Determinants of farmer empowerment in agriculture in Kenya: A Tobit approach

Henry Muli Mwololo a,∗, Jonathan Makau Nzuma a, Lilian Mugure Githinji b

a Department of Agricultural Economics, University of Nairobi - Kenya. P.O. Box 29053 – 00625 Nairobi, Kenya
b Alliance for a Green Revolution in Africa (AGRA), Kampala, Uganda

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ABSTRACT

Empowerment in agriculture plays an important role in improving food and nutrition security. Understanding the determinants of farmer empowerment in agriculture is vital in improving the targeting of key indicators that matter for policy and practice. Most of the existing studies focus on female empowerment, leaving out the equally important aspect of male empowerment. We compute empowerment in agriculture index for male and female farmers and assess its determinants by applying the Tobit and Logit models on cross-sectional data of 835 farmers in Kenya. We find that only 11% of the farmers were empowered, 5% of whom were female. Econometric results show that gender had a positive and significant association with empowerment in agriculture and male and female farmers benefited to varying extents even from the same determinants. Thus, empowerment initiatives should compensate for such differences by targeting male and female farmers. Moreover, commercialization, access to government extension services and value of assets were positively and significantly associated with empowerment in agriculture indicating extra pathways through which empowerment in agriculture could be enhanced.

1. Introduction

The world has experienced a general decline in poverty (World Bank, 2017). Nevertheless, 10% of the world’s population is still poor and half of the poor people live in Sub-Saharan Africa (World Bank, 2020). Sub-Saharan Africa (SSA) is the only region in the world where the first Millennium Development Goal (Eradicate Extreme Poverty and Hunger) was missed (Anyanwu and Anyanwu, 2017). Ending poverty, therefore, remains a global priority as shown by the pursuit of the first Sustainable Development Goal (UNDP, 2020), the aspiration of the Africa Union’s 2063 agenda (African Union, 2015), and the Kenya Vision 2030 (Republic of Kenya, 2007).

Many of the poor in the World are farmers (Cervantes-Godoy and Dewbre, 2010; Ogutu and Qaim, 2019), possibly explaining the observation that the agriculture sector is more effective in eradicating poverty than non-agriculture sectors (Cervantes-Godoy and Dewbre, 2010; Christiaensen et al., 2006). However, agriculture faces numerous challenges that constrain its performance. One such constraint is gender inequality.

According to the United Nations Development Programme (UNDP, 2020), females earn 23% less income than males from the same activities. A similar finding was also reported by Psacharopoulos and Winter (1992) in Latin America. In Malawi, Murray et al. (2016) found that, females worked for longer hours than males on average. The patriarchal system in Africa exacerbates the problem of gender inequality as it excludes females from owning critical factors of production especially inherited land (Shimeles et al., 2018; Kameri-Mbote, 2005), which is the main means of accessing farmland in Africa. A viable pathway of addressing gender inequality is through empowerment in agriculture as it is associated with desirable benefits.

Empowerment in agriculture was found to improve dietary diversity and household nutrition status among female farmers in numerous African countries (Kassie et al., 2020; Jones et al., 2020; Murugani and Thamaga-Chitja, 2019) as well as farm productivity (Diiro et al., 2018). Empowering farmers is therefore worth pursuing as it has a positive association with desirable development outcomes including improved food and nutrition security status.

Nevertheless, determinants of farmer empowerment in agriculture have received minimal research attention with only a few published studies such as Sell and Minot (2018); Sraboni et al. (2014) and Enete and Amusa (2010) identifying some important indicators. Moreover, the existing literature focuses on female empowerment leaving out the...
equally important aspect of male empowerment. Recommendations by such studies may be misleading in cases where male farmers are not empowered. This study fills this gap by assessing the extent of farmer empowerment in agriculture in Kenya. Furthermore, this study includes commercialization and social network indicators that are omitted in previous studies.

We define empowerment as one’s capacity to make choices and transform them into desired decisions, actions and outcomes following Alsop et al. (2006). Therefore, gender empowerment or lack of it is seen in the decisions and activities one is involved in or excluded from by virtue of being a male or a female. The pathways to empowerment are referred to as domains, which are areas of influence that allow people to organize and mobilize themselves toward desired social change (Lavack, 2005). Malapit and Quisumbing (2015) and Alkire et al. (2013) define five empowerment domains namely production; resources; income; leadership and time.

The production domain concerns the sole or joint decisions regarding the crops to grow and livestock to keep. The resources domain is about decision making power over use of productive assets including land and credit. The income domain is concerned with decision making power over the allocation of income whereas leadership concerns one’s ability to lead e.g., in common interest groups and religious organizations. Lastly, the time domain is about allocation of one’s time between farm activities and non-farm activities that may be high paying as well as leisure that has been found to have a positive and significant effect on labor productivity (Cui et al., 2019).

Understanding the determinants of farmer empowerment in agriculture is an important ingredient in designing responsive policies and programs. The hypothesis tested in this paper is whether gender has a bearing on farmer’s empowerment in agriculture. The key findings are that, only a tenth of the farmers in the study area were empowered and that empowerment in agriculture was gender heterogeneous. Thus, Therefore, empowerment in agriculture initiatives need to be cognizant of such heterogeneities and compensate for them.

2. Study methodology

2.1. Analytical framework

Available literature is consistent on the role empowerment in agriculture, especially female empowerment, can play in improving farmers’ welfare including productivity, income and food security e.g., Seymour (2017) found that, reducing gender disparities within households was associated with higher levels of technical efficiency in Bangladesh. Likewise, Sraboni et al. (2014) reported a positive effect of female empowerment on calorie intake and diet diversity in Bangladesh. Similar findings were reported by Sharaunga et al. (2015) in South Africa, Bonis-Proftumo et al. (2021) in Timor Leste, and Mwololo et al. (2021) in Kenya. However, a glaring gap is that literature does not pay attention to the drivers of empowerment in agriculture. This is important because empowerment is a function of factors like education and wealth. The important drivers of empowerment in agriculture need to be well understood to improve their targeting.

Determinants of farmer empowerment in agriculture in this study are conceptualized in Figure 1 following Osanya et al. (2020) and Sell and Minoti (2018). In the top three boxes of Figure 1, it is hypothesized that, farmer demographics (individual, household and economic characteristics) are the drivers of decision-making power, a proxy of empowerment and a hypothesis that is in agreement with studies such as by Sell and Minoti (2018) who concluded that age and education had a positive and significant effect on empowerment of female farmers in Uganda and Anete and Amusa (2010) who found a significant association between hours spent on the farm, financial contribution of female farmers in farming activities and their empowerment in Nigeria.

Although the household head is considered the main decision maker in most cases, this may not always be the case, especially in households whose composition has a spouse, adult children and other adult members. The power of a household head to make farm decisions including the crops to grow, access to credit and use of farm income is therefore a function of their demographics relative to the composition of their household. For example, opinion of a resource endowed spouse may matter more compared to that of the head. The more decisions one can make, the more they are considered to be empowered and vice versa (see second and third level boxes from the top of Figure 1).

Empowerment has direct impacts on desirable development outcomes (lower most box of Figure 1). Anderson et al. (2020) and Diliro et al., (2018) found significant associations of female empowerment on yields, labor productivity, household nutrition status, soil fertility and education. Thus, understanding the key drivers of farmer empowerment in agriculture can contribute towards achieving desired development outcomes such as food security by improving the design of relevant interventions. We enrich the conceptual framework in Figure 1 by including commercialization, access to government extension, value of household assets and social network variables that have not been considered in previous gender-based literature.

On the one hand, the relationships in Figure 1 can give rise to binary outcomes. At empowerment level, a farmer is either empowered or not empowered and at domain level, a farmer can report adequacy or inadequacy in a given indicator. Binary choices are modelled using Probit or Logit probability models (Gujarati, 2004). Although the two models give similar estimates, the probit model is preferred if the data (y|x) is normally distributed while the logit model relaxes the normality condition (Gujarati, 2004). On the other hand, empowerment in agriculture can be measured as a score giving rise to a dependent variable that is double bounded between zero and one. Bounded dependent variables are modelled using the Tobit technique as it controls for corner solutions giving consistent estimates (Tobin, 1958). Both cases of binary and bounded dependent variables were observed in this study and therefore, the Logit and Tobit models were used.

2.2. Empirical methods

The study had two sets of estimations, one for the drivers of empowerment in agriculture and another for the drivers of various empowerment domains so as to identify the important pathways of empowerment in agriculture. In the first estimation, the Tobit model was applied following Tobin (1958) since the dependent variable (empowerment in agriculture index) is a score limited between zero and one. The empowerment in agriculture index (I) for the ith farmer is a function of demographic factors (X) such as commercialization and is modelled as shown in Eq. (1).

\[ I_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon_i \]  

(1)

The Tobit model uses the maximum likelihood estimator and the marginal effects are reported. The marginal effects are interpreted as the percentage change of the dependent variable for every unit change in the explanatory variable. Standard errors were clustered at the group level to control for within group homogeneity following Muthini et al. (2020).

The second set of analyses involved estimation of the drivers of the various empowerment domains. The dependent variables are binary where farmers reported adequacy (coded one) for a particular empowerment domain or otherwise (coded zero). Predicted residuals (\( YX \)) were not normally distributed (\( P < 0.01 \)) and therefore the Logit model was used since it relaxes the non-normality constraint. The Logit model was specified following Sureshwaran et al. (1996) as shown in Eq. (2).

\[ P_i = F(X_i \beta) = \frac{1}{1 + \exp(-X_i \beta)} \]  

(2)

Where \( P_i \) is the probability that the ith farmer reports adequacy in a given empowerment domain such as production, which is dependent on a vector of independent variables \( X_i \) such as commercialization and a
vector of unknown parameters \( \beta_i \) to be estimated. Both models were estimated using Stata version 14.

### 2.3. Data sources

This study used cross sectional data from a sample of 835 farmers in Kisii and Nyamira Counties of Western Kenya collected over in October–December 2015. The two counties were purposively selected because despite being high potential agricultural zones, they also experience high levels of malnutrition against expectations. They have two rain seasons, a long season from March to July and a short season from September to December.

The sample was drawn from a sampling frame comprising 94 registered farmer groups provided by the Counties’ Departments of cooperatives. In Kisii County, 71 farmer groups were registered while in Nyamira County, the list had 23 registered groups. Considering the number of groups in each county as a proportion of the total groups in the sampling frame to ensure unbiased representation of the groups in the sample, the study adopted a two-stage sampling procedure. In the first stage, 48 groups (32 from Kisii and 16 from Nyamira) were selected. In the second stage, simple random sampling technique was used to select 20 farmers from each of the selected groups given that the average number of group members was 20. In cases where a group had 20 or fewer members, a group census was conducted. The resultant target sample size was 960 but 835 farmers were available to be interviewed, representing a response rate of 87%. The sample size determination was a departure from the usual use of formulae that give a limited sample size that do not significantly change for large populations.

### 2.4. Measurement of key variables

#### 2.4.1. Dependent variable

Empowerment in agriculture index is the dependent variable in this study. Farm level empowerment especially of female farmers is an ongoing debate as it has been found to be a viable pathway of improving farm performance through superior capacity, better decisions and efficient processes. Recent studies that have contributed to this debate include Ntakyo and Berg (2022) and Anik and Rahman (2020). Empowerment in agriculture index is measured as a score ranging from zero (for farmers not empowered at all) to one (for fully empowered farmers). A higher score implies a higher level of empowerment. Resource, production, leadership, income, and time domains were adopted as suggested by Alkire et al. (2013) and Malapit and Quisumbing (2015) to compute the empowerment index. Although Alkire et al. (2013) suggests the use of 10 indicators; Malapit et al. (2015) provides a revised set of six indicators which were adopted for this study because they are robust and yield similar conclusions yet, they are less time consuming to collect data on (Malapit et al., 2015), a desirable trait since resources are always limited.

The indicators were adapted based on insights gained during the questionnaire testing as follows. For the time domain, Malapit and Quisumbing (2015) and Alkire et al. (2013) recommend asking farmers about the number of hours they spent in their farm in the 24 h preceding the survey. This was not possible in our case because some of the farmers had not spent time in their farm in the 24 h preceding the interview due to various reasons, mostly heavy rain. Instead, farmers were asked whether they contributed labor to their farm operations on full-time or on part-time basis which was farmer subjective based on the activity they considered main in an ordinary day between farm and non-farm activities. Part-time farming was considered to leave farmers with spare time to seek for leisure and complementary non-farm activities thus, contributing to empowerment.

The production domain was split into two indicators, decisions regarding the crops to grow and livestock to keep. Often, households assign farm enterprises to male or female depending on the enterprise type (Doss, 2016). While large stock such as cattle often belong to the male, small stock like chicken is often regarded as female enterprises. Thus, it was important to record the person who makes decision regarding a particular enterprise. For leadership, farmers were not asked if they were a group member because farmer groups were the sampling units in this study. Instead, farmers were asked whether they were an official in a social group. Group officials are considered to be more empowered relative to other members.

For the resource domain, it was asked whether the household head had a title deed for their land. This is important because a title deed is a requirement in transactions requiring land as collateral like accessing a loan. The survey also sought responses as to whether the household head could have accessed credit in the reference period if needed. This was a departure from the norm of asking farmers whether they accessed credit given that it is possible that some credit worthy farmers did not apply for it. Table 1 defines the indicators used and their respective adequacy threshold following Alkire et al., (2013). Each domain contributed 20% to the empowerment index.

The empowerment in agriculture index was computed in three steps. In the first step, indicators that met the adequacy threshold were coded one but zero otherwise. The second step involved deriving each indicator’s contribution to the overall empowerment score by multiplying the indicator code with its weight. The technology indicator in the production domain is used to demonstrate how the adequacy threshold or lack of it was arrived at. Farmers were asked, “who made decisions on the

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**Figure 1.** Drivers of empowerment in agriculture. Source: Adapted from Osanya et al. (2020) and Sell and Minot (2018).
crops to grow during the reference period?" The possible responses were (1) head, (2) spouse, (3) both, and (4) others. A respondent was required to choose a single option. Options (1) and (3) were considered to represent adequacy. This approach applied for all the indicators. In the third and last step, the empowerment in agriculture index for each farmer was calculated by summing the individual indicator scores (Equation 3).

$$I_i = \sum_{i=1}^{n} X_i$$  \hspace{1cm} (3)$$

Where for the $i^{th}$ household, $I_i$ is the empowerment index that ranges from 0 – 1, $X_i$ is the score for the $i^{th}$ indicator and $\sum_{i=1}^{n} X_i$ is the sum of all the individual indicator scores.

### 2.4.2. Independent variables

Commercialization was computed as the share of total farm output sold, in monetary terms, during the reference period for all the crops and livestock species managed by each household. The implication is that the total output and the portion of produce that was marketed had to be valued using market prices. Due to the subsistence nature of smallholder farmers in Kisii and Nyamira Counties, most of the agricultural produce is consumed at home. Thus, market prices were observed only for those commodities whose part was sold resulting in many missing values. To overcome the problem of missing values, the sample average price for commodities whose part was sold resulting in many missing values. To overcome the problem of missing values, the sample average price for each commodity was used to value sold and consumed produce. The resulting commercialization index is continuous and ranges between zero and one. Market access has been found to positively influence empowerment in agriculture (Ntakyo and Berg, 2022).

The value of assets in Kenya Shillings (KES) was computed as the number of a particular asset a farmer owned multiplied by its value as estimated during the interview in a first step. In the second step, all estimated asset values were summed up to arrive at the total asset value per household as shown in Eq. (4). The choice of asset value as a measure of household wealth was motivated by the study of Akter and Francis-Tan (2020).

$$Y_i = \sum_{i=1}^{n} (X_i V_i)$$  \hspace{1cm} (4)$$

Where for the $i^{th}$ household, $Y_i$ is the household asset value in KES, $(X_i V_i)$ is the value of the $i^{th}$ asset in KES, and $\sum_{i=1}^{n} (X_i V_i)$ is the sum of all individual asset values.

The intensity of social networks was measured as the number of group members the responded exchanged agriculture information with during the reference period. The higher the number, the intense the social network for that particular responded. Osanya et al. (2020) found a positive association between group membership and joint decision making. Gender, marital status and access to government extension services were measured as binary variables whereas education was measured as the number of years of formal education. The patriarchy nature of most developing countries has been reported as an important driver of empowerment rivalries (Shohel et al., 2021). Gender of the household head and marital status were used as proxies of patriarchy. The interest on access to government extension services was guided by the fact that public extension is affordable and available to many farmers compared to private extension services. Extension was included because it improves one’s decision-making capacity (Mwoollo et al., 2019), thus access to public extension services was hypothesized to have a positive association with empowerment in agriculture.

### 3. Results

#### 3.1. Farmer empowerment in agriculture

Table 2 presents the empowerment in agriculture index, disaggregated by gender. On the average, the empowerment index was 40.9% and it was significantly higher among male farmers than female farmers (Table 2). Considering the 80% empowerment threshold recommended by Alkire et al. (2013), only 11% of the farmers were empowered out of which, 5% were females. Adequacy among male farmers was significantly higher for the leadership, production and income domains than for the female farmers suggesting that even when female farmers are the de jure household heads, family ties may work against them.

Male and female farmers were not statistically different with regard to the resource and time domains. This is not surprising as it is difficult for other (than the head) household members to change ownership of the land title deed once issued and access to credit (indicators for the resource domain) neither can they influence how one spends their time. The results in Table 2 further show that all the domains (other than time) were limiting as they contributed less than half of their 20% possible contribution to empowerment in agriculture suggesting the need to empower farmers on those domains regardless of their gender.

#### 3.2. Determinants of empowerment in agriculture

The determinants of empowerment in agriculture are presented in Table 3 where gender is a key driver. Male farmers were 12.5% more likely to be empowered compared to their female counterparts. This finding was expected given our earlier results in Table 2 showing higher adequacy levels for male farmers in numerous domains. Commercialization improved empowerment in agriculture where a 10% increase in commercialization increased the likelihood of overall empowerment by 0.77% and by 1% among male farmers (Table 3). Similar findings were reported by Sell and Minot (2018) in Uganda.

Access to government extension services increased the likelihood of empowerment in agriculture by about 4% for all the models in Table 3, pointing to the important role of public extension services and in corroboration with Lecoutere et al. (2020) who found that exposure to information improved the role of females in agricultural decision making similar to Quisumbing et al. (2021). Wealth in form of asset value had a positive and significant association with empowerment in agriculture. A 1% increase in asset value increased the overall likelihood of being empowered by about 5% (Table 3). An observation worthy noting is that, male farmers benefitted more from household wealth compared to female farmers possibly because they own key factors of production especially land which is also the biggest contributor of household asset value. Quisumbing et al. (2021) observed that household wealth was not associated with female empowerment but men with a higher wealth score benefitted more than their counterparts with lower scores.

Social networks had a negative and significant association on the empowerment of females at the 5% significance level (Table 3). Although this finding was unexpected, Mbugua et al. (2020) provide a plausible explanation, where they concluded that smallholder farmers in Kenya use

### Table 1. Adequacy criteria for indicators of empowerment in agriculture.

| Domain          | Indicators                     | Adequacy threshold | Weight |
|-----------------|--------------------------------|--------------------|--------|
| Production      | Technology use.               | Farmer decided on the crops to grow, either solely or jointly. | 0.1    |
|                 |                                | Farmer decided on the livestock to keep, either solely or jointly. | 0.1    |
| Leadership      | Group official.                | Farmer was an official or ex-official in a group. | 0.2    |
| Income          | Control over use of farm income. | Farmer decided on how to use farm income, either solely or jointly. | 0.2    |
| Resources       | Title deed.                   | Farmer had a title deed. | 0.1    |
|                 | Access to credit.             | Farmer could access credit if they needed it. | 0.1    |
| Time            | Labor contribution to the farm. | Farmer contributed farm labor on part time basis. | 0.2    |
social networks as informal insurance implying that social network can be used to compensate for lack of empowerment among farmers, in other words, stronger social ties can be an indication of lack of empowerment.

3.3. Drivers of the empowerment domains

The results presented in Table 3 are inadequate on the drivers of the individual empowerment domains considering that most empowerment interventions target to improve specific domains such as production. To address this shortcoming, separate models were estimated for each of the empowerment domains to identify their specific drivers (Table 4).

Commercialization reduced the likelihood of reporting adequacy in the time domain by 20.5% (Table 4), possibly because market requirements may be involving to an extent that farmers do not have time left for non-farm activities and leisure. However, commercialization increased the likelihood of reporting adequacy in the income domain by 28.3% (Table 4) since more sales translate to higher farm incomes and thus, commercialized farmers are likely to have bigger say about the resulting income.

An extra year in school increased the likelihood of reporting adequacy in the leadership domain by 2% (Table 4). This is plausible as education increases one’s influence among peers, perhaps explaining the positive and significant association. Likewise, access to government extension services had a positive and significant association on the leadership and income domains. Farmers who accessed government extension services were more likely to report adequacies in the two domains by 9.5% and 11.6% respectively. Extension contributes to empowerment by providing information ‘which is power’.

Asset value was an important driver of four of the five domains and increased the likelihood of reporting adequacies in those domains by between 4.8% and 9.4% (Table 4). The opinion of wealthy farmers matters more relative to that of poor farmers. Consistent with results in Table 3, social networks had a negative and significant association on the resource, leadership, and time domains indicating that stronger ties were among less empowered farmers (Table 4).

Lastly, gender of the household head was positively and significantly associated with the production and income domains. Male farmers were more likely to report adequacy in the production and income domains by 29% and 25.8% respectively, relative to female farmers (Table 4), implying a gender-based heterogeneity in decision making power with respect to the two domains. This finding is of particular interest since this paper attempts to find out whether gender of the farmers matters in their empowerment. As a result, the determinants of the two domains for male and female farmers were tested separately (Table 5).

The results are consistent with those of earlier models where, commercialization, access to government extension services, and value of assets are significant drivers of empowerment in agriculture. A factor influencing female empowerment that is not significant in earlier models is their marital status. Married female farmers were more likely to report adequacy in the production domain by 41.3% compared to single ones as they may enjoy joint decisions with their husbands (Table 5).

4. Discussion

In conformity with our expectations, it was found that 89% of the farmers were not empowered and four of the five domains were limiting regardless of the gender of the farmer. The finding that a majority of the farmers, regardless of their gender, were not empowered underpins the need to understand the key drivers of empowerment as a first step in transforming agriculture especially by smallholder farmers who produce more than half of the globally consumed foods (Herrero et al., 2010). Gender, commercialization, access to public extension services, value of household assets and social networks were the most important drivers of empowerment in agriculture.

Overall, male farmers were more likely to be empowered in agriculture compared to female farmers possibly due to the patriarchal nature of most rural farming households in Kenya where males control key factors of production especially land. Indeed, male farmers were more likely to report adequacy in the production and income domains than their female counterparts in agreement with Shimeles et al. (2018) and Kameri-Mbote (2005) who found that patriarchy in Africa excludes females from owning land. Gender influenced empowerment in agriculture through the production and income domains.

### Table 2. Gender disaggregated levels of empowerment in agriculture and farmer characteristics.

| Variables                               | Overall | Female (F) | Male (M) | Mean difference (F-M) |
|-----------------------------------------|---------|------------|----------|-----------------------|
| Empowerment index (0–1)                 | 0.409   | 0.282      | 0.446    | -0.164***             |
| Resource                                | 0.047   | 0.046      | 0.048    | -0.002                |
| Leadership                              | 0.066   | 0.051      | 0.070    | -0.019**              |
| Time                                    | 0.129   | 0.122      | 0.131    | -0.009                |
| Production                              | 0.099   | 0.033      | 0.118    | -0.085***             |
| Income                                  | 0.056   | 0.013      | 0.069    | -0.056***             |
| Commercialization index (0–1)           | 0.440   | 0.400      | 0.453    | -0.057***             |
| Formal education of the household head  | 9.007   | 6.532      | 9.726    | -3.195***             |
| Proportion accessing government extension| 0.357   | 0.340      | 0.362    | -0.021                |
| Value of farm implemented (KES)         | 6,322.501| 4,203.278| 6,938.287| -2,735.009***         |
| Social network intensity (number)       | 10.931  | 9.484      | 11.351   | -1.867***             |
| Proportion married                      | 0.762   | 0.059      | 0.965    | -0.097***             |

Notes: Values are sample means. Standard errors are in parentheses. Significance of mean differences was tested using t-statistics and reported at the 1% (***) and 5% (**) levels. 1 US$ = 100 KES.

### Table 3. Tobit estimates of the drivers of empowerment in agriculture.

| Variables                               | Overall | Males | Females |
|-----------------------------------------|---------|-------|---------|
| Gender of household head (man – 1)      | 0.125***| (0.040)|        |
| Educational (score 0–1)                 | 0.077** | (0.036)| 0.105***| (0.041)| -0.003| (0.060)|
| Education of the household head (years) | 0.003 (0.002)| 0.003 (0.003)| 0.001 (0.003)|
| Access to government extension services (yes – 1) | 0.042***| (0.016)| 0.044 ***| (0.018)| 0.044*| (0.026)|
| Value of assets (log KES)               | 0.052** | (0.009)| 0.064***| (0.012)| 0.038**| (0.013)|
| Social network intensity (number)       | -0.001 | (0.001)| 0.000 (0.001)| -0.003**| (0.002)|
| Marital status (married – 1)            | -0.008 | (0.039)| -0.017 | (0.046)| 0.030| (0.066)|
| F statistic                             | 25.94***| 9.70***| 1.84* |
| Observations                            | 815     | 629    | 186     |

Notes: Standard errors are in parentheses and clustered at the group level. Significance levels are reported at the 1% (***) and 5% (**) and 10% (*) levels. Dependent variable is the empowerment in agriculture index. Exchange rate was 1 US$ = 100 KES.
Empowerment in agriculture improved with commercialization for the case of males. Owusu and Işcan (2021) observed in Nigeria and Tanzania that the key drivers of commercialization included land and high value enterprises such as cash crops. Dos (2016) associates land ownership and the management of high value enterprises with males. Another obvious observation in the rural areas is that males mostly own the means of transport especially bicycles and motor cycles that are enablers of market access given the poor road network and long distances to the main markets (Oguta et al., 2020). The implication is that males are better placed to take advantage of market opportunities and the resulting benefits such as better farm income. Moreover, the results in Table 4 show that commercialization can improve empowerment through the income domain.

Access to government extension services empowered farmers regardless of their gender. This finding is not unexpected given the role of agricultural extension services in empowering farmers by strengthening their decision making capacity through access to information (Mwololo et al., 2019). The positive association of extension on empowerment in agriculture is through the leadership and income domains. On the one hand, farmers with access to extension services are likely to be more informed, for example about use of new agricultural technologies thus winning them trust from their fellow farmers as opinion leaders. On the other hand, optimal farming decisions like adoption of improved technologies can lead to increased farm incomes explaining the positive association between access to extension services and the income domain.

The value of household assets (a proxy for wealth) increased empowerment in agriculture, regardless of farmer's gender indicating the paramount role of resource endowment in influencing agricultural decisions. The magnitude of the association of the value of assets on the empowerment of male farmers was twice that of female farmers. This is possibly because male farmers control most of the household assets. The value of household assets influenced empowerment through all the domains other than time. Kabunga et al. (2012) provide a plausible explanation that asset ownership is highly correlated with higher social status. Thus, farmers who control more assets are likely to be more influential explaining the positive and significant association.

Social networks were found to have a negative and significant association with female empowerment against expectation given the role such networks were thought to play on the welfare of smallholder farmers. According to Jäckering et al. (2019), social networks are important in diffusing agriculture and nutrition information in Kenya. Seeing that the negative association of social networks is through the resource and time domains, it could be argued that poor farmers (who are also less likely to be empowered) are more likely to strengthen their social networks as a form of insurance during times of need in line with findings of Mbugua et al. (2020). Similarly, Katungi et al. (2007) found a negative association between wealth and social networks in Uganda.

### Table 4. Logit estimates of the drivers of empowerment domains.

| Variables                      | Resource          | Leadership         | Time              | Production        | Income             |
|--------------------------------|-------------------|--------------------|-------------------|-------------------|--------------------|
|                                | Mean marginal effects |                    |                   |                   |                    |
| Commercialization (score 0–1)  | 0.079 (0.069)     | 0.089 (0.071)      | –0.205*** (0.076) | 0.184 (0.111)    | 0.283*** (0.073)   |
| Education of the household head (years) | 0.004 (0.006)     | 0.021*** (0.005)   | 0.006 (0.006)     | –0.007 (0.007)    | –0.005 (0.005)     |
| Access to government extension services (yes – 1) | –0.012 (0.032)     | 0.095*** (0.043)   | –0.014 (0.045)    | 0.048 (0.037)     | 0.116*** (0.029)   |
| Value of assets (log KES)      | 0.064*** (0.020)  | 0.068*** (0.023)   | 0.021 (0.018)     | 0.094*** (0.025)  | 0.048*** (0.021)   |
| Social network intensity (number) | –0.004** (0.002)  | 0.004* (0.002)     | –0.005*** (0.002) | 0.002 (0.002)     | 0.001 (0.001)      |
| Marital status (married – 1)   | –0.082 (0.071)    | –0.002 (0.106)     | –0.040 (0.100)    | 0.157 (0.107)     | –0.015 (0.085)     |
| Gender of household head (man – 1) | 0.030 (0.062)     | –0.007 (0.109)     | 0.071 (0.104)     | 0.291*** (0.112)  | 0.258*** (0.055)   |
| Observations                   | 815               | 815                | 815                | 815                | 815                |
| Wald Chi²                      | 17.13***          | 71.11***           | 13.91**           | 131.01***         | 77.31              |
| Pseudo R²                      | 2%                | 6%                 | 2%                | 12%                | 11%                |

Notes: Standard errors are in parentheses and clustered at the group level. Significance levels are reported at the 1% (***) and 5% (**) levels. Dependent variables are adequacy dummies for each of the empowerment domains. Exchange rate was 1 US$ = 100 KES.

### Table 5. Gender disaggregated logit estimates of the drivers of empowerment domains.

| Variables                      | Males Proportion | Males Income | Females Proportion | Females Income |
|--------------------------------|------------------|--------------|-------------------|----------------|
|                                | Mean marginal effects |                  |                   |                 |
| Commercialization (score 0–1)  | 0.251** (0.111)  | 0.355*** (0.095) | –0.161 (0.110)    | 0.052 (0.053)   |
| Education of the household head (years) | –0.007 (0.007)  | –0.009 (0.006)  | –0.003 (0.008)    | 0.005 (0.004)   |
| Access to government extension services (yes – 1) | 0.052 (0.040)    | 0.147*** (0.037) | 0.017 (0.049)     | 0.016 (0.031)   |
| Value of assets (log KES)      | 0.085*** (0.025)  | 0.061** (0.027)  | 0.081*** (0.025)  | 0.013 (0.016)   |
| Social network strength (score 0–37) | 0.002 (0.002)    | 0.002 (0.002)   | –0.002 (0.003)    | –0.003 (0.002)  |
| Marital status (married – 1)   | –0.009 (0.104)   | –0.038 (0.116)   | 0.413** (0.176)   | 0.014 (0.055)   |
| Observations                   | 629              | 629             | 186               | 186             |
| Wald Chi²                      | 22.80***         | 42.26***        | 19.59***          | 5.53            |
| Pseudo R²                      | 3%               | 5%             | 9%                | 7%             |

Notes: Standard errors are in parentheses and clustered at the group level. Significance levels are reported at the 1% (***) and 5% (**) levels. Dependent variables are adequacy dummies for each of the empowerment domains. Exchange rate was 1 US$ = 100 KES.

5. Conclusions and recommendations

This study assessed the determinants of empowerment in agriculture and identified the important empowerment pathways among smallholder farmers in Kenya using Kisii and Nyamira Counties as cases. The average empowerment index of 40% indicates that both the male and female farmers were not empowered despite male farmers having been used in gender studies as a benchmark in evaluating female empowerment in agriculture. Thus, the conclusion is that, reducing the gender empowerment gap between male and female farmers is necessary but not sufficient in eliminating gender disparities among smallholder farmers. Instead, empowerment policies and programs should aim at empowering farmers in absolute terms using a desired minimum threshold over and above narrowing the gender empowerment gap between male and female farmers.

The results provide evidence that male farmers were more likely to be empowered in agriculture than their female counterpart and that the drivers of empowerment were different between the two groups. The study concludes that, male and female farmers are heterogeneous implying that the design of empowerment policies and programs need to
be cognizant of such heterogeneities and compensate for them. The compensation may include targeting male and female farmers separately or having gender smart activities for each of the groups. This finding is particularly relevant in Kenya where affirmative action is taking root in numerous government decisions.

In addition to the farmer’s gender, commercialization, access to extension services, value of assets, and social networks had a consistent bearing on policy and practice. Since more commercialized male farmers were more likely to be empowered compared to the female farmers, it was concluded that agricultural commercialization is an important pathway of empowering male farmers. Agricultural commercialization should therefore be enhanced by investing in enablers of market access such as road and market infrastructure and strengthening market institutions. Moreover, initiatives that increase agricultural productivity such as use of improved technologies are relevant as they enable smallholder farmers to produce marketable surplus and consequently, act as an incentive for market development.

Since access to government extension services increased the likelihood of empowerment of the farmers, regardless of their gender, the national and county governments in Kenya (since agriculture is a devolved function) need to strengthen provision of public agricultural extension services, albeit partly, debate on privatization of extension services in Kenya. Strengthening public extension services may include retraining agricultural staff on current developments in the sector and providing mobility equipment such as motor cycles and vehicles. Some of the strengths of public extension services is that it has a wide geographic coverage, it is affordable and sustainable in the long term as government is a going concern compared to extension services provided by non-governmental organizations through short lived projects of about 1–5 years, and extension services provided by private companies that are often expensive, locking out many needy farmers.

The finding that the value of household assets had a positive and significant association with empowerment, regardless of the farmer gender, is particularly appealing and suggests that policy and development initiatives should prioritize the accumulation of assets. One of the mechanisms of asset accumulation is through savings mechanisms. Farmers can therefor use the savings to acquire assets that can augment their farm operations further reinforcing commercialization. In addition, farmers can use their savings to acquire assets such as mobile phone and radio, which are important sources of agricultural information. The accumulated assets can also be used as collateral to access credit which is a limiting factor of the resource domain of empowerment.

Finally, we stronger social ties had a negative association with female empowerment an observation interpreted from the view point of why farmers engage in social networks in the first place. Poor female farmers suffer the effects of patriarchy and are not likely to be empowered since they are deprived of key factors of production such as land and credit. Consequently, they strengthen their social networks as a way of insuring themselves during times of need. In conclusion, by increasing commercialization, strengthening public extension services and supporting farmers to accumulate assets, the importance of social networks on the welfare of female farmers would decrease as they become more empowered and independent. Strengthening social networks should therefore be promoted as a short-term strategy as female farmers develop long term empowerment strategies like asset accumulation.

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