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Impact of Round Potato Production on Household Food Security in the Southern Highlands of Tanzania

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Abstract
Smallholder farmers in Mbeya Rural and Makete Districts recognise food insecurity as a problem affecting them. They also recognise the potential of round potato as a crop contributing to household food security. However, the extent to which the crop contributes to food security had not been quantified. The purpose of this study was to determine the contribution of potato production to household food security in Mbeya and Makete Districts in the Southern Highlands of Tanzania. The specific objectives of the paper are to: (1) analyse round potato production and other crops grown in the study area, (2) assess food security in terms of dietary energy consumed (DEC) and (3) determine the impact of round potato production on food security. Multistage sampling was used to select 233 potato farmers. The research was a cross-sectional one and was conducted mainly through structured interviews using a questionnaire, which was supplemented with focus group discussions and key informant interviews. The dependent variable, food security in terms of dietary energy consumed per adult equivalent per day, was regressed on seven independent variables to find the impact of each of them on the dependent variable. The variables were household size, age of household head, DEC from potato, income from potato, income from other crops, years of schooling of household head and income from non-agricultural activities. The results showed that there were positive significant impacts of DEC from potato, household size and income from non-agricultural activities on food security. It is recommended that the government should support farmers in terms of availability of inputs, training on improved technologies and support research on round potato.
Keywords: Round potato, Food security, Southern Highlands, Tanzania

1.0 Introduction

Round potatoes are grown in all continents, in around 130 countries in the world, and under various climatic conditions. The crop ranks fourth in the world as food after maize, rice and wheat. Among root and tuber crops, potato ranks first in terms of volume produced and consumed followed by cassava, sweet potato and yams as over a billion people worldwide eat potatoes (Martine *et al.,* 2010). Potato provides roughly half of the world's annual output of all root and tuber crops, making it the largest non-cereal food and cash crop worldwide (FAOSTAT, 2004). Potato crop is currently grown on an estimated 18 million hectares, with a global production of 314 million tons, whereby Asia and Europe are the two major potato growing areas (FAO, 2010). Potato contributes energy and substantial amounts of high quality protein and essential vitamins, minerals and trace elements to the diet (Horton, 1987). A single medium sized potato tuber contains about half the daily adult requirements of vitamin C, more protein, and twice the amount of calcium than maize (Dean, 1994; McGlynn, 2007).

There is a wide variation in potato production systems in the developing countries depending on local growing and marketing conditions. In regions where potatoes are relatively cheap, which is usually the case at high altitudes, a large proportion of the crop is stored in very simple ways and used for home consumption. In regions where potatoes are relatively expensive such as in Central America and South East Asia, farmers sell largest proportions of potatoes to purchase cheaper foods using the earnings from potato sales. Moreover, the earnings from potato sales are used to improve other staple food crops productivity. In comparison with other food crops, dry matter, energy and protein production of potato per hectare and per day are high.

In Tanzania, potato is increasingly becoming an important cash and food crop especially in the Southern and Northern highlands of Tanzania (Mayona *et al*., 1992). Previously, the crop was grown by highland farmers for their own food, but recently it has become a favourite of many people in rural and urban centres. Potato is mainly grown in Southern and Northern Zones of Tanzania with altitudes ranging from 1500 to 3000 metres above sea level (m.a.s.l.) The Southern highlands zone of Tanzania, particularly Mbeya and Iringa Regions, are the highest producers of potato in Tanzania and larger suppliers in market places in other regions of the country (Anderson, 1996, MOAC, 2001, URT (2003), Kabungo (2008). Potato can be grown in three seasons in a year (each season being 3 – 4 months long), unlike maize which takes up to 10 months in those areas to mature. This makes potato an important source of income and is grown for both food and cash. In the southern highlands of Tanzania, potato is the third most important starchy food and cash crop after maize and rice. Potato demand is fast increasing in rural and urban areas due to fast foods industry that is quickly developing in many

urban centres. Tanzanian urban population growth is the main driving force for demand for potato. Currently, the major production supply is in the Southern and Northern Highlands of Tanzania where potatoes are produced for both cash and food.

Smallholder farmers in Mbeya and Makete Districts recognise the potential of potato as a crop of choice contributing to household food security (Socio-Economic Profile, Mbeya Rural, 2003; Makete, 2007). The crop is compatible with their environment (good climate which favours production of the crop), suitable land for the crop and market access. Little was known on the relationship between potato production and household food security in the study area. There was lack of information on the impact of potato production on household food security as compared to other major crops in the study area. Therefore, there was a need to: a) analyse round potato production and other crops grown in the study area, b) assess food security in terms of dietary energy consumed and c) determine the impact of round potato production on food security. The information from this study can inform strategies to improve crop production with a view to improving food security through more intensive efforts to improve potato productivity.

2.0 Methodology

2.1 Description of the Research Areas

The study was conducted in Mbeya and Makete Districts in Mbeya and Iringa Regions respectively. The districts are among the leading districts in the Southern highlands zone for potato production. They represent the major potato production areas in Mbeya and Iringa regions, respectively. They have climatic conditions that are suitable for potato production. They would offer good comparative results regarding potato production and its contribution to household food security. The findings can be applicable to other areas in Tanzania where the crop is grown.

Mbeya District is among eight districts of Mbeya Region. The district is divided into three divisions namely Tembela, Isangati and Usongwe having 25 wards, and 148 villages. It borders with Mbarali District to the East, and Rungwe and Ileje Districts to the South. Its altitude ranges from 1000 to 2400 m.a.s.l. The average temperature ranges between 12^{o}C and 30^{o}C annually. The mean annual rainfall ranges from 650 mm to 2700 mm. The district has a total land area of 2,432.0 square kilometres of which 1,898.2 square kilometres is arable land ideal for agricultural production (Socio-Economic Profile, Mbeya District (2003). The district had a population of 305,319 people, with an average household size of 4.1 people in 2012 (URT, 2013).

Makete District is one of 3 districts in Njombe Region. The region was established in 2013. The district is divided into six divisions namely Ikuwo, Ukwama, Lupalilo, Bulongwa, Magoma and Matamba. It lies adjacent to the North shores of Lake Nyasa, separated by a steep escarpment, and stretches slowly into the lower and flatter lands of Njombe District on the Eastern side. The district is bordered by Njombe District to the East, Mbarali District to the North, Ludewa District and Lake Nyasa to the South, and Rungwe District to the West. The altitude ranges from 1,500 to 3,000 m.a.s.l. The average temperature ranges between 2^{o}c and 20^{o}c annually. The mean annual rainfall ranges from 1,500 mm to 2,800 mm. The district has a total land area of 5,800 square km, but it is mostly mountainous with steep hills, ridges, valleys and escarpments. The district has a total of 4,195.0 square km of arable land available for agricultural production. The district had a population of 97,266 in 2012 with an average household size of 3.7 people in 2012 (URT, 2013).

2.2 Research Design

The study adopted a cross-sectional design. The design was chosen because it entails collection of data on more than one case at a single point in time in order to collect a body of quantitative and/or qualitative data about two or more variables, which are then examined to detect patterns of association (Bryman, 2004). The design is also useful for descriptive purposes as well as for determination of relationships between variables at the time of the study. Moreover, the design allows the use of other methods of data collection such as observations and use of official records.

Purposive sampling was employed to select some members for focus group discussions based on sex, age distribution, experience, leadership and influence in the community. Two focused group discussions were conducted in each village. Each group consisted of 8 people making a total of 16 people per village. The main aspects discussed were the meaning of household food security according to local communities' point of view. Views of men and women on how potato production contributes to household food security were collected. The information supplemented that obtained using the questionnaire.

The target population (N) was all households in areas where potatoes are grown in Mbeya Rural and Makete Districts. The study employed a multistage sampling technique which is appropriate for studying large and diverse populations with no particular records of the actual individuals to be studied (Fowler, 1993). Additionally, the technique reduces the amount of travelling for interviews and hence the corresponding costs (Casley and Kumar, 1998). The first stage involved selection of two divisions per district where potato is grown as a major food and cash crop. The second stage involved purposive selection of one ward from each of the

divisions selected in the districts. The third stage involved random selection of two villages from each ward making a total of eight villages. That means four villages per district were selected.

The last stage was sampling of households. The sampling frame was households which grew potato as a major food and cash crop, and those which did not grow the crop. Equal numbers of households which grew potato and those which did not grow potato as a major food and cash crop in each of the selected villages were selected. Lists of potato growers registered by the village authorities for the year 2011/12 cropping season were obtained from village leaders.

2.3 Data Collection

Primary data were the main source of information for this paper and were collected through interview of potato growers using a structured questionnaire. Both quantitative and qualitative information were collected. Key informant interviews were held with people who had in-depth understanding and knowledge on potato production and its contribution to food security in the respective districts. Key informants included District Agricultural and Livestock District Officers (DALDOs), village and ward extension officers, village government leaders, leaders of farmer groups and traditional elders.

Secondary information for the study was obtained from published documents and unpublished documents and reports from different sources as follows: Ministry of Agriculture, Food and Cooperatives; District Agricultural and Livestock Development Offices (DALDOs) in Mbeya Rural and Makete Districts; Agricultural Research Institute – Uyole, Mbeya; Sokoine National Agricultural Library (SNAL); and websites. The information collected included round potato production trends, production technologies, varieties grown, production constraints, opportunities and contribution of potato crop to household food security compared to other crops and current potato improvement programmes.

2.4 Data Processing and Analysis

The primary quantitative data collected were analysed using the Statistical Package for Social Sciences (SPSS) software. Data were analysed by computing descriptive statistics to determine frequencies, percentages, statistical means, and standard deviations of individual variables. Multiple linear regression was used to assess impacts of independent variables on the dependent variable that was food security in terms of dietary energy consumed per adult equivalent. All the variables for multiple linear regression, including the dependent one, were first checked for normality by computing their normal distribution curves and checking the curves visually. Age of household head, household size, years of schooling of household head and dietary energy consumed from potato were found to have normal distribution; therefore they were not transformed. Income from potato sales and income from non-agricultural activities were found to be skewed; therefore they were transformed by using $\log_{10}$ transformation, which was identified to be the appropriate transformation function. It is their $\log_{10}$ values that were entered in the multiple linear regression model. Multicollinearity was checked by computing Variance Inflation Factors (VIFs) and tolerance values, which are interpreted as follows, according to (Landau and Everitt, 2004): Tolerances below 0.1 imply multicollinearity, and VIF values that are greater than 10 imply multicollinearity.

2.5 Adult Equivalent Units Computation

Cognisant of the fact that if variables like income and dietary energy consumed are expressed per capita they do not reflect good comparative figures in households with different sizes and composition by age and sex, dietary energy consumed was expressed per adult equivalent following procedure used by Collier *et al.,* (1990). In order to calculate adult equivalent units, the sex and age of every household member were determined. A two-step procedure was followed whereby in the first step adult equivalent scales for East Africa by age and sex were added up for all household members to get all the household members in terms of adult equivalents. The equivalent scales are presented in Table 1. The second step involved adjusting the above adult equivalents for economies of scale due to the fact that larger households need fewer resources per person due to sharing of some facilities. The economies of scale are taken into account by multiplying the adult equivalent units by the average cost (Table 2) corresponding to the number of people in the household. The adjusted adult equivalent units were used as denominators for calculating values per adult equivalent in relevant households.

2.6 Dietary Energy Consumed Computation

Quantities of all food items consumed were recorded. Quantities of dietary energy in all the food items were computed using Tanzania Food Composition Tables (Lukmanji *et al.*, 2008). The quantities of dietary energy consumed by all household members were expressed per Adult Equivalent Units (AEU). Dietary Energy Consumed per AEU was computed to DEC per capita and per adult equivalent per day based on all foodstuffs eaten on thirty days.

3.0 Results and Discussions

3.1 Demographic characteristics of the respondents

3.1.1 Sex of respondents

The results showed that, of the 233 the households which participated in the study, male headed households were dominant making 88.8% and 78.6% in Mbeya Rural and Makete Districts respectively. Patriarchy system and male dominance in decision making in many African societies have resulted into most households being led by men (Duze and Mohammed 2006; Kisinza *et al.,* 2008

3.1.2 Age of respondents

The minimum age of the respondents was 19 years while the maximum was 71 years with a mean age of 39.4 years. The majority of respondents were in the 36 to 50 years age group, accounting for 45.7% in Mbeya Rural District and 46.2% in Makete District. Also, the 19 - 35 years age group accounted for 41.4% and 40.2% in Mbeya Rural and Makete Districts respectively. The proportion of respondents in the 51 to 71 years group was relatively small. This indicates that young to middle aged individuals are more active in potato production. Fewer old people were involved in round potato production. Quite often, age is used as an indicator of farming experience. It has been perceived that young people are less conservative to changes than their elders, and hence are more likely to participate in agricultural production. Nanai (1993) contends that the level of participation tends to increase with the optimum age group after which participation starts to decline with increase in age.

However, a study by Mwanyika (2001) showed that young people, particularly those in rural areas, are not very well decided about their future. This usually affects their seriousness and commitment to participation in rural development programmes despite their high potentials. Young people in the villages tend to prefer urban life, and they consider rural life as short of basic human necessities. On the other hand, Minga (1998, cited by Mwanyika, 2001) observed that the age range between 26 to 45 years to be a more active group in agricultural activities. The same was found by Liedholm (1998) in Botswana, Kenya, Malawi and Zimbabwe.

3.1.3 Educational level of the respondents

The survey results revealed that 100% and 92.3% of respondents from Mbeya Rural and Makete Districts respectively had primary education. Also, results showed that in Mbeya Rural District none of the respondents had Ordinary Level (O-Level) and Advanced Level (A-Level) Secondary education while in Makete District 2.6% and 5.1% of household heads had O-Level and A-Level of secondary education respectively. The results also showed that the majority of the household heads had primary education, and indicated that there was a good literacy level in the study area. This implies that the majority of the farmers can reasonably interpret and use agricultural extension packages to improve productivity. Literacy might also enhance the adoption of improved production technologies. Low education level can lower farmers' efforts to improve productivity and become vulnerable to food insecurity. Other researchers such as Hawassi (2006) and Nkuba (2007) found that educational level influences productivity and market access. Low level of education among the household heads could be an obstacle to farmers as it prevents them from getting opportunities other than farming such as formal employment, running business efficiently and ability to bargain when selling their agricultural products.

3.1.4 Marital status

The results on marital status showed that 91.4% of the respondents from Mbeya Rural District and 87.2% from Makete District were married. Given the very low proportions of single, widower, widow, separated and divorced people in Mbeya and Makete Districts, this might imply that the majority of the respondents will have additional responsibilities to their spouses and children. Marital status is said to influence farm practices (World Bank, 2009). Moreover, marital status has implication on social organization and economic activities such as agriculture and resource management. Married couples are likely to be more productive than single persons due to labour supply in farm activities and access to productive resources in agriculture.

3.1.5 Household size

The mean household size of the respondents was 4 persons while the minimum and maximum household sizes were 1 and 10 persons respectively. The majority of the respondents had family sizes under medium category of between 4 to 6 persons for both Mbeya Rural District (57.8%) and Makete District (59.0%). Food requirements increase with the number of persons in a household. This implies that as the household size gets larger, the probability of being food security decreases, but the contrary is also possible. In some situations large family size is an important asset in working together to reduce vulnerability to food insecurity. This occurs when almost all of the household members take part in production and or service provision to contribute to the economy of the household (Kayunze, 2000). On the other hand, having big families is said to be one of the causes of poverty in Tanzania (URT, 2002).

3.1.6 Farming experience

The results showed that the mean experience of years of farming was 8 years with a minimum of 1 year and a maximum of 54 years. The majority of the respondents were in the 1 to 10 years group. This group accounted for 75.9% of the respondents in Mbeya Rural District and 77.8% in Makete District. Experience in potato farming may lead to better husbandry practices and managerial skills and hence increase crop productivity.

3.2 Major Crops Grown and Food Security Status in the Study Area

Besides round potato production, the respondents mentioned maize, wheat, beans and vegetables among other crops grown in the study area (Table 5). The results showed that round potato, maize and wheat were grown by the majority of the respondents and had larger acreages as compared to other crops.

The results from dietary energy consumed per adult equivalent per day showed that a minimum of 792 and a maximum of 21,100kcal/AE/day were consumed. They also showed a mean of 3,368.6 kcal /AE/day and a standard deviation of 1,728.1kcal/AE/day. The households surveyed were divided into two groups of food secure and food insecure households, based on a cut-off point of 2,200 kCal per adult equivalent per day at and above which people are considered to be food secure and vice versa. Food secure households were found to be 79% while food insecure households were 21%. The proportion of food secure households (79%) was not so good since the study areas have good potential for production of other major crops including maize and wheat. It was expected that if the farmers could improve productivity of the crops, they could sell part of the harvests and purchase other foodstuffs and become food secure. During focus group and key informant discussions the respondents mentioned a number of potato production constraints. The major ones included diseases and insect pests, lack of improved potato varieties, inadequate knowledge of improved technologies, high prices of inputs (fertilizers and pesticides) and unreliable markets for the produce.

3.3 Correlation between Independent Variables to the Dependent Variable

All the independent variables recorded at the ratio level were correlated with the dependent variable using Pearson Correlation to determine the levels of correlation and significance with the dependent variable (Table 3). According to Cohen and Holliday (1982), correlation coefficients (regardless of positive or negative signs) are interpreted as follows: below 0.19 is very low, 0.20 – 0.39 is low, 0.40 – 0.69 is modest, 0.70 – 0.89 is high, and 0.90 – 1.00 is very high. The correlation results in Table 3 show that four out of twelve independent variables that were correlated with the dependent variable had significant correlation.

Age of household head had a low negative correlation with food security ($r = -0.188$, $p \leq 1\%$), and the correlation was significant. This correlation suggests that the higher the age of household head the more the household is likely to be food insecure, particularly with old age. Household size was moderately negatively correlated with food security ($r = -0.454$, $p \leq 0.1\%$), and the correlation was highly significant. This implies that as household size gets larger, the probability of food security decreases. However, other studies elsewhere for example Babatunde *et al*., (2007) in Nigeria argued that household size could have great implications for labour supply for farm work and also for food security. A large household size is expected to cultivate a large farm size, but the contrary is also possible especially when there are many dependents (children and elderly people) in the family.

Dietary Energy Consumed from potato showed high positive correlation with food security in terms of overall DEC consumed, and the correlation was highly significant ($r = 0.706$; $p \leq 0.1\%$). This indicates that dietary energy from potato has high relationship with food security since it is eaten daily in a variety of dishes. Other independent variable had very low insignificant association with the dependent variable (Table 3).

3.4 Impact of some of Independent Variables on Food Security

The dependent variable, food security, was regressed on seven independent variables which were thought to account for more of variation in household food security (Table 4). The independent variables were household size, age of household head, dietary energy consumed from potato, income from potato, income from other crops and income from non-agricultural activities. On the basis of the adjusted R-square value that was 0.721, the independent variables entered in the multiple linear regression model explained 72.1% of variation in the dependent variable. The remaining 27.9% was probably due to other independent variables not included in the model, incorrect model formulation and errors in the research (Mendenhall and Beaver, 1991). The statistical tests of the model itself showed that the explanatory power of the model was highly significant, ($p \leq 0.1\%$). With regard to influence of independent variables on food security, the results in Table 4 indicate that four out of the seven independent variables had significant impacts on the dependent variable. The levels of significant were as follows: household size ($p \leq 0.1\%$), DEC from potato ($p \leq 0.1\%$), income from non-agricultural activities ($p \leq 0.1\%$), and years of schooling of household head ($p \leq 5\%$).

Household size having shown negative significant impact on food security is not surprising because since food requirements increase with the number of persons in the household, hence the expected effect is negative. This result is in conformity with neo-Malthusian contention that population has negative influence on food security. However, some previous studies have shown positive correlations between household size and food security. For example Kayunze (2000) found this in Mbeya Region. The explanation for this is that it happens more where households have more labour force in terms of a bigger proportion of adult members who work either on farm or otherwise. Kayunze (2000) argues that in households with higher dependency ratios or where households depend on one or a few members who are working, the bigger the household size the less the

food security.

Dietary Energy Consumed from potato showed positive impact (Beta = 0.746, $p \leq 0.1\%$) with food security, and the relationship was highly significant. The positive beta weights result indicates that dietary energy from potato had high influence on food security. This was confirmed by key informants during discussions in Mbeya and Makete Districts. They argued that potatoes are grown for home consumption as well as a source of family income, and they are eaten daily in a variety of dishes. The farmers added that, planting seasons are arranged in such a way that there are potatoes to eat throughout the year. In some areas planting starts in August to September, October to November, July and spread to October. There is, therefore, a long stretch of planting dates which could mean that there are potatoes throughout the year. This situation may also justify the highly significant positive impact of dietary energy consumed from potato on overall food security. Other studies on potato have shown that potato is more profitable than traditional staples, as it has higher yield per unit of land, matures earlier and provides relatively high income (Blanken *et al*., 1994, CIP, 2008, Namwata *et al*., Kabungo, 2008; UARC, 1990)

Income from non-agricultural activities showed positive significant (Beta = 0.228, $p \leq 0.001$) impact on food security. This indicates that households which are involved in non-agricultural activities are more likely to be food secure. This could be expected because they will increase income to buy food and ultimately become food secure. Income from non-agricultural activities can be used to accumulate farm capital investments and purchase inputs for example seeds, fertilizers, pesticides and other inputs needed to adopt appropriate technologies and improve agricultural productivity. It is expected that households with larger non-agricultural activities diversification are more likely to be food secure.

Income from potato had low negative impact on food security which was not significant. This probably indicates that after farmers sell potatoes they use the income to buy non-food items. Income from other crops had low positive insignificant impact on food security. This probably indicates that most of the crops grown in the study areas had low productivity, and they were used for food and small amounts of them were sold.

4.0 Conclusion and Recommendations

It was found that the major constraints to round potato production in the southern highlands of Tanzania include diseases and insect pests, lack of improved potato varieties, lack of knowledge on improved technologies and high costs of inputs. On the basis of this conclusion, the government through the Ministry of Agriculture, Food Security and Cooperatives should support farmers through training on improved technologies, availability of improved potato varieties and farm input availability in affordable prices. Moreover, since the study areas have high potential for other major crops including maize and wheat on food security, farmers are urged to grow more than one crop in order to improve their food security status.

Also, it was found that of the 233 sampled households, 79% were food secure. This proportion is not so good since the study area has high potential for other major crops including maize and wheat. The findings might imply that the productivity potential of the study area was not fully utilized. Improving productivity of potato and other major crops in the study area could improve its food security status. On the basis of this conclusion, potato farmers in Mbeya Rural and Makete Districts are urged to grow more than one crop in order to improve their food security status.

The dietary energy consumed from potato showed positive significant impact on household food security. On the basis of the findings, potato is a short maturing crop and the farmer can complete three planting seasons per year, unlike maize which takes up to ten months to mature. It can be concluded that potatoes are a reliable source of food and income since it can be eaten as a staple and sold to get income for purchasing other foodstuffs. On the basis of this conclusion, farmers are urged to be serious in potato farming in order to realise its contribution to food security. Moreover, policy makers and the Ministry of Agriculture, Food Security and Cooperatives are urged to help farmers in terms of supporting research on potato in order to improve productivity, and consequently improved food security.

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Table 1: Adult equivalent scales for East Africa

Age group	**Sex**	
	Male	**Female**
0 - 2	0.40	0.40
3 - 4	0.48	0.48
5 - 6	0.56	**0.56**
7 - 8	0.64	0.64
9 - 10	0.76	0.76
11 - 12	0.80	0.88
13 - 14	1.00	**1.00**
15 - 18	**1.20**	1.00
19 - 59	**1.00**	**0.88**
Above 60+	**0.88**	0.72

Source: Latham (1965), cited by Collier et al. (1990)
*Figures in bold are the values corresponding to six hypothetical household members' caloric requirements

Table 2: Household economies of scale constants

Household size (Number of adults)	**Marginal costs**	**Average costs**
1	1.000	1.000
2	0.892	0.946
3	0.798	0.897
4	0.713	0.851
5	0.632	0.807
6	0.632	0.778
7	0.632	0.757
8	0.632	0.741
9	0.632	0.729
Above 10+	0.632	0.719

Source: Deaton (1980), cited by Collier at al. (1990)

Table: 3: Correlation between the dependent variable and independent variables

Variable	n	Correlation coefficient (r-value)	p-value
Age of household Head	233	-0.188***	0.004
Years of schooling	233	-0.038^{ns}	0.564
Household size	233	-0.454***	0.000
Land under potato	233	-0.025^{ns}	0.708
Land under other crops	228	0.023^{ns}	0.726
DEC from potato	233	0.706***	0.000
Pesticide cost	101	0.065^{ns}	0.521
Fertilizer cost	152	0.032^{ns}	0.695
Income from potato	199	0.037^{ns}	0.602
Income from other crops	165	-0.056^{ns}	0.476
Income from non-agric. activities	125	0.071^{ns}	0.432
Total technologies used	233	0.131*	0.046

The dependent variable was Dietary Energy Consumed per adult equivalent per day
*** Correlation is significant at the 0.01 (2-tailed)
*Correlation is significant at the 0.05 (2- tailed)

Table: 4: Impact of some of the independent variables to food security

Model	Unstandardized Coefficients		Standardized coefficients	t	Sig
	B	Std Error	Beta		
Constant	2552.954	1668.756		1.530	0.129
Household size	-343711	76.192	-0.267	-4.511***	0.000
Age of HH head	8.243	13.216	0.040	0.624	0.534
DEC from potato	3.473	0.250	0.746	13.886***	0.000
Income from potato	-285.846	222.092	-0.069	-1.287	0.201
Income from other crops	79.974	321.279	0.017	0.249	0.804
Years of schooling of household head	-201.968	94.273	-0.128	-2.142*	0.035
Income from non-agric. activities	701.169	167.840	0.228	4.178***	0.000

Dependent variable: Dietary Energy Consumed per Adult Equivalent per day
R^2 adjusted = 0.721, *** $p < 0.001$, * $p < 0.05$

Table 5: Descriptive statistics of acreages under major crop grown

Crop	N	Minimum	Maximum	Mean	Standard Deviation
Round Potato	233	0.2	10.0	1.1	1.1
Maize	232	0.25	15.0	1.7	1.7
Wheat	133	0.25	5.0	1.0	0.8
Beans	70	0.1	2.5	0.4	0.4
Vegetables	18	0.25	2.0	0.7	0.6

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