne *et al*. (2008) showed that an increase in farm size under farming is positively associated

with an increase in agricultural sales, hence increasing disposable income and reducing households' vulnerability to poverty. These findings also confirm those of De Janvry and Sadoulet (2002), Jayne *et al*. (2003) and Adugna and Sileshi (2013).

Access by the female spouse to agricultural extension services is negatively and significantly associated with the household multidimensional poverty index. This result suggests that households whose female spouse has access to extension services are less likely to fall into poverty traps. Agricultural extension services equip farmers with skills and knowledge that improve and strengthen their production techniques, which translate directly or indirectly into an increase in household agricultural output, hence improving their general well-being. These results confirm those of Danso-Abbeam *et al*. (2018), who found that access to extension services was considered as a critical vessel for disseminating agriculture-related information to farmers. It thereby improves farmers' technical and managerial skills, which indirectly increase farm productivity and farm revenue, reduce poverty, and minimise food insecurity.

Access to credit by female spouses has a significant and negative association with household MPI. This implies that households in which the female spouse has access to credit or loans are less likely to be poor. These results can be explained by the ability of women to use the borrowed money to boost their agricultural productivity by acquiring the needed key inputs, such as fertilisers and improved, good-quality seeds. Besides, women can use the money to cushion their households against unforeseen shocks such as droughts or illness. A study done in India showed that access to microfinance results in both social and economic empowerment for women farmers, as women who access credit are able to financially support their families and even invest in better income-generating ventures (Sultana *et al*. 2017). These findings underpin the importance of access to credit.

The participation of the household head in off-farm income-generating activities and the diversification of crop farming negatively and significantly affected household poverty level. This result suggests that households of which the head diversified the income are less likely to be poor. Income diversification is considered a strategy for minimising risk, as it enables farmers to derive income from a wide range of sources, thereby reducing income instability. Besides, this can be explained by the fact that such a household could use the income generated from other sources to cater for family expenses. The finding indicates the need to encourage farmers to diversify their income by engaging in other income-generating activities, as this will reduce the risk of falling into poverty when another livelihood source fails, such as low crop harvests. The results agree with those of Barrett *et al*. (2001) and Eyasu (2020), who report that access to stable and well-paying off-farm employment leads to a reduction in household poverty and food insecurity. However, this result contradicts that of Akerele and Adewuyi (2011), who noted that household heads who focused on farming as their main economic activity were better off than those in off-farm business activities, as most of the farmers engaged in crop diversification and therefore had a stable income throughout the production period. This means that sugarcane farmers, particularly women, should receive training on different types of crop production so that they can integrate or inter-crop, if possible, sugarcane farming with other crops.

These findings show that access to markets reduces the likelihood of households falling into poverty traps. This could be attributed to the ability of the household to use the available market outlets to sell their farm outputs at better prices. In addition, access to markets is an indicator of access to good quality and improved farm inputs that can be used to improve agricultural productivity. Taylor *et al*. (2009) report that access to markets leads to increasing agricultural sales, which later reduce hunger and poverty among smallholder rural poor households.

We also found that a high household dependency ratio in rural areas significantly increases the household's probability of being poor. This finding indicates that families with a high dependency ratio channel their income to household expenditure; hence, little is left for saving or investing in other income-generating activities. This result suggests that a household with a larger dependency ratio experiences a higher poverty level than a household with a lower dependency ratio. This result shows that the more the household members who do not generate income, the more the family will be poor, as there is a heavy burden on the few household members who do participate in income-generating activities. Families with a high dependency ratio channel most/all their income to household expenditure, which means that little is left for saving or investing in other income-generating activities. This result confirms those of Christiaensen and Subbarao (2005), Lekobane and Seleka (2017) and Ginting *et al*. (2020), where households with a higher dependency ratio are more likely to be poor due to limited resources. Distance to the nearest market has a significant and positive association with the household multidimensional poverty index. Household size in terms of adult equivalents negatively influences the multidimensional household poverty level. This could be attributed to the ability of a larger household to use its available labour for more income generation. As expected, household dependency ratio has a positive and significant association at a 10% level with the household multidimensional poverty index.

4. Conclusions and recommendations

The objective of the study was to determine the effect of empowering women in sugarcane farming on household poverty, using data from smallholder sugarcane farmers in Kakamega county, Kenya. The WEAI and MPI were used to calculate and determine women's empowerment and poverty status respectively in sugarcane farming. We used the IV tobit regression model to evaluate the association between women's empowerment in sugarcane farming and household poverty status. The IV tobit was preferred the most because, unlike linear econometric models, this model has the capability to control for endogeneity that might inflate or deflate the model's coefficients.

After controlling for potential endogeneity, the results show that overall, the WEAI is highly significant and negatively correlated with household MPI, suggesting that households with empowered women are less likely to be poor than those with disempowered women. Besides women's empowerment, other factors that positively and significantly influenced household poverty were total annual off-farm income, education of the household head and the spouse, the household's active labour force, land size under farming, access to credit and access to extension services. There is a need to strengthen existing and new local financial institutions, establish community-based village savings and loans associations (VSLAs), and facilitate linkages between VSLAs and financial institutions to enhance women's access to credit facilities and the ability to reinvest in productive agricultural assets. In addition, digital savings accounts and affordable mobile money-based credit schemes targeting women should be introduced in rural areas.

Market access measured by distance to the nearest market furthermore reduces the household poverty level because of the household's ability to use available market outlets to bargain for higher prices for their produce and for better farm inputs, hence improving yields. This underpins the need to promote value addition and post-harvest handling practices, thereby creating market linkages for small-scale farmers and promoting agri-enterprise development to ensure that farmers have access to better markets for their produce. Household land size under farming significantly affected the poverty level of a household. This finding suggests that an increase in land size under farming gives rise to a decrease in household poverty levels. This could be attributed to the ability of a household with a larger farm size to diversify their resources by planting different crops, thus producing more that boost their income. The ever-increasing population with limited arable land calls for small-scale farmers to adopt sustainable and climate-smart agricultural practices.

Finally, while our study points to women's empowerment having a positive effect on reducing the level of household vulnerability to multidimensional poverty, our data is not nationally representative and thus may not reflect women's empowerment status across all sugarcane-growing zones in Kenya. Besides, by the time of data collection, the only existing tool for measuring women's empowerment was general WEAI, but now there has been improvement in and refinement of the tool, which is now known as pro-WEAI (http://tools4valuechains.org). It therefore is necessary to use this tool to validate our findings. More research using nationally representative and repeated data from sugarcane-growing areas in Kenya and beyond, particularly elsewhere in SSA, is needed to fully understand the relationship between women's empowerment in agriculture and reducing household vulnerability to multidimensional poverty.

References

Abaidoo A, 2021. The nexus between education and poverty reduction in Ghana from 2013 to 2017. Cogent Social Sciences 7(1): 1–19.

Achandi EL, Kidane A, Hepelwa A & Mujawamariya G, 2019. Women's empowerment: The case of smallholder rice farmers in Kilombero District, Tanzania. Agrekon 58(3): 324–39.

Adeoti AI, 2009. Factors influencing irrigation technology adoption and its impact on household poverty in Ghana. Journal of Agriculture and Rural Development in the Tropics and Subtropics 109(1): 51–63.

Adepoju A, 2020. Determinants of multidimensional poverty transitions among rural households in Nigeria. Review of Agricultural and Applied Economics 23(1): 55–64.

Aderemi TA, 2021. Nutritional deficiency and women's empowerment in agriculture: Evidence from Nigeria. African Journal of Agricultural and Resource Economics 16(4): 314–36.

Adugna E & Sileshi M, 2013. Determinants of poverty in (agro-) pastoral societies of southern Ethiopia. Livestock Research for Rural Development 25(2): Article #20.

Akerele D & Adewuyi SA, 2011. Analysis of poverty profiles and socioeconomic determinants of welfare among urban households of Ekiti State, Nigeria. Current Research Journal of Social Sciences 3(1): 1–7.

Alkire S & Foster J, 2011. Counting and multidimensional poverty measurement. Journal of Public Economics 95(7–8): 476–87.

Alkire S & Santos ME, 2014. Measuring acute poverty in the developing world: Robustness and scope of the Multidimensional Poverty Index. World Development 59: 251–74.

Alkire S, Meinzen-Dick R, Peterman A, Quisumbing A, Seymour G & Vaz A, 2013. The Women's Empowerment in Agriculture Index. World Development 52: 71–91.

Anderson CL, Reynolds TW, Biscaye P, Patwardhan V & Schmidt C, 2021. Economic benefits of empowering women in agriculture: Assumptions and evidence. Journal of Development Studies 57(2): 193–208.

Barrett CB, Reardon T & Webb P, 2001. Nonfarm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics, and policy implications. Food Policy 26(4): 315–31.

Bilenkisi F, Gungor MS & Tapsin G, 2015. The impact of household heads' education levels on the poverty risk: The evidence from Turkey. Kuram ve Uygulamada Egitim Bilimleri 15(2): 337–48.

Christiaensen LJ & Subbarao K, 2005. Towards an understanding of household vulnerability in rural Kenya. Journal of African Economies 14(4): 520–58.

Clement F, Buisson MC, Leder S, Balasubramanya S, Saikia P, Bastakoti R, Karki E & Van Koppen B, 2019. From women's empowerment to food security: Revisiting global discourses through a cross-country analysis. Global Food Security 23: 160–72.

Damisa MA & Yohanna M, 2007. Role of rural women in farm management decision making process: Ordered probit analysis. Trends in Applied Sciences Research 2(3): 241–5.

Danso-Abbeam G, Ehiakpor DS & Aidoo R, 2018. Agricultural extension and its effects on farm productivity and income: Insight from northern Ghana. Agriculture & Food Security 7(1): 1–10.

De Janvry A & Sadoulet E, 2002. World poverty and the role of agricultural technology: Direct and indirect effects. Journal of Development Studies 38(4): 1–26.

Diiro GM, Seymour G, Kassie M, Muricho G & Muriithi BW, 2018. Women's empowerment in agriculture and agricultural productivity: Evidence from rural maize farmer households in western Kenya. PLoS ONE 13(5): e0197995.

Dohmwirth C & Liu Z, 2020. Does cooperative membership matter for women's empowerment? Evidence from South Indian dairy producers. Journal of Development Effectiveness 12(2): 133–50.

Doss CR, Kovarik C, Peterman A, Quisumbing A & Van den Bold M, 2015. Gender inequalities in ownership and control of land in Africa: Myth and reality. Agricultural Economics 46(3): 403–34.

Elezaj E, Ramful N, Karpati J & De Neubourg C, 2020. Kenya comprehensive poverty report: Children, youth, women & men, elderly. From national to county level. Nairobi: Kenya National Bureau of Statistics.

Eyasu AM, 2020. Determinants of poverty in rural households: Evidence from North-Western Ethiopia. Cogent Food and Agriculture 6(1): 1–20.

Fabiyi EF & Akande KE, 2015. Economic empowerment for rural women in Nigeria: Poverty alleviation through agriculture. Journal of Agricultural Science 7(9): 236–41.

Galab S & Rao NC, 2003. Women's self-help groups, poverty alleviation and empowerment. Economic and Political Weekly 38(12/13): 1274–83.

Galiè A, Teufel N, Girard AW, Baltenweck I, Dominguez-Salas P, Price MJ, Jones R, Lukuyu B, Korir L, Raskind IG, Smith K & Yount KM, 2019. Women's empowerment, food security and forage in pastoral communities of Tanzania. Global Food Security 23: 125–34.

Ginting TABR, Sudibia IK, Dewi NPM & Marhaeni AAIN, 2020. The effect of education and dependency ratio on economic growth and poverty in Papua. American Journal of Humanities and Social Sciences Research 4(6): 186–95.

Greene WH, 2003. Econometric analysis. Upper Saddle River NJ: Prentice Hall.

Huyer S, 2016. Closing the gender gap in agriculture. Gender, Technology and Development 20(2): 105–16.

Imam MF, Islam MA & Hossain M, 2018. Factors affecting poverty in rural Bangladesh: An analysis using multilevel modelling. Journal of the Bangladesh Agricultural University 16(1): 123–30.

Islam R, 2004. The nexus of economic growth, employment and poverty reduction: An empirical analysis. Issues in Employment and Poverty Discussion Paper No. 14, Recovery and Reconstruction Department, International Labour Office, Geneva.

Jayne TS, Yamano T, Weber MT, Tschirley D, Benfica R, Chapoto A & Zulu B, 2003. Smallholder income and land distribution in Africa: Implications for poverty reduction strategies. Food Policy 28(3): 253–75.

Jayne TS, Zulu B., Kajoba G & Weber MT, 2008. Access to land and poverty reduction in rural Zambia: Connecting the policy issues. Food Security Collaborative Policy Briefs No. 55054, Department of Agricultural, Food, and Resource Economics, Michigan State University, East Lansing MI.

Jones RE, Haardörfer R, Ramakrishnan U, Yount KM, Miedema SS, Roach TD & Girard AW, 2020. Intrinsic and instrumental agency associated with nutritional status of East African women. Social Science and Medicine 247: 112803.

Jumba H, Teufel N, Baltenweck I, De Haan N, Kiara H & Owuor G, 2020. Use of the infection and treatment method in the control of East Coast fever in Kenya: Does gender matter for adoption and impact? Gender, Technology and Development 24(3): 297–313.

Kabeer N, 1999. Resources, agency, achievements: Reflections on the measurement of women's empowerment. Development and Change 30(3): 435–64.

Kamuzora CL, 2005. Africa's population: A critical global asset for development. Paper presented at the 11th General Assembly of CODESRIA, 6–10 December, Maputo, Mozambique. Available at https://catalog.ihsn.org/index.php/citations/44808

Karugia JT, Oluoch-Kosura W, Nyikal R, Odumbe M & Marenya PP, 2006. Access to land, income diversification and poverty reduction in rural Kenya. Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, 12–18 August, Gold Coast, Australia.

Kothari C, 2004. Research methodology: Methods and techniques. Second revised edition. New Delhi: New Age International.

Kwenya G, Kimani E & Mwai W, 2021. Gender dynamics in access to and control over sugarcane benefits in Uriri constituency in Migori county. Nairobi: Gender and Development Studies, Kenyatta University.

Lekobane KR & Seleka TB, 2017. Determinants of household welfare and poverty in Botswana, 2002/2003 and 2009/2010. Journal of Poverty 21(1): 42–60.

Maher J, Wagstaff P, O'Brien J, 2015. Empowering women through conservation agriculture: Rhetoric or reality? Evidence from Malawi. In Chan C & Fantle-Lepczyk JE (eds), Conservation agriculture in subsistence farming: Case studies from South Asia and beyond. Wallingford: CABI.

Malapit HJL & Quisumbing AR, 2015. What dimensions of women's empowerment in agriculture matter for nutrition in Ghana? Food Policy 52: 54–63.

Malapit HJL, Kadiyala S, Quisumbing AR, Cunningham K & Tyagi P, 2015. Women's empowerment mitigates the negative effects of low production diversity on maternal and child nutrition in Nepal. Journal of Development Studies 51(8): 1097–123.

Meinzen-Dick R, Quisumbing A, Doss C & Theis S, 2019. Women's land rights as a pathway to poverty reduction: Framework and review of available evidence. Agricultural Systems 172: 72–82.

Moestue H, 2005. Adult education and child nutrition: The role of family and community. London: University of London.

Mwololo HM, Nzuma JM & Ritho CN, 2021. Farmer empowerment in agriculture and its association with smallholder farm incomes in Kenya. African Journal of Agricultural and Resource Economics 16(4): 355–69.

Netondo GW, Waswa F, Maina L, Naisiko T, Masayi N & Ngaira KJ, 2010. Agrobiodiversity endangered by sugarcane farming in Mumias and Nzoia Sugarbelts of Western Kenya. African Journal of Environmental Science and Technology 4(7): 437–45.

OECD, 2012. Poverty reduction and pro-poor growth. The role of empowerment. Paris: OECD.

Oluwatayo IB & Babalola MA, 2020. Asset ownership and income as drivers of household poverty in South Africa. The Journal of Developing Areas 54(3): 119–130.

Opata PI, Ezeibe AB & Ume CO, 2020. Impact of women's share of income on household expenditure in southeast Nigeria. African Journal of Agricultural and Resource Economics 15(1): 51–64.

Open Data Kit (ODK), 2021. Available at http://www.opendatakit.org

Oseni G, Corral P, Goldstein M & Winters P, 2015. Explaining gender differentials in agricultural production in Nigeria. Agricultural Economics 46(3): 285–310.

Quisumbing AR & Pandolfelli L, 2010. Promising approaches to address the needs of poor female farmers: Resources, constraints, and interventions. World Development 38(4): 581–92.

Sharaunga S, Mudhara M & Bogale A, 2015. The impact of "women's empowerment in agriculture" on household vulnerability to food insecurity in the KwaZulu-Natal province. Forum for Development Studies 42(2): 195–223.

Slavchevska V, 2015. Gender differences in agricultural productivity: The case of Tanzania. Agricultural Economics 46(3): 335–55.

Sraboni E, Malapit HJ, Quisumbing AR & Ahmed AU, 2014. Women's empowerment in agriculture: What role for food security in Bangladesh? World Development 61: 11–52.

Sultana HY, Jamal MA & Najaf D-E, 2017. Impact of microfinance on women empowerment through poverty alleviation: An assessment of socio-economic conditions in Chennai city of Tamil Nadu. Asian Journal for Poverty Studies 3(2): 175–183.

Taylor JE, Zezza A & Gurkan A, 2009. Rural poverty and markets. ESA Working Paper No. 09-05, Agricultural Development Economics Division (ESA), Food and Agriculture Organization of the United Nations, Rome.

Theis S, Lefore N, Meinzen-Dick R & Bryan E, 2018. What happens after technology adoption? Gendered aspects of small-scale irrigation technologies in Ethiopia, Ghana, and Tanzania. Agriculture and Human Values 35(3): 671–84.

Tsiboe F, Zereyesus YA, Popp JS & Osei E, 2018. The effect of women's empowerment in agriculture on household nutrition and food poverty in northern Ghana. Social Indicators Research 138(1): 89–108.

UN Women, UNDP, UNEP & World Bank, 2015. The cost of the gender gap in agricultural productivity in Malawi, Tanzania, and Uganda. Available at https://africa.unwomen.org/sites/default/files/Field%20Office%20Africa/Attachments/Publicatio ns/2015/10/Costing%20Gender%20Gap.pdf

Wanka FA & Rena R, 2019. The impact of educational attainment on household poverty in South Africa: A case study of Limpopo province. African Journal of Science, Technology, Innovation and Development 11(5): 597–609.