

Contribution of Round Potato Production to Household Income in Mbeya and Makete Districts, Tanzania

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Abstract

In Tanzania, agriculture remains the largest sector of the economy, and hence its performance has substantial impacts on income and poverty. Round potatoes are grown in all continents under various climatic conditions. Smallholder farmers in Mbeya Rural and Makete Districts in Tanzania recognise the potential of round potatoes as a crop contributing significantly to household income and food security. The purpose of this study was to determine the contribution of potato production to household income in Mbeya and Makete Districts in the southern highlands of Tanzania. The specific objectives of the research were to: (1) analyse round potato production and other crops grown in the study area, (2) assess household income from round potato and from other sources in the study area and (3) determine the impact of round potato production on household income. A cross-sectional research involving 233 potato farmers was conducted in March 2012 through structured interviews using a questionnaire, focus group discussions and key informant interviews. The dependent variable, household income, was regressed on eight independent variables to find the impact of each of them on the dependent variable. The results showed that there was high positive significant impact of income from round potato per adjusted adult equivalent unit (AAEU) on household income ($p < 0.001$). It is concluded that round potatoes are more profitable than other major crops grown in the study area. Moreover, if given due attention and care, round potatoes can contribute greatly to household income. It is recommended that the government should support farmers in terms of availability of inputs, training on improved agricultural technologies and support for research on round potatoes so that they can help increase household income.

Keywords: Round potato, household income, Southern Highlands, Tanzania

1.0 Introduction

Agriculture remains one of the dominant sectors in Tanzania in terms of its contribution to gross domestic product (GDP), generation of employment and export earnings. In 2010 the sector contributed nearly 28% to national gross domestic product (GDP) and approximately 24% of the country's export earnings (Msambichaka *et al.*, 2009). In addition, about 87% of the rural income is earned from agricultural activities. The importance of agriculture is also reflected in food security as over 70% of Tanzania's population depends on subsistence agriculture for food production. The agricultural sector plays an important role in the Tanzanian economy and has the potential to advance the country's objectives of economic growth and poverty reduction. The performance of the overall Tanzanian economy has been driven by the performance of the agricultural sector, due to its large share in the economy (URT, 2005). Agriculture in Tanzania employs about 75% of its population and has consumption linkages with other sectors (URT, 2012). Smallholder farming dominates agricultural production, and a large proportion is for subsistence. Since agriculture is a major economic activity for rural population, the success in poverty reduction depends on performance of the agricultural sector.

Round potatoes are grown in all continents of the world, 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. Potatoes provide 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). The genetic diversity of round potatoes makes it possible to produce new varieties that can grow well under a wide range of ecological conditions. Potato crop is currently grown on about 18 million hectares of land, with a global production of 314 million tons, whereby Asia and Europe are the two major potato growing areas (FAO, (2010). Potatoes have a short growing cycle and a large production per area and per time. It provides more nutritious food per unit area of land in less time and often under more adverse conditions than other food crops due to its efficient use of water (FAO, 2006). It is one of the most

efficient crops in converting natural resources, labour and capital into high quality food (FAO, 2006). “For low-income people in both urban and rural areas, “Round potato is a buried treasure”.

In Tanzania, potatoes are an important food and cash crop and are gaining importance both at the farm level and in urban markets (Mayona *et al.*, 1992). The bulk of potato production is from the Southern Highlands zone that includes Mbeya and Iringa Regions and the Northern Zones. Mbeya and Makete Districts in Mbeya and Iringa Regions respectively are among the major potato producers in the southern highlands zone of Tanzania. Potato can contribute to household income in various ways including: creation of employment, as it employs farmers, market agents, transporters, processors, food vendors and retailers. Potatoes are sold, and the revenue obtained is used to purchase other foodstuffs and non-food items. Potatoes can be profitably intercropped and rotated with other crops grown in the highlands. Potatoes have higher production per unit of time (can have three crops per year) per unit of land and per unit of water and a good rotational crop with maize, wheat and other crops (FAO, 2008; Mpogole *et al.*, 2012; Muthoni *et al.*, 2009). Potato is characterized as a high input, high output crop. Its high yield response to inputs such as high quality seed tubers, fertilizers, pesticides and additional labour motivates farmers to use inputs more on it than on other crops. Because of the relatively high level of potato yields, a short growing period and a high market value, potato generates larger returns per hectare than most other crops grown in the research area.

A study by Kabungo (2008) in Mbeya District revealed that potato is a highly valuable crop in the main production areas with a considerable contribution to household income. For the majority of the farmers, potato is the most important source of income. The study also found that the average crop production area for the farmers was 1.25 ha of which 0.7 ha was used for potato production. The majority of farmers in Mbeya and Makete Districts grow potato for both cash and food. Studies on round potato have shown that production and consumption of the crop is increasingly becoming popular (Anderson, 1996, 2008; Kabungo, 2008; Koizumi, 2007; Namwata *et al.*, 2010). The potato has great potential in both national and regional markets, due to growing demands for chips and snacks/crisps (Anderson, 2008). This growth in demand can be attributed to many factors, including increasing economic activities, urbanisation, tourism and changing lifestyles, all of which are shifting consumer food preferences towards easy to cook and processed foods (Anderson, 2008; CIP, 2008; FAOSTAT, 2008).

Smallholder farmers in Mbeya and Makete Districts recognise the potential of potato as a crop of choice contributing to household income (Socio-economic profiles, Mbeya Rural, 2003; Makete, 2007). Compared with other major crops in the area, which are maize and wheat, potatoes produce more energy per unit land and time. The crop is compatible with their environment (good climate which favours production of the crop), presence of land suitable for the crop and market access. The majority of smallholder farmers in Mbeya and Makete Districts grow potatoes as the major source of income. However, little was known on the relationship between potato production and household income in the study area. Therefore, there was a need to: a) analyse round potato production and other crops in the study area, b) assess household income from round potato and other sources and c) determine the impact of round potato production on household income. The information from this study can inform strategies to improve potato production with a view to improving household income through more intensive efforts to improve potato productivity and other income generating activities.

2.0 Methodology

2.1 About the Study Area

Data were collected from Mbeya and Makete Districts in Mbeya and Iringa Regions respectively. These are among the leading districts in the southern highlands zone for potato production and represent the major potato production areas in Tanzania. They have climatic conditions that are suitable for potato production hence could offer good comparative results on potato production and its contribution to household income. There is a possibility of the findings being applicable to other areas in Tanzania where the potato crop is grown.

Mbeya District is among the eight districts of Mbeya Region. The district is divided into six divisions, 25 wards and 148 villages. The district is located at altitudes between 1000 and 2400 metres above sea level. The average temperature ranges between 12°C and 30°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). Makete District is one of 3 districts in the newly established Njombe Region. The district is divided into six divisions, 17 wards and 97 villages. The district is located at an altitude ranging between 1,500 and 3,000 metres above sea level. The average temperature ranges between 2°C and 20°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 square km of arable land available for agricultural production (Makete socio-economic profile; 2007). Eight villages; four from Mbeya (Shibolya, Ilembo-Usafwa, Sanje and Mpande) and four from Makete (Isapilano, Iyoka, Kitula and Ivilikinge) District; were selected for the study.

2.2 Research Design

The sampling frame was all households in areas where potatoes are grown in Mbeya and Makete Districts. A cross-sectional study design and a multistage procedure were adopted in the selection of respondents. The first stage involved purposively selection of two divisions per district where potato is grown as a major cash crop. The second stage involved purposive selection of one ward from each division from each of the two divisions per district, making four wards. The third stage involved random selection of two villages from each ward making a total of eight villages. The last stage was sampling of respondents. The sampling frame was households which were growing potato as a major cash and food crop and those which were not growing the crop. Equal numbers of households in these two categories were randomly selected. Lists of potato growers registered by the village authorities for year 2011/12 cropping season were obtained from village leaders.

2.3 Data Collection

Primary data were the main source of information for the study and were collected through interviewing potato growers using a structured questionnaire. Quantitative as well as qualitative information was collected. Key informant interviews were held with people who had in-depth understanding and knowledge on potato production and its contribution to household income in the respective districts. Key informants included District Agricultural and Livestock Development 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 and unpublished documents including 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 from some websites. The information collected included round potato production trends, production technologies, potato varieties grown, production constraints, opportunities for and contribution of potato crop to household income compared to other sources and in view of 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. All independent variables recorded at the ratio (scale) level were correlated with the dependent variable using Pearson Correlation to determine the levels of correlation and significance with the dependent variable. The correlation results were interpreted according to Cohen and Holliday (1982), cited by Bryman and Cramer, 1992) who have it that, correlation coefficients (regardless of positive or negative signs) are interpreted as follows: below 0.19 is very low, 0.20 to 0.39 is low, 0.40 to 0.69 is modest, 0.70 to 0.89 is high and 0.90 to 1.00 is very high. Multiple linear regression was used to assess impacts of independent variables on the dependent variable that was household income. Independent variables were first checked for normality and multicollinearity. Normality was checked by computing distribution curves of all the variables and observing them visually to find whether any of them was skewed. Income from non-agricultural activities, income from livestock and income from maize were found to be skewed. Therefore, they were transformed into normal distributions using \log_{10} transformations. Multicollinearity was checked by computing variance inflation factors (VIFs) and the tolerances of the explanatory variables. According to Landau and Everitt (2004), tolerance values of 0.1 and above, and VIF values of not more than 10 show that there is no multicollinearity.

3.0 Results and Discussion

3.1 Demographic Characteristics of Respondents

3.1.1 Sex of respondents

The results showed that, of the 233 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 and male dominance in decision making in many African societies have resulted into most households being led by men (Dube and Mohammed 2006; Kisinza *et al.*, 2008). It has widely been shown in Africa that when a crop is perceived as profitable, men are more likely to take over from women (Kaaria *et al.*, 2007, World Bank, 2009)

3.1.2 Marital status

The results on marital status showed that 91.4% of households from Mbeya Rural District and 87.2% from Makete District were married. Given the very low rate of single, widowed, separated and divorced household heads in Mbeya and Makete Districts, this might imply that the majority of the respondents would have additional responsibilities for their spouses and children. A study by Low (2005) indicated that marital status has positive implication on social organization and economic activities such as agriculture and resource management. This might imply that married couples are likely to be more productive than single household heads due to labour supply in the farm activities and access to productive resources.

3.1.3 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 the respondents were in the 36 to 50 years age group. This age group accounted for 45.7% in Mbeya Rural District and for 46.2% in Makete District indicating that most of the household heads were of middle age, the age at which they were still energetic and hence could actively be involved in production activities (Lupiya, 2007). Kabungo (2008) reported that age has influence on round potato production since activities associated with its production are very tough hence require energetic people. The 19 - 35 years age group accounted for 41.4% and 40.2% in Mbeya Rural and Makete Districts respectively. The proportion of household heads in the 51 – 71 years group was relatively small. This result indicates that young to middle aged household heads (19 – 35 years and 36 – 50 years) are more active in potato production. Fewer old household heads were involved in round potato production. 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. Concerning this, 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.

3.1.4 Educational level

The survey results revealed that 100% and 92.3% of household heads from Mbeya Rural and Makete Districts had primary education. Also, the results showed that in Mbeya Rural District none of the household heads had Ordinary Level (O-Level) and Advanced Level (A-Level) Secondary education while in Makete District 2.6% and 5.1% of the household heads had O-Level and A-Level secondary education respectively. The implication of these results is that the majority of household heads in Mbeya and Makete Districts were literate enough to adopt and use agricultural production technologies from different sources such as agricultural extension agents, publications and mass media. It is also expected that educated farmers would be more profit oriented than those with no formal education. Low formal education level can lower farmers' efforts to improve productivity, hence become vulnerable to poverty. Other studies such as those by Hawassi (2006) and Nkuba (2007) found that educational level influences production decisions, productivity and market access.

3.1.5 Household size

The mean household size of the respondents was 4.0 persons while the minimum and maximum household sizes were 1.0 and 10.0 persons respectively. The results showed that the household size of 3.0 people accounted for 22.4% and 27.3% in Mbeya and Makete Districts respectively. Also, the household size of between 4 to 6 people accounted for 57.8 and 59% in Mbeya and Makete Districts respectively. The proportion of respondents with between 7 to 10 people accounted for 19.8% and 13.7% in Mbeya and Makete Districts respectively. The results show that the majority of the households had family sizes of from 4 to 6 persons in both districts. Household size has implication on family labour availability and production costs. Large household size is an important asset in working together in household economic activities. However, this occurs where almost all of the household members take part in production and or service provision to contribute to the economy of the household (Kayunze, 2000).

3.1.6 Farming experience

The results showed that the mean experience of years of farming was 8.0 years with a minimum of 1 year and a maximum of 54 years. The majority of the household heads had 1 to 10 years' experience in growing potatoes. This group accounted for 75.9% of the households surveyed in Mbeya Rural District and 77.8% in Makete District. The group with 11 to 20 years' experience accounted for 19% and 12.8% for Mbeya and Makete Districts respectively. The proportion of household heads in the 21 to 54 years experience was relatively small, and they accounted for 5.2% and 9.4% for Mbeya and Makete Districts respectively. Farming experience is an important factor determining both productivity and the production level as it may lead to better managerial skills being acquired over time. But the effect of farming experience on productivity and production may be positive or negative. Generally, it would appear that up to a certain number of years, farming experience would have a positive effect. After that, the effect may become negative. The negative effect may be derived from aging or

reluctance to change from old familiar farm practices and techniques to those that are modern and improved. The majority of respondents had 1 to 10 years' experience, which may imply that round potato was emerging fast as a cash crop in the study area after the abandonment of pyrethrum. This was confirmed by the farmers during key informant interviews and focus group discussions. They argued that previously they depended on pyrethrum and potato as cash crops. Unfortunately, the world market for pyrethrum became unreliable and discouraged farmers from continuing with its production. Most of farmers who had abandoned pyrethrum production were engaged in potato production as their main cash crop.

3.2 Production of Round Potato and Other Crops in Mbeya and Makete Districts

The minimum acreage under potato production was 0.2 acres while the maximum was 10 acres, with a mean of 1.2 acres (Table 1). The results showed that the majority of the households allocated land for potato production in sizes ranging between 0.2 and 1.0 acres. This category accounted for 69% and 67.5% in Mbeya Rural and Makete Districts respectively. The proportions of households which allocated land for potato production ranging in sizes of between 1.1 and 5.0 acres were 31% and 30.8% in Mbeya and Makete Districts respectively. For the category 5.1 – 10.0 acres there were 0% and 1.7% households in Mbeya and Makete Districts respectively.

Other crops grown in Mbeya and Makete Districts include maize, wheat, beans and vegetables. The minimum acreage under other crops was 0.25 acres while the maximum was 15.0 acres, with a mean of 2.7 acres. The results showed that land size categories between 0.25 and 2.00 acres were allocated under other crops by 69% and 38% of the households in Mbeya and Makete Districts respectively. The proportions of household heads who allocated land for other crops production of sizes between 2.10 and 5.00 acres were 25% and 50.4% for Mbeya and Makete Districts respectively. For the category of land size between 5.10 and 15.00 acres there were 6% and 11.1% of respondents in Mbeya and Makete Districts respectively. The results showed that the average land sizes under round potato and other crops production were small. These results are not surprising since it has been often reported from other studies that smallholders in Tanzania farm on small and fragmented plots (Sokoni, 2008, Wolter 2008). This implies that the majority of the households surveyed were of small scale farmers.

3.3 Income from Potato Production and Other Sources

The results showed that round potato was the main source of income in both Mbeya and Makete Districts. During focus group discussions and key informant interviews, the respondents mentioned potato as a leading crop for their earnings. Other crops contributing to their earnings were maize, wheat, beans and vegetables. The study revealed that, due to shortage of land, most of the households had been obliged to undertake non-agricultural activities to improve their incomes. Non-agricultural activities had been filling up the gap by directly increasing households' income and providing cash for investment in farm inputs to increase agricultural production. The main non-agricultural sources of income were casual labour, local brewing, petty business, remittances, lumbering, loan seeking and renting out houses. Livestock keeping was also one of the income sources for most of the households. Livestock keeping plays multiple roles in the study area as it facilitates income generation, employment and draught power. The main livestock types kept were cattle, goats, sheep, pigs, poultry and donkeys. Incomes from round potatoes and other sources are presented in Table 2.

3.4 Relationships between Independent Variables and the Dependent Variable

The correlation results in Table 3 show that five out of eight independent variables correlated significantly with the dependent variable. Income from potato sales had medium positive correlation with household income ($r = 0.315$). The correlation was highly significant ($p < 0.001$). These results are not surprisingly for Mbeya and Makete Districts. During key informant interviews and focus group discussions the respondents reported that potato was the main cash crop. Previously, they also depended on pyrethrum but since its market became unstable in the 1990s most of farmers abandoned the crop and expanded areas under potato production. They added that, for high altitude areas (between 1700 – above 2000 m.a.s.l) like in their places, the value of potato represents 80% or more of agricultural production and accounts for close to 100% of agricultural products sold. A study by Mpogole *et al.* (2012) in Njombe, Mbeya and Nkasi Districts revealed that potato production was more profitable than the production of cereals such as maize and wheat. The profitability scenarios between crops competing with potato (maize and wheat) were assessed. It was found that, although potato production is more expensive compared to cereals, they are also more profitable.

Income from non-agricultural activities had very high correlation with household income ($r = 0.942$). The correlation was highly significant ($p < 0.001$). Age of household head had very low negative correlation ($r = -0.035$) which, nonetheless, was highly significant ($p < 0.001$). Land under cultivation per adult equivalent unit had low positive correlation ($r = 0.236$). The correlation was highly significant ($p < 0.001$).

3.5 Impact of Some Independent Variables on Household Income

The dependent variable, household income, was regressed on eight independent variables which were thought to account for more of variation in household income (Table 4). The independent variables were incomes from potato, maize, wheat, livestock and non-agricultural activities; adjusted adult equivalent units; age of household head and land under cultivation. On the basis of the adjusted R-square value, the model showed that 98.4% variation in the dependent variable (household income) was due to the eight independent variables entered in the model. The remaining 1.6% was probably due to other independent variables not included in the model, incorrect model formulation and errors in the research (Mendenhall and Beaver, 1991). With regard to influence of independent variables on household income, the results in Table 4 indicated that six out of the eight independent variables had significant impacts on the dependent variable. The levels of significant were as follows: income from potato ($p < 0.001$), income from wheat ($p < 0.05$), income from non-agricultural activities ($p < 0.001$), income from livestock ($p < 0.01$), age of household head ($p < 0.01$) and land under cultivation ($p < 0.001$).

According to the explanation of variance inflation factors (VIFs) and tolerances of explanatory variables in the Methodology section, the levels of the VIFs and of the tolerances in Table 4 show that there was no multicollinearity because none of the VIFs was more than 10 and none of the tolerances was less than 0.1.

Income from potato had positive significant ($p < 0.001$) impact on household income. This implies that, as potato sales increase, the household income increases substantially. This was confirmed by the farmers during key informant interviews and focus group discussions. They argued that potato production is highly paying particularly in high altitudes and cool temperatures. Potatoes are said to create employment not only to farmers who produce them but also to the communities surrounding the farmers in terms of casual labour, market agents and all participants in the whole potato value chain. Income from wheat showed positive significant ($p < 0.05$) impact on household income. This implies that improving wheat productivity will lead to household income improvement. During key informant interviews and focus group discussions the respondents mentioned wheat as among the major crops contributing to household income in Mbeya and Makete Districts respectively.

Income from non-agricultural activities showed positive significant ($p < 0.001$) impact on household income. Non-agricultural activities are additional activities in which households are engaged besides agriculture, to supplement household income. During key informant interviews and focus group discussions the respondents argued that apart from agricultural production they were also involved in several non-agricultural activities in order to increase their household income. They added that non-agricultural activities enabled them to spend more on their basic needs including spending on food, education for children, clothing and health care. Other respondents argued that agricultural production alone may not be enough to fulfil their household needs.

Income from livestock showed positive significant ($p < 0.01$) impact on household income. This probably indicates that households with large numbers, and diversification, of livestock are wealthier as compared to those with small numbers and few types of livestock. During key informant interviews and focus group discussions the respondents argued that livestock form an important component of household income generation. The major livestock types kept in both districts included cattle, local chickens, pigs, goats and donkeys. In Makete District it was observed that at least each household was keeping donkeys. When asked about the use of the donkeys, they said that they are useful livestock as they are used for transportation of various goods. In Makete District, potatoes are grown in mountainous areas and valleys where it is difficult to transport them by vehicles. The convenient means of transportation for potato is the donkeys.

Adjusted Adult Equivalent Units (AAEU) had negative non-significant impact on household income. This implies that as the AAEU get larger, the household income decreases. However, Adjusted Adult Equivalent Units may have both positive and negative impact on household income depending on activities done by household members, and the number of them who work effectively (Kayunze *et al.*, 2002). Age of household head had low negative significant ($p < 0.05$) impact on household income. This probably indicates that the older the household head, the lower the probability that he/she can participate efficiently in agricultural production. Age of household head is also expected to have a negative impact on ability to seek and obtain off-farm jobs which could increase household income. However, the expected effect of age on household income could be positive or negative depending on activities done by the household head. Land under cultivation had low positive significant ($p < 0.001$) impact on household income. This implies that the larger the farm size the higher the production level hence high income. A study by Reddy *et al.* (2012) argued that, greater efficiencies in the use of modern inputs are associated with larger farms than with smaller farms.

4.0 Conclusion and Recommendations

In this study it was found that most of the farmers in Mbeya and Makete Districts are small scale and also grow maize, wheat, beans and vegetables in addition to round potato. This was evidenced by the proportion of the land that was allocated for round potato and other crops production. Also, it was found that the major production constraints for round potato and other crops included inadequate land, high prices of inputs (fertilizers, pesticides), lack of capital, and inadequate knowledge of improved technologies. On the basis of this conclusion, the government is urged to support farmers through provision of extension services, farm inputs availability in affordable prices and availability of improved potato varieties. Moreover, farmers are urged to use the available land efficiently in order to increase productivity and improve household income.

It was also found that, among the major crops grown in the study area, round potato was the main source of income. Other sources of household income were non-agricultural activities which included casual labour, local brewing, petty business, remittances, lumbering, loan seeking, renting out houses and livestock keeping. Since the average land allocated for round potato and other crops production is low, farmers are urged to look for profitable non-agricultural activities so they can get more income besides income from potato for their household needs. The government is also urged to support farmers in non-agricultural activities since agricultural activities alone may not be enough to fulfil their household needs.

Income from potatoes showed significant impact on household income. It can be concluded that round potato is more profitable as compared to other major crops. This implies that, given due attention and care, potatoes can contribute greatly to household income. Based on this conclusion, farmers in Mbeya and Makete Districts are urged to use improved technologies in potato farming in order to realize its productivity potential and improve their incomes. Moreover, policy makers, and the Ministry of Agriculture, Food Security and Cooperatives are urged to support farmers in farm inputs availability at affordable prices, training sessions on improved technologies, improve infrastructure to reduce transportation costs and support research on round potato.

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Table 1. Total land allocated for round potato and other crops in Mbeya Rural and Makete District

Round potato acreage	Mbeya Rural		Makete	
	Frequency	Percentage	Frequency	Percentage
0.2 – 1.0 (small)	80	69	79	67.5
1.1 – 5.0 (medium)	36	31	36	30.8
5.1 – 10.0 (large)	0	0	2	1.7
Total	116	100	117	100
Other crops acreage				
0.25 – 2.0 (small)	80	69	45	38.5
2.1 – 5.0 (medium)	29	25	59	50.4
5.1 – 15 (large)	7	6	13	11.1
Total	116	100	117	100

Table 2. Income per adult equivalent from potato, other crops and other sources

Income from other sources	n	Minimum	Maximum	Mean	Standard deviation
Income from potato	219	8,000	12,000,000	722,250	1,325,210
Income from other crops	233	-285,000	6,350,000	115,410	462,495
Income from non-agricultural activities	129	-200,000	56,400,000	566,870	3,811,790
Income from livestock	117	-310,000	3,010,000	92,550	267,762

Table 3. Correlation between the dependent variable and independent variables

Variable	n	Correlation coefficient (r-value)	p-value
Income from potato	219	0.315***	0.000
Income from maize	102	0.145*	0.027
Income from wheat	71	0.059 ^{ns}	0.367
Income from livestock	96	0.185 ^{ns}	0.070
Income from non-agric activities	127	0.942***	0.000
Adjusted Adult Equivalent Unit	233	-0.033 ^{ns}	0.614
Household head age	233	-0.035***	0.000
Land under cultivation per Adult Equivalent Unit	233	0.236***	0.000

The dependent variable was household income per adult equivalent unit

*** Correlation was significant at the 0.001 (2-tailed)

*Correlation was significant at the 0.05 (2-tailed)

Table 4. Impact of some of the independent variables to household income per adult equivalent unit

Independent variables	Unstandardized Coefficients		Standardized coefficients	t	Sig	Collinearity tests	
	B	Std Error	Beta			Tolerance	VIF
Constant	-144763.869	212325.631		-682	0.497		
Income from potato	0.253	0.019	0.218	13.265***	0.000	0.628	1.591
Income from maize	-0.236	0.174	-0.020	-1.358	0.178	0.745	1.342
Income from wheat	0.592	0.242	0.033	2.452*	0.016	0.915	1.092
Income from non-agric activities	0.273	0.004	0.940	71.265***	0.000	0.977	1.023
Income from livestock	103827.548	38805.103	0.037	2.676**	0.009	0.872	1.147
Adjusted Adult Equivalent Unit	-38411.579	23876.345	-0.25	-1.609	0.111	0.732	1.366
Age of household head	-6794.983	2574.779	-0.37	-2.639**	0.010	0.882	1.134
Land under cultivation per Adult Equivalent Unit	138279.508	28854.483	0.076	4.792***	0.000	0.669	1.494

Dependent variable: Household income per adult equivalent unit
 R^2 adjusted = 0.984, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

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