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DETERMINANTS OF FOOD SECURITY AMONG SMALL-SCALE SOYBEAN HOUSEHOLDS IN BUTERE SUB-COUNTY, KENYA

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SUMMARY

Food and nutritional (in)security remain an important matter of concern, especially in developing countries. Despite the efforts to enhance food security among smallholder soybean households, the proportion of the undernourished population in Butere Sub-County still remains high for unknown reasons. Therefore, the purpose of this paper is to examine the determinants of food security among smallholder soybean households in Butere Sub-County, Kenya. The study adopted the exploratory research design. A multi-stage sampling procedure was used to select a sample of 201 respondents. Cross-sectional data were gathered through face-to-face interviews using pretested semi-structured questionnaires and analyzed using ordered logistic regression model. Household Food Insecurity Access Scale was used to measure and categorize the soybean household food (in)security status. The results revealed that the household food (in)security status differed across soybean households and was greatly influenced by an interplay of socio-economic, market, and institutional factors. Age of the household head negatively influenced food security, whereas the level of soybean commercialization, education, livestock units, network density, extension visits, and credit access were positively associated with household food security. The study recommends policy interventions that seek to ensure intensive literacy development, frequent extension and training, improved access to credit, and reinvestment in productive assets or inputs for increased production, commercialization and food security. Strengthening of social ties and increased allocation to safety net programs for the aged, vulnerable, and resource-poor households are also recommended.

Key words: soybean, undernourished, determinants, commercialization, food security, Household Food Insecurity Access Scale

INTRODUCTION

Globally, food and nutritional (in)security remain an important matter of concern for both the developed and developing nations (Bashir et al., 2012; Todaro & Smith, 2015). Importantly, food (in)security is directly related to poverty at various levels (FAO, 2013). According to Food and Agriculture Organization (FAO, 2010), the decline in hunger the world has been enjoying over the past decades due to doubling world food production was at an end, in that the absolute number of undernourished people continues to rise, albeit slowly. Currently, more than 820 million people around the world are undernourished, thus posing a challenge of realizing the zero hunger (Goal number 2) target of Sustainable Development Goals by 2030 (FAO, 2019). The report further revealed that about 2 million people in the world experience moderate or severe food insecurity which puts them at a greater risk of poor health and malnutrition. Globally, the lack of regular access to nutritious and sufficient food remains the major cause of malnourishment. Bashir et al. (2012) reported that malnourishment is an indication of food insecurity existing when

caloric intake of a household goes below the minimum dietary energy requirement. According to FAO (2019), food security is achieved at an individual, household, national, regional, and global levels, when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

The problem of food insecurity, however, is more worrying in developing countries compared to developed countries. Although food insecurity is primarily concentrated in low- and middle-income countries, FAO (2019) reported that severe or moderate food insecurity still affects more than 8% of the population in Europe and Northern America. Moreover, the situation is worse in developing countries of Asia and Africa, where more than 770 undernourished people reside (FAO, 2019). Importantly, food insecurity continues pose immense challenges in several Sub-Saharan African nations including Kenya (Mota et al., 2019). FAO (2019) reported that the number of undernourished people in sub-Saharan Africa remained high at 239 million in 2018. Despite the evidenced progress in welfare improvement and economic growth in these sub-Saharan African countries over the last decades, food security has not been fully attained in these nations (Mota et al., 2019). Being one of the developing countries in sub-Saharan Africa, Kenya is not an exception.

According to the Kenya National Bureau of Statistics (KNBS, 2018), nearly 16.4 million Kenyan households live below the poverty line. FAO's most recent estimates further showed that in Kenya over 10 million people are food insecure, thus unable to meet their dietary energy requirements, with the majority of them living on food relief (FAO, 2019). However, the achievement of food security in Kenya has been a key objective of the agricultural sector (GoK, 2018). Although the agricultural sector is the mainstay of Kenya's economy, contributing to 24% of the Gross Domestic Product (GDP), 45% of the government revenue, 50% of the export earnings, 27% of GDP through linkages with manufacturing, distribution and other service-related sectors, 75% of industrial raw materials, and 60% of the total employment, the proportion of the undernourished population in Kenya is 29.4%, which is too high compared to 26.4% recorded in the past years (FAO, 2017; KNBS, 2020). The report further indicates that by 2017, food insecurity had reduced from 48.5% in 2003 to 26.7% (FAO, 2017). Over 80% of the Kenyan population lives in rural areas of Kenya, deriving their livelihoods mainly from agriculture-related activities (KNBS, 2019). Among this population, more than 80% are small-scale farmers owning less than 5 acres of land. In Kenya, these smallholder households are the most susceptible to food insecurity since they have to deal with the uncertainties in their daily food provision (KNBS, 2019).

Literature on the determinants of food security is enormous, but the results are diverse depending on the location of the study, other factors considered. The current food insecurity problems are attributed to several factors. Mota et al. (2019) presented that the food security situation in Ethiopia results from severe, recurring food shortage, and famine, which is associated with recurrent drought. Altman & Ngandu (2010) revealed that extensive unemployment, high dependency ratios, and low wage levels contribute to food insecurity in South Africa; thus to achieve food security, there should be adequate income and amounts of food at all times. Ngema et al. (2018) used a binary logistic regression model and found that education, infrastructural and irrigation support, household income and access to credit positively influenced the food security status of households in South Africa. Drammeh et al. (2019) also identified social factors, income, and environmental calamities as important factors causing numerous smallholder households in Sub-Saharan Africa to experience food insecurity.

Bouis & Hunt (1999) echoed that household food security is directly linked to the physical availability of food, the ability of households to access the available food, and the ability of individuals to secure entitlement to it. Human resource development such as education, clean water, displacement of people, health care, urbanization, availability and accessibility to livelihood assets, and population growth were also identified to be highly correlated to food and nutritional security (Drammeh et al., 2019). Other factors such as cost of labor, size of land owned, crop and income diversification, livestock units owned, safety net programs, access to credit, household indebtedness, agricultural inputs and extension services, use of improved agricultural technologies as well as participation and performance of input-output markets were also found to determine household food security (O'Ajao et al., 2010; Harris-Fry et al., 2015; Schmidt et al., 2016; Ali & Vallianatos, 2017; Mansura et al., 2020). These factors help smallholder farmers in improving their subsistence production to a surplus level to increase the overall income. The reviewed studies emphasized that multiple interrelated factors determine food (in)security among households. However, it is important to note that such influence varies from one context to another, thus the need for diverse strategies and food policies to address food security problems around the world.

As a means to enhance food and nutritional security, the Government of Kenya (GoK), researchers, donors, planners and international development partners have given high priority to food systems and the problem of food insecurity through promotion and development of agricultural projects as a way of increasing food supplies, generating household income, and creating jobs. Also, it is important to note that the food insecurity situation in the western

region of Kenya, especially in Butere Sub-County in Kakamega County, shares similar features with the situation of other regions in Kenya and the world. In Kenya, soybean was identified as one of the leguminous crops representing an essential opportunity for economic development (Nyongesa et al., 2017). Again, soybean is among the potential value chain crops in most of the county's integrated development plans (CIDPs) in western Kenya. The multiple uses of soybean make it an important industrial crop (Chianu et al., 2009). Soybean is an important source of protein and oil for the human diet and contributes to improvement of soil fertility through biological nitrogen fixation (Chianu et al., 2006). Soybean production is dominated by smallholder farmers, who have limited capability in dealing with crop production challenges such as the effects of climate change (Idrisa et al., 2010). Soybean production enables smallholder farmers to gain higher yields and increase their profits and family income, which further helps them promote improved living standards and food security (Osmani et al., 2014). Therefore, in recognition of the role of soybean in improving the nutritional status of poor rural households, governments and private organizations are increasingly promoting soybean production and commercialization in developing regions (Varia, 2011).

In Kenya, western counties such as Kakamega, Bungoma, Busia and Vihiga are the largest producers of soybean, majorly grown as an intercrop with maize, sorghum, finger millet, cassava or sugarcane; however, these counties are yet to meet their production potential and food security status (Rachier, 2001; Mahasi et al., 2011; Nyongesa et al., 2017; Mbembe et al., 2019). Mahasi et al. (2011) estimated that about 2,500 hectares of land are under soybean production in Kenya. Kenyan's soybean production per hectare is averagely 0.8 tons, which falls short of an average potential of 1.5 to 3.0 tons per hectare (Mahasi et al., 2011). Further, demographic shifts have led to an increase in demand for soybean and soybean products as safer and nutritious food, thus leading to increased industrial demand for soybean as a raw material for production of human food and livestock feed (AGRA, 2017). These represent opportunities for encouraging soybean commercialization and food security especially among smallholder farmers in Kenya. Commercialization of soybean would be a major milestone for improving soybean productivity, improving smallholder farm incomes and meeting the domestic consumption and industrial demand for soybean to improve food security (Nyongesa et al., 2017; Mbembe et al., 2019).

Moreover, many efforts have been focused on enabling smallholder farmers to participate in soybean production and marketing in the region as a way of enhancing food security (Tinsley, 2009; GoK, 2018; Mbembe et al., 2019). These remain some of the strategies for encouraging the production and commercialization of soybean not only for meeting the increasing demand for soybean products but also for improving smallholder farmers' food security (GoK, 2007; GoK, 2018). Despite these efforts to enhance food security among the smallholder soybean households in Butere Sub-County, the proportion of the undernourished population remains high. Although the reviewed studies made a significant contribution in understanding the determinants of food security in Kenya and beyond, no study has empirically and explicitly estimated the influence of these factors on food security among small-scale soybean households in Butere Sub-County, Kakamega County, Kenya. This study is, therefore, aimed to fill this knowledge gap based on an exploratory study design. In light of the foregoing, the objective of the study is to determine factors influencing food security among small-scale soybean households in Butere Sub-County. The significance of the study is to contribute to the empirical literature on the determinants of food security among small-scale soybean households in Butere Sub-County, Kakamega County, Kenya. Based on the results, various policy recommendations are drawn to enhance smallholder farmers' incomes, food, and nutritional security as well as to meet broader economic goals such as the Sustainable Development Goals of ensuring zero hunger and Kenyan Big Four Agenda of ensuring food security (GoK, 2018).

MATERIAL AND METHODS

Study area

The study was conducted in Butere Sub-County in Kakamega County. Kakamega County is one of the western counties in Kenya. It has three regions, twelve sub-counties, sixty wards, two townships, and several village units. The choice of Butere Sub-County was motivated by the fact that the majority of its farmers are practicing soybean production as part of their livelihood and it is also a region where soybean commercialization has been largely promoted. Butere Sub-County covers approximately 210.6 square kilometers with a population of 154,100 people and a population density of 186 persons per square kilometer (KNBS, 2019). The altitude of the Sub-County ranges from 1240 meters to 2000 meters above the sea level and it is located between the latitude 0° 16' 60.00" North and the longitude of 34° 45' 0.00" East. Butere Sub-County experiences a bimodal rainfall pattern, where long rains occur between March and July and short rains occur between August and October. Annual rainfall in the study area ranges from 1280.1 mm to 2214.1 mm per year while the temperature ranges from 18 to 29 degrees Celsius, where January, February, and March being the hottest months. Other months experience relatively similar temperatures except for

July and August, which have relatively cold spells. Agriculture is the main economic activity in the area. The Sub-County is characterized by well-drained, rich, and fertile soils that support the production of major crops like maize, soybean, tea, beans, sugar, and horticulture.

Sampling and data collection

The target population of this study was small-scale farmers in Butere Sub-County in Kakamega County. The sampling unit was the smallholder soybean farmers in Butere Sub-County. Since the population was unknown, the study sample size of 201 respondents was determined using proportionate to size sampling approach as propounded by Cochran (2007). Based on the exploratory research design a sample of 201 respondents was randomly selected from a population of smallholder soybean farmers in Butere Sub-County using a multistage sampling technique. In the first step, Kakamega County was purposively selected because it represents one of the leading soybean producing counties in the western region of Kenya (Nyongesa et al., 2017; Mbembe et al., 2019). In the second stage, Butere Sub-County was purposively selected because it is one of the leading soybean producing and commercializing sub-counties in Kakamega County with high level of undernourished people. In the third step, the following two wards were purposively selected from Butere Sub-County: West Marama (because it represents a ward where most farmers are engaged in production and commercialization of soybean) and Masaba (because it represents area with the least soybean production and commercialization activities). In the last stage, 201 soybean producers were randomly sampled from two purposively selected wards in Butere Sub-County, namely West Marama (114) and Masaba (87). Primary data were then collected through observations and face to face interviews, using pretested semi-structured questionnaires administered during November and December 2019 by a group of trained enumerators.

Food security measurement

Different scales or methods have been developed to group or classify various levels of food (in)security. However, this study defines food security as physical access to sufficient and preferred food at all times by household members (Lutomia et al., 2019). Maxwell & Frankenberger (1992) also considered food security to compose of three basic elements including availability, access, and utilization. The classification of households' food (in)security used here is based on scores obtained from the Household Food Insecurity Access Scale (HFIAS). This scale scores household food (in)security using self-reported food security data. It comprises two different types of questions namely the occurrence questions and the occurrence frequency questions (Coates et al., 2007). The occurrence questions include nine questions that capture the household experience of food insecurity. Each occurrence question has a corresponding frequency-of-occurrence question. According to Coates et al. (2007), the frequency-of-occurrence questions capture the frequency of household food (in)security situations. Responses from both the occurrence questions and the occurrence frequency questions are then used to calculate scores. On the basis of the responses, Household Food Insecurity Access Scale was then used to group the households into four food security levels: severely food insecure, moderately food insecure, mildly food insecure, and food secure. Therefore, households were assigned the value of 1 if they were severely food insecure, 2 if they were moderately food insecure, 3 if they were mildly food insecure, and 4 if they were food secure. Based on the study definition, severe food insecurity occurs when a soybean household is persistently unable to meet the minimum daily food and nutritional requirement over the past 12 months. Moderate food insecurity occurs when a soybean household experiences a cyclical pattern of inadequate access to food over the past 12 months. Specifically, the period of food shortage is between planting and harvesting, commonly linked with climate shocks, economic crises, natural disasters, or conflicts. Mild food insecurity occurs when a soybean household is at risk of chronic or transitory food insecurity but currently has a minimum acceptable food intake. Finally, food security occurs when all members of a soybean household have not lived in hunger over the past 12 months.

Econometric estimation strategy

The study was based on the expected utility theory. An ordered logit model was then used to identify the determinants of food security. Since the dependent variable is ordinal, there is a relative ordering of the food security status thus making an ordered logit model appropriate for estimating the determinants of food (in)security in soybean households. This model assumes the existence of cutoffs between the ordinal outcomes, but the distance between them is not exact. Therefore, an ordered logit model was used to take into account the ordinal nature of the food security categories. For instance, a soybean household in the severely food insecure category is "worse off" than a household in the moderately food insecure category. Again, a household in the mildly food insecure category is "better off" than moderately food insecure households. Finally, a household in the food secure category is "better off" than a mildly food insecure household. According to Wooldridge (2002), an ordered logit represents an

extension of the previous conditional logit model by adding multiple cutoff points, to find out the factors associated with the likelihood of a household being in a higher category. Household food security depends on certain measurable factors x_i and certain unobservable factors ε_i . The ordered logit model was therefore estimated for the polychotomous dependent variable with four food security categories as follows.

- 1 = Severely food insecure
- 2 = Moderately food insecure
- 3 = Mildly food insecure
- 4 = Food secure

Following Wooldridge (2002), if y is an ordered response, taking values 1,2,3,4, and y^* is the latent value representing expected utility of y , then ordered logistic model for y (conditional on explanatory variables x_i and certain unobservable factors ε_i) can be derived from a latent variable model as follows:

$$y_i^* = x_i \beta_i + \varepsilon_i \quad (1)$$

The j cutoff point will be given as $\mu_a < \mu_b < \mu_c$ such that:

$$y_i = \begin{cases} 1 \text{ (severely food insecure), if } y_i^* \leq \mu_a, \\ 2 \text{ (moderately food insecure), if } \mu_a \leq y_i^* \leq \mu_b, \\ 3 \text{ (mildly food insecure), if } \mu_b \leq y_i^* \leq \mu_c, \\ 4 \text{ (Food secure) if } y_i^* \geq \mu_c \end{cases} \quad (2)$$

Furthermore, the model assumes a zero mean and a constant variance. The vector of independent parameter estimates is provided in the coefficient vector β consisting of socio-economic, farm, market, and institutional factors (Wooldridge, 2002; Greene, 2008). According to Greene (2008), the ordered logit model adjusts better to a probability curve by using a normal distribution function to estimate the probability of falling in a certain ranking or ordered category. The model was adopted because the dependent variable was the ordinal variable given a number of independent variables. The model also results in robust and efficient estimates. The model coefficients can be interpreted using the marginal change in the explanatory variables on the expected value of the dependent variable. The outcome variable in Equation (2) is household food security categories. The independent variables include the level of soybean commercialization. To determine the influence of soybean commercialization on food security, this study was expanded to the commonly adopted concept of commercialization, mostly measured as a binary choice variable of whether a farmer is engaged in commercialization or not or the commercialization level measured using Household Commercialization Index (value of the marketed produce over total production). The binary choice or Household Commercialization Index variable of soybean output market participation has been largely criticized for losing valuable information about the intermediate-level of commercialization. Therefore, in this study, the level of commercialization was based on the individual commercialization level observed and measured beyond the commonly used household commercialization index. This was measured in the following terms: a farmer did not sell any quantity of soybean in the market (1), a farmer sold less than 50% of soybean produced (2) or a farmer sold more than 50% soybean produced at the time of data collection (3). Therefore, the respondents indicated their level of soybean commercialization as grouped into 3 abovementioned groups. The study expected that socio-economic, farm, market, and institutional factors would have either a positive or negative effect on food security as shown in Table 1.

RESULTS AND DISCUSSION

Descriptive statistics of the dependent and independent variables

Table 2 presents descriptive statistics of the soybean household characteristics in Butere Sub-County. Food insecurity is one of the major problems faced by smallholder farmers in Kenya (FAO, 2017). Unexpectedly, the results revealed that the majority of the sampled soybean households, approximately 28%, were food secure. The proportion of soybean households that were mildly food insecure and moderately food insecure was 24% and 27%, respectively. Additionally, approximately 20% of soybean households were severely food insecure. This implies that most of the farming households in the study area were experiencing food security. The study results revealed that a

majority of the respondents (approximately 57%) had commercialized their soybean production, although their level of commercialization varied. About 43% of the respondents did not participate in the soybean market. Descriptive results further revealed that the majority of the respondents (30%) sold less than 50% of their soybean produced. Approximately 27% of the sampled soybean households sold more than 50% of their produced soybean. These results imply that the level of soybean commercialization in the study area was expected to increase upon the implementation of effective production and marketing policies. The heads of soybean household had averagely 9 years of education (Tab. 2). It is worth noting that some household heads did not attend school at all as indicated by the education range of 0 to 16 years. The results showed that on average the age of the soybean household head was 54 years old, with an average household size of 6 members. The size of soybean households also varied from as low as one member to 18 members. On average, the tropical livestock unit of the sampled soybean household was 6.27. The minimum and maximum values of the tropical livestock units were 0 and 30.14 respectively. On average, soybean households earned approximately KES 47,729 (\$ 477) as off-farm income per annum. Network density and the number of extension visits are important factors influencing the household food security status. Descriptive results in Table 2 further revealed that the average number of people that a household can rely on for help in times of need was 13 people, with a minimum value of 0 and a maximum value of 105. This implies that some households had zero network density or relied on nobody in terms of help. The average number of extension visits in the last 12 months was 5 (Tab. 2). However, some farmers did not have such an extension visit. The proportion of soybean households that were male-headed was 65%. This implies that soybean farming is dominated by male farmers compared to their female counterparts. Similarly, the majority of the soybean farmers were married (76%). Married household farmers benefit from joint decision-making on the issue of ensuring food security.

Table 1. Description of dependent and independent variables used in the ordered logit model and their expected signs

Variables	Description	Variable Type	Measurement	Expected Sign
Dependent Variable				
Food security	Household food security status calculated from the Household Food Insecurity Access Scale	Ordered Category	1 = Severely food insecure 2 = Moderately food insecure 3 = Mildly food insecure 4 = Food secure	None
Independent Variables				
Age of house head	Age of the household head in years	Continuous	Number	±
Education	Years of schooling of the household head	Continuous	Number	±
Household size	Number of household members	Continuous	Number	±
TLU	Tropical livestock unit	Continuous	Number	±
Network density	Number of relatives and non-relatives that a household can rely on for help in times of need	Continuous	Number	±
Extension Visit	Number of extension visits had in the last one year	Continuous	Number	±
Log off-farm income	Natural logarithm of the total amount of income a household got from off-farm activities	Continuous	KES	±
Soybean commercialization level	Level of soybean commercialization of a household	Ordered category	1= Sold 0% of soybean produce 2= Sold less than 50% of soybean produce 3= Sold more than 50% of soybean produce	±
Gender of the house head	Gender of the household head	Categorical	0=Female 1=Male	±
Marital status	Marital status of the household head	Categorical	1=Not married 2=Married	±
Occupation	Primary occupation of the household head	Categorical	0= Non-farming 1= Farming	±
Credit access	Whether a household had access to credit services	Binary	0=No 1=Yes	±
Group membership	Whether the household head participated in rural institutions	Binary	0=No 1=Yes	±

A majority of the respondents (78%) had farming as their primary occupation. Primary occupation influences the amount of time allocated for soybean production and marketing. Credit services are important in accessing commercial inputs such as fertilizer and hybrid seeds thus positively contributing to food production and food security. The results in Table 2 show that 46% of the sampled population had access to credit to buy inputs such as seeds, pesticides, fertilizer, and other inputs. However, the majority of soybean households (51%) did not have access to credit services. Lastly, over 62% of the respondents had membership in rural institutions.

Table 2. Descriptive statistics of soybean household characteristics, N=201

Variables	N	Mean/ Percent	Standard deviation	Minimum	Maximum
Age of the house head	201	54.24	11.59	28	83
Education	201	8.99	4.00	0	16
Household size	201	6	3	1	18
TLU	201	6.27	3.56	0	30.14
Network density	201	13.41	9.81	0	105
Extension Visit	201	5	4	0	30
Off-farm income (KES)	201	47729.43	56896.93	300	456000
Commercialization level					
Sold 0% of soybean produce	87	43.28			
Sold less than 50% of soybean produce	60	29.85			
Sold more than 50% of soybean produce	54	26.87			
Gender of the house head					
Female	70	34.83			
Male	131	65.17			
Marital status					
Not Married	48	23.88			
Married	153	76.12			
Occupation					
Non-farming	45	22.39			
Farming	156	77.61			
Credit access					
No	102	50.75			
Yes	99	49.25			
Group membership					
No	77	38.31			
Yes	124	61.69			
Food security					
Severely food insecure	40	19.90			
Moderately food insecure	54	26.87			
Mildly food insecure	50	24.88			
Food secure	57	28.36			

Econometric results of factors influencing food security among small-scale soybean households in Butere Sub-County

Food security was ordered into four categories, and an ordered logistic regression model was then used to determine the factors influencing food (in)security among soybean households in Butere Sub-County. However, to ensure that the model was correctly specified, fit, and robust, various post-estimation tests were conducted. The test for multicollinearity among the predictors was conducted using variance inflation factors (VIF), and the results in Table 3 revealed that they were all below the recommended value of 10, with an average of 1.57 (Greene, 2008). Estimation of robust standard errors was also done to correct for heteroscedasticity. The model's statistics, Wald $\chi^2(14) = 136.42$; Prob > Chi-square = 0.0000 were significant, meaning that the ordered logistic regression model fitted data well. Brant test for parallel line assumption was also performed. The results (Chi-square = 33.11; Prob > Chi-square = 0.873) failed to reject the null hypothesis that the model without independent variables is as good as the model with the predictors. In other words, the results of the model specification test implied that the parallel lines assumption was not violated. The results of the model are presented in Table 3.

The model results indicated that the level of soybean commercialization, age of the house head, education of the house head, tropical livestock units, network density, number of extension visits, and credit access had statistically significant influence on household food security. However, the levels of significance of predictors differed across food security categories. This implies that different factors influenced household food security differently. In addition, differences in the magnitude of the average marginal effects of predictors suggest variations in factors influencing household food security. Marginal effects were interpreted based on signs and categories. A positive value for a given food (in)security category indicates that an increase in that variable increases the likelihood of being in that food (in)security category, whereas a negative value indicates a decrease in the possibility of being in

that food (in)security category. However, the influence of household size, off-farm income, gender, marital status, primary occupation of the household head, and group membership on food security was found to be insignificant.

The age of the soybean household head was negatively and significantly associated with household food security status at a 5% significance level. The marginal effects indicated negative influence of the age of the house head on the probability of being food secure and positive influence on the probability of being severely food insecure. Particularly, an increase in the age of the household head decreased the possibility of soybean households being food secure, while increasing the possibility of being severely food insecure. Aging beyond a given level reduced the economic contribution of the soybean household heads to welfare improvements or food security. As the age of the household head increased, their production potential to overcome food insecurity reduced. This is consistent with the findings by Oluwatayo & Ojo (2019) and Lutomia et al. (2019) that the age of the household head is a significant determinant of food insecurity in Nigeria, and Western and Eastern regions of Kenya, respectively.

Food security was also positively and significantly influenced by the education level of the household head at a 5% significance level. Marginal effect results show that an increase in the years of formal education increased the possibility of being mildly food insecure and food secure, while reducing the likelihood of being severely food insecure. A higher education level enhanced innovativeness and knowledge of the household heads, thus it is a very critical aspect in making informed decisions on opportunities to access and use productive resources to explicitly or implicitly improve the household food security status. This finding is concurrent with the results of Mitchell & Lusardi (2015) that higher literacy levels allow an individual to make an objective judgment on better investment opportunities which translates to higher income and food security levels.

The tropical livestock unit as a measure of household assets was positive and significantly associated with food security. The marginal effects indicated negative influence of tropical livestock units on the probability of being severely food insecure (at 1% significance level) and positive influence on the probability of being mildly food insecure (at 10% significance level) and food secure (at 5% significance level). This finding points to the fact that tropical livestock units were more important resources used to prevent household food shortages thus ensuring continuous food consumption. This implies that livestock such as poultry could be used as food and source income. The positive relationship between tropical livestock units and household food security could also be attributed to the ease of converting livestock units explicitly into cash to purchase food. Some households may also use livestock units as an economic capital for traction to generate income used to acquire food. Reincke et al. (2018) also found a positive association between livestock ownership and food security in Tanzania.

Network density was found to be a positive and significant determinant of household food security at 1% level. An increase in network density raised the probability of being food secure whereas it decreased the probability of being severely food insecure. In other words, network density increased the likelihood of being mildly food insecure and food secure. Greater network density ensured mutual social relationships and support for soybean households. Households with greater social networks often receive food such as groceries and cereals from their networks which positively influenced their household food security status. Network density represents many helping hands that can come to aid in the form of food production or food donation. Similarly, Gwada & Mayaka (2020) also found network density as a measure of social capital to be positively and significantly associated with household maize availability equivalent in Kenya.

The number of extension visits was also revealed to positively and significantly influence household food security at 1% level. The marginal effects indicated negative influence of the number of extension visits on the probability of being severely food insecure and positive influence on the probability of being mildly food insecure and food secure. This can be attributed to intensive discussions between soybean farmers and agricultural extension officers during such visits which helped in the transfer of knowledge and information on improved crop and livestock production technologies. The agents deliver extension information, skills, knowledge, and resources that enable soybean farmers to increase their food production to be food secure (Asfaw et al., 2010).

Household access to credit was negatively and significantly associated with household food security. The marginal effect of credit access was significant in three food security categories: severely food insecure, mildly food insecure, and food secure. Households having access to credit were more food secure compared to those that lack credit access. Credit access increased the probability of being in the mildly food insecure and food secure categories while decreasing the probability of being in the severely food insecure category. Credit access enables soybean farmers to acquire farm inputs such as improved seeds, fertilizers, and agro-chemicals, and thus it is most likely related to increased yields. These inputs are expected to raise agricultural yields thus ensuring higher yields for smooth household consumption. Higher yields can also be sold and income used to purchase other food items hence providing household food security.

Table 3. Ordered logistic regression results of factors influencing household food security in Butere Sub-County

Variables	Coefficients	Marginal effects (dy/dx) when food (in)security equals				VIF
		1 Severely food insecure	2 Moderately food insecure	3 Mildly food insecure	4 Food Secure	
Age of the house head	-0.032** (0.015)	0.003** (0.001)	-0.001 (0.000)	-0.001 (0.000)	-0.002** (0.001)	1.38
Education	0.114** (0.055)	-0.010** (0.005)	0.001 (0.000)	0.002* (0.001)	0.008** (0.004)	1.99
Household size	-0.007 (0.050)	0.001 (0.005)	-0.001 (0.000)	-0.001 (0.001)	-0.001 (0.003)	1.43
TLU	0.177*** (0.041)	-0.016*** (0.004)	0.003 (0.001)	0.003* (0.001)	0.013*** (0.003)	1.63
Network density	0.059*** (0.012)	-0.005*** (0.001)	0.001 (0.000)	0.001** (0.000)	0.004*** (0.000)	1.33
Extension Visit	0.237*** (0.084)	-0.022*** (0.007)	0.003 (0.001)	0.004** (0.002)	0.017*** (0.005)	1.59
Log off-farm income	0.040 (0.133)	-0.004 (0.012)	-0.001 (0.000)	0.001 (0.002)	0.003 (0.009)	1.27
Soybean commercialization level						
Sold < 50% of soybean produce	0.786* (0.472)	-0.075* (0.044)	-0.080* (0.011)	0.025 (0.019)	0.057* (0.034)	2.01
Sold > 50% of soybean produce	1.581*** (0.549)	-0.132*** (0.040)	-0.040* (0.032)	0.049** (0.024)	0.122*** (0.047)	2.42
Gender of the house head	0.684 (0.454)	-0.625 (0.041)	0.010 (0.004)	0.011 (0.009)	0.050 (0.033)	1.63
Marital status	-0.653 (0.556)	0.059 (0.050)	-0.001 (0.004)	-0.011 (0.010)	-0.048 (0.041)	1.78
Occupation	-0.248 (0.427)	0.023 (0.039)	-0.001 (0.001)	-0.004 (0.007)	-0.018 (0.031)	1.18
Credit access	1.017*** (0.350)	-0.093*** (0.032)	0.011 (0.007)	0.017** (0.006)	0.075*** (0.028)	1.21
Group membership	-0.351 (0.349)	0.032 (0.001)	-0.001 (0.003)	-0.006 (0.005)	-0.026 (0.021)	1.13
/cut1	-1.771 (2.292)					
/cut2	1.056 (2.324)					
/cut3	4.163 (2.434)					
Mean VIF						1.57

Legend: *, **, ***, denote significance at 10%, 5%, and 1% levels, respectively. Number of observations: 201; Wald (14) = 136.42, Prob > Chi-square = 0.0000; Pseudo R² = 0.4389, Log pseudo-likelihood = -155.40; Robust standard errors are given in parenthesis; VIF is variance inflation factor; Brant test for parallel line assumption: Chi-square = 33.11, Degree of freedom = 35 Prob > Chi-square = 0.873; dy/dx for factor levels is the discrete change from the base level

Finally, the level of soybean commercialization was positive and statistically significant in influencing household food security. The marginal effects of the level of soybean commercialization were significant in three food (in)security categories: severely food insecure, moderately food insecure, and food secure. The results in Table 3 show that soybean households selling less than 50% of soybean produced had 7.5% and 8% less chance of falling into severely food insecure and moderately food insecure categories, respectively, compared to those households not participating at all in the soybean output market. Similarly, households selling less than 50% of soybean produced had 5.7% chance of being food secure, compared to those households not participating at all in the soybean output market. Additionally, selling more than 50% of soybean produced decreased the probability of being severely food insecure by 13% and moderately food insecure by 4% compared to non-participation in the soybean market (0% soybean sale). Similarly, selling more than 50% of soybean produced increased the probability of a household being in the food secure category by 12.2% compared to those not participating in the market at all. This implies that as soybean commercialization level increases, the household food security status also increases. Soybean commercialization increases household incomes to purchase inputs to increase agricultural productivity or diversified food items thus ensuring household food security. Studies such as Muricho (2015), Muriithi & Matz (2015), and Carletto et al. (2017) also reported similar positive and significant associations between the level of commercialization and food security.

CONCLUSION

Household food (in)security status differed across soybean households in Butere Sub-County. The marginal effects of the predictors for the differences in household food (in)security status also varied in magnitude, sign, and significance. Therefore, understanding these differences in factors influencing household food (in)security status is crucial for formulating sustainable agricultural, market, and food security policies. Interplay of socio-economic, market, and institutional characteristics greatly influenced the food security status of soybean households. Whereas the age of the household head negatively influenced food security, soybean commercialization level, education of house head, tropical livestock units, network density, number of extension visits, and credit access were positively associated with household food security in the study area. Based on the study results, five policy recommendations emerge to improve the soybean commercialization and food security status of soybean households. First, there is a need to focus on intensive improvement of the literacy level and extension training among soybean farmers as a strategy for improving agricultural productivity, commercialization level, and food security. Second, there is a need to improve the institutional framework, especially in the credit markets through implementation of credit reforms that ensure that soybean farmers access credit services with ease. Safer, accessible, and affordable credit input services improve access to yield-enhancing agricultural inputs for increased household food production, commercialization, and consumption. Third, the results point to a need to increase reinvestment in agricultural productive assets as well as strengthening of societal ties. Stronger network density or social capital often provides avenues for food donation, information, and knowledge transfer, as well as change in attitudes and perception which are important for critical food security decisions. Four, there is a need for a policy that encourages the use of soybean yield-enhancing inputs such as commercial seeds and chemical fertilizers to improve the level of soybean commercialization and the food security status. Finally, there is a need for the government to continue providing alternative sources of livelihoods through increased allocation to safety net or social fund programs for the majority of aged, vulnerable, and resource-poor household heads. Social funds enable the aged, vulnerable, and resource-poor household heads to reinvest in agricultural activities thus smooth their household food consumption.

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