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RESEARCH ON POVERTY ALLEVIATION

# Determinants of Rural Income in Tanzania:

## An Empirical Approach

By Jehovaness Aikaeli

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# Abbreviations

| | |
|---|---|
| EA | Enumeration area |
| FGLS | Feasible generalised least squares |
| HBS | Household budget survey |
| HIV/AIDS | Human immunodeficiency virus/Acquired immune deficiency syndrome |
| LDCs | Less developed countries |
| ML | Maximum likelihood |
| NBS | National Bureau of Statistics |
| OLS | Ordinary least squares |
| PHDR | Poverty and Human Development Report |
| PSU | Primary sampling unit |
| RAWG | Research and Analysis Working Group (within the Ministry of Finance and Economic Affairs) |
| REPOA | Research on Poverty Alleviation |
| SRS | Simple random sampling |
| SSU | Secondary sampling unit |
| TRICS | Tanzania Rural Investment Climate Survey |
| TZS | Tanzania shillings |
| UNDP | United Nations Development Programme |
| URT | United Republic of Tanzania |

# Abstract

Despite many initiatives to reduce rural poverty in Tanzania in the last ten years, rural incomes have not improved significantly. Rural poverty remains a critical economic problem. To better inform rural policies and interventions, this study conducted an econometric analysis of data from the 2005 Tanzania Rural Investment Climate Survey to assess the impact of selected socio-economic and geographic factors on the income of rural households and communities. Linear models for these factors were estimated by applying a generalised least squares technique. The analysis found that improvements in four variables had a significant positive impact on the incomes of rural households: the level of education of the household head, size of household labour force, acreage of land use and ownership of a non-farm rural enterprise. The study also found that income was lower in female-headed households than male-headed households. At the community level, greater use of telecommunications, which enables increased access to market information, and improvements in road infrastructure have noticeable positive effects on rural incomes. With respect to climatic factors, which are largely beyond community control, sufficient rainfall raised rural income, while the incidence of drought and flood impaired income generation.

# Acknowledgements

# 1 Introduction

Although the Human Development Index (HDI) for Tanzania rose from 0.458 in 2000 to 0.530 in 2007, poverty in the country is still widespread and acute. Four decades after independence Tanzania remains one of the world's poorest economies, ranking 151 out of 182 countries based on the HDI score (UNDP, 2009).[1]  Poverty is a predominantly rural phenomenon; more than 80% of Tanzania's poor live in rural areas, and the sale of food and cash crops is still the most important source of cash income for rural households (NBS, 2009). Rural residents commonly face cyclical and structural constraints, including dependence on seasonal rain-fed agriculture and lack of irrigation schemes, low levels of inputs to improve productivity, limited or poor extension services, unavailability of credit, absence of infrastructure and lack of market linkages.  At the same time, they are confronted by limited access to adequate public services – education, healthcare and safe drinking water. Data from the Household Budget Survey (HBS) 2007 clearly shows the existence of broader and deeper poverty in rural areas than in urban centres, mainly because of relatively low incomes in the villages (Table 1).

**Table 1: Incidence of Poverty in Tanzania**

|  | Year | Dar es Salaam | Other Urban areas | Rural areas | Mainland Tanzania |
|---|---|---|---|---|---|
| Food | 1991/92 | 13.6 | 15.0 | 23.1 | 21.6 |
|  | 2000/01 | 7.5 | 13.2 | 20.4 | 18.7 |
|  | 2007 | 7.4 | 12.9 | 18.4 | 16.6 |
| Basic needs | 1991/92 | 28.1 | 28.7 | 40.8 | 38.6 |
|  | 2000/01 | 17.6 | 25.8 | 38.7 | 35.7 |
|  | 2007 | 16.4 | 24.1 | 37.6 | 33.6 |

Source: HBS 2007

Between 2000/01 and 2007 there was no significant decrease in poverty in urban or rural areas. In terms of the head-count index (percentage of households below the poverty line), basic needs poverty incidence fell by 1.7 percentage points in urban Mainland Tanzania over this period, while in rural areas it declined by 1.1 percentage points. Also during this period the incidence of food poverty in urban areas decreased by 0.3 percentage points and by 2.0 percentage points in rural areas. The incidence of basic needs and food poverty among rural residents remain substantially higher than urban residents. These data point to the need for greater efforts to alleviate poverty, particularly in rural areas, if noticeable improvement in wellbeing for the majority of Tanzanians is to be achieved.

Despite the implementation of many rural development strategies in recent decades, rural incomes have not improved significantly. The question is why rural income has remained low and rural poverty continues to be a critical economic problem for Tanzania. While many reports have focused on the status of poverty in urban and rural areas (NBS, 2002; World Bank, 2006; UNDP, 2007, 2009; RAWG, 2006, forthcoming), there is a gap in information on the specific causes of low income at both household and community levels. Because a strong correlation exists between income and poverty, it is necessary to examine determinants of rural income to better inform poverty reduction strategies.

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[1]  Countries are classified into one of three clusters based on their HDI score: high human development (HDI ≥ 0.800), medium human development (HDI of 0.500–0.799) and low human development (HDI < 0.500).

To examine the determinants of rural income, this study analyses data from the Tanzania Rural Investment Climate Survey conducted in seven regions of Mainland Tanzania in early 2005. The paper is organised as follows: Section 1 reviews current literature on income and poverty in Tanzania and other developing countries; Section 2 describes the research methodology; Section 3 presents the findings of the analysis; and Section 4 provides conclusions and outlines policy implications.

# 2 Literature review

There are two popular strands in the literature on poverty; the first contends that poverty is a cultural/behavioural phenomenon and the second views poverty as a structural/economic phenomenon. The cultural thesis argues that poverty is rooted in the deficient character and behaviour of the poor which undermine economic well-being and success (Jordan, 2004; Lewis, 1970; Ellwood & Summers, 1986; Mead, 1986; Patterson, 2000; Rodgers, 2000). This school of thought points to rising rates of crime, violence, drug/alcohol misuse and family breakdown as evidence of the poor's dysfunctional values relative to mainstream social norms on family, education and work. As a consequence, poverty tends to perpetuate itself from generation to generation; children of impoverished parents are incapable or unable to escape the vicious cycle of poverty. This argument, however, is criticised because it merely points at the symptoms. It blames and insults the poor rather than offering explanations.

On the other hand the "structural or economic" strand argues that most poverty can be traced back to structural factors in an economy or institutional environments that favour certain groups over others. For example, economic opportunities may vary markedly between different locations with significant impact on income levels and poverty. The poverty of an individual cannot, therefore, be solely attributed to personal characteristics without paying attention to the circumstances prevailing where a person lives (Holzer, 1991). Economic factors underlying impoverishment include exposure to available economic opportunities, the level of median income and inequality (Keynes, 1936; Ellwood and Summers, 1986; Abramovitz, 1996). This direct relationship between poverty and income supports the argument that productive work is the best mechanism for lifting people out of poverty which, in turn, suggests that strategies to expand economic opportunities and promote income growth are necessary for sustained poverty reduction. This is the view adopted by most empirical studies on income and poverty.

The structural strand also finds support among Marxists who argue that income poverty in less developed countries (LDCs) has its origin in the historical relationships between developed and developing countries. Rweyemamu (1971) explained that the misery of poverty in less developed countries could be traced to historical relationships with colonial powers, which firmly integrated LDCs as satellites to the world capitalist system. This view of poverty in the developing world emphasises historical exploitation by developed countries. However, this view suffers from the lack of sufficient evidence since some currently rich countries were former colonies.

The current study has adopted the structural approach that links incomes in rural areas with factors that influence production in those areas, including ecological conditions, the size and education of the labour force, and land developments (Fisher, 1987; Samuelson and Nordhaus, 1992). A number of empirical studies using the structural approach have influenced this choice of approach. Sen and Palmer-Jones (2006) examined the link between poverty and location in rural India and concluded that being poor or rich was strongly related to where a person lived. The study applied spatial econometric methods, including ordinary least squares (OLS) and maximum likelihood (ML) estimation techniques, to explore the determinants of rural income poverty in relation to agricultural growth. The study found that low incomes and poverty were highly correlated with agricultural performance. Therefore, factors that promote agricultural production are important to poverty alleviation. Initial conditions, i.e., agro-ecological factors, were also highly associated with spatial dependence in India. Places where conditions were unfavourable to the development of

irrigation facilities experienced little agricultural growth and, consequently, these areas were characterised by low income levels and minimal declines in rural poverty. These results are supported by Son (2007) who looked at the effect of irrigation and water availability on rural incomes in Vietnam. Using an OLS model, the study found that between 2000 and 2005 rural incomes more than doubled in irrigated areas compared with non-irrigated areas. Unstable marketing channels, most often due to information barriers and high access costs, also constrained incomes in rural Vietnam. Nevertheless, as Mung'ong'o and Mwamfupe (2003) found among migrant Maasai pastoralists of Morogoro and Kilosa districts in Tanzania, communities adapt to new conditions; in particular, environmental and political factors have caused a switch in traditional livelihoods from nomadic pastoral activities to sedentary agricultural activities. This has not, however, made a noticeable impact on income and poverty alleviation as the types of activities are simply for subsistence.

Studies have also shown that the quality of human capital is an important factor in explaining rural poverty. Using growth models, Solow (1957) and Nelson (1964) postulated that education adds to the effectiveness of labour through technical progress. In general, education allows people to adapt more easily to both social and technical changes in the economy and, to changes in the demand for labour. In their analysis of poverty in Uganda, Okurut et al. (2002) found that the higher the educational attainment of the household head the wealthier the household, while the larger the household size the poorer the household. Smith (2007) in a study on the determinants of Soviet household income found that human capital and demographic factors were the main determinants of income. The well-educated, middle-aged and self-employed people had relatively comfortable incomes. The study also concluded that location had strong influence on household incomes.

In Mozambique, Bruck (2001) analysed the determinants of rural poverty and the coping strategies during the post-war period. Using a reduced form linear welfare function to estimate the impact of hypothesised variables – including land, assets, social capital, war-effects, and village level endowments or characteristics – on indicators of household well-being, such as household consumption, the study indicated that a poverty trap existed in certain areas of the country. Nevertheless, households in the land-abundant northern parts of the country as well as those supplied with better social services were relatively richer. In Tanzania, studies have found that because agriculture is mainly labour intensive expansion in rural smallholder agricultural production depends upon a bigger labour force (Kamuzora & Gwalema, 1998; Kamuzora & Mkanta, 2000; Kamuzora, 2001).

Inadequate infrastructure has also featured prominently in rural poverty studies. In Argentina, a study on the rural poor found that the principal causes of poverty were low education, poor health facilities and inadequate infrastructure (Verner, 2006). Combined together, these factors severely constrained income. In this category, some studies have focused on the availability of financial services as one of the explanatory variables. Kessy and Urio (2006) have shown that the provision of loans by micro-finance institutions boosted the livelihoods of poor Tanzanian households. The study also found that the lack of infrastructure, especially rural roads, was the main reason why micro-finance institutions failed to operate in rural areas.

From the literature reviewed, it is clear that the causes of low income and poverty in low income rural areas are complex and diverse. Analyses of rural poverty in developing countries must take into account the structural realities in these areas. Many rural areas of LDCs are characterised by location disadvantages as well as very low levels of basic social and economic infrastructure. In designing policies and strategies for growth and poverty reduction, governments and other key stakeholders must understand and address the structural factors that constrain income and perpetuate poverty.

# 3 Research Methodology

For this study, linear models of hypothesised determinants of rural income were estimated by applying a generalised least squares technique to assess factors affecting rural per capita income. The models were fitted with secondary data from the Tanzania Rural Investment Climate Survey (TRICS) conducted by the National Bureau of Statistics (NBS) in selected rural areas and small market towns in 2005.

## 3.1 Study Objectives

The overall objective of the study is to identify determinants of rural income in Tanzania. The study seeks to better understand the causes of differences in income between households and across communities. To achieve this, the study's specific objectives are to:

- Estimate hypothesised determinants of household income, such as household labour force, extent of land use, and education of the household head. These are referred to as decomposable variables, as they can be analysed at both community and household level.

- Estimate an equation linking rural community income with broad, zone-based infrastructural determinants.

- Analyse the strength of location (i.e., weather) determinants of rural community income, in order to ascertain what may have caused differences in income levels among the surveyed communities.

## 3.2 The Tanzania Rural Investment Climate Survey

### 3.2.1 Sampling Design

The TRICS collected data on households, enterprises and communities in seven regions of Mainland Tanzania: Kilimanjaro, Morogoro, Mtwara, Mbeya, Tabora, Kigoma and Kagera. The regions were selected to represent all of the major geographical and climatic zones in Tanzania. Respondents were identified through the following sampling methods:

- **Community data:** A simple random sample technique was used to select one primary sampling unit from each region. A cumulative random selection procedure was then employed to select an appropriate number of enumeration areas (EAs) from the districts (secondary sampling units) in each region.

- **Household data:** After choosing the communities, households in those communities were listed. Two samples were made from the list of households: i) households that operated a rural non-farm enterprise; and ii) households that did not operate an enterprise. Households that conducted non-farm economic activities completed the enterprise questionnaire.

- **Enterprise data:** Households with non-farm enterprises had their projects stratified by major economic activities: manufacturing, trade and services. Each EA had about 11 non-farm enterprises included in the sample.

In total, the survey covered 150 communities, 1,239 enterprises and 1,610 households in the seven regions. As shown in Table 2, response rates were good for all three categories. Out of 1,500 enterprises initially sampled, 1,239 completed the questionnaire satisfactorily (83% response rate). Out of 1,620 questionnaires administered to the households, 1,610 were adequately completed (99% response rate), while all 150 community questionnaires were completed (100% response rate).

**Table 2: Distribution of TRICS Sample Data**

| Region | Households N=1,620 | Enterprises N=1,500 | Communities N=150 |
|--------|--------------------|---------------------|--------------------|
| Kilimanjaro | 201 | 114 | 20 |
| Morogoro | 236 | 238 | 24 |
| Mtwara | 200 | 199 | 20 |
| Mbeya | 294 | 285 | 30 |
| Tabora | 291 | 142 | 20 |
| Kigoma | 149 | 138 | 15 |
| Kagera | 239 | 123 | 21 |
| **Total** | **1,610** | **1,239** | **150** |

Source: TRICS 2005

### 3.2.2 Types of Data Collected

Data were collected through questionnaires administered to heads of households, community leaders and the owners/managers of rural non-farm enterprises. Three separate but interrelated survey questionnaires were used.

• The household module collected data on household demographics, education, income, other economic issues and assets (land and household property).

• The enterprise module collected information about ownership of rural non-farm activities, factors hindering rural investments, production, markets, and the state of local infrastructure and services.

• The community questionnaire gathered data on community characteristics, consumer and producer prices, and other community-level issues.

## 3.3    Study Hypotheses

The study's hypotheses on the determinants of household income in the rural areas were developed in consideration of data collected by the TRCIS and with reference to the literature. The hypotheses are:

H1:  The higher the level of education of the household head, the higher the household's income.
H2:  The larger the size of the household's labour force, the higher the household's income.
H3:  The wider the extent of land use by the household, the higher the household's income.
H4:  Households owning rural non-farm economic activities have higher incomes than those without such activities.
H5:  Households with high dependency ratios have lower per capita income than those with low dependency ratios.
H6:  Male-headed rural households have higher income than female-headed households.

## 3.4    Analytical Models

The following linear model was used by the study for estimating the determinants of rural household income.

**Equation 1:**  $Y = \beta_0 + \beta_1 E + \beta_2 A + \beta_3 L + \beta_5 D + \beta_6 R + \beta_7 NA + \beta_8 G + \varepsilon$

The terms of the equation are as follows:
$Y$  =  household per capita income, measured as the amount of household annual income including remittances divided by household size;
$E$  =  level of education of the household head;
$A$  =  household's labour force;[2]
    =  acreage of land used by the household;
$D$  =  dependency ratio, measured as the ratio of household members who are wholly dependent, i.e. those depending fully on the working members of the household for their livelihood;
$NA$ =  a dummy variable capturing household ownership of a rural non-farm activity (0 if the household does not own/operate such an activity and 1 if they do);
$G$  =  a dummy variable for the gender of the household head (1 if male, 2 if female);
$\varepsilon$  =  the error term.

Although more complex models can be used to estimate socio-economic determinants of income or poverty, the equation used by the current study includes only those variables that are most relevant to policy and for which survey data were available.

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[2]    Household labour force is defined as the proportion of household members of working age and those who can contribute to household income. The study assumed that household members above 15 but less than 71 years of age formed the active labour force in rural areas. This variable, however, functions as hypothesized only under the assumption that other resources (land availability and use) are not a limiting factor.

Equation 1 is used to fulfil the study's first specific objective. It is a linear model for cross-sectional household data. Given that the data from the TRCIS covers households from all zones of Tanzania, it is likely that the sequence of random variables examined would have differing variances; i.e., would be heteroscedastic. As the heteroscedasticity of the variables may not be known, Equation 1 is estimated by using a feasible generalised least squares (FGLS) technique. Because communities have many households, unique household identities were created and applied in data collection and processing to facilitate separation and aggregation of respective households' items.

In estimating the impact of climatic or geographic factors on the income of rural communities, several variables were considered. The main economic activity in rural Tanzania is agriculture which depends on weather conditions as well as the status of infrastructure and market access in particular locations. Therefore, the study used two community-based equations to estimate the effect of infrastructural and weather variables on rural income.

The first community-based model considers the impact of infrastructure on rural income in different locations. The equation is:

**Equation 2:** $\quad P\ income_i = \theta V + u_i,$

The terms of the equation are:
$P\ income_i$ =  community per capita income;
$V$ =  a vector of independent infrastructure and market access variables;
$\theta$ =  a vector of the variables' parameters;
$u_i$ =  a conventional error term.

The infrastructure and market access variables included are:

- distance to the goods market in kilometres;

- proportion of households supplied with water and with electricity, respectively;

- use of telecommunication facilities, measured by the percentage of households in the community using telecommunications services;

- length of time roads are passable over the year (average number of months);

- time taken in hours to travel/transport goods by road to the market or nearest urban centre.

The analysis assumes that these variables are linearly correlated with community per capita income.

Given that the majority of farmers in Tanzania are engaged in traditional rain-fed agriculture, rural areas are immensely affected by weather conditions that influence agro-ecologica phenomena (for example, drought and flood) that are largely beyond the control of communities. The second community-based equation, therefore, estimates the impact of climatic conditions on rural income in different locations.

**Equation 3:** $$Pincome_i = \delta_0 + \delta_1 Rain_i + \delta_2 Temp_i + \delta_3 Flood_i + u_i$$

The exogenous variables included in the equation are:

*Rain* = rainfall. This was the amount of rainfall over the past 12 months as perceived by survey respondents in comparison with normally experienced conditions;

*Temp* = drought intensity gauged by temperature levels. This was the temperatures over the past 12 months as perceived by survey respondents in comparison with normally experienced conditions;

*Flood* = episodes of floods over the past 12 months.

As data from different zones of a country have significant variability, the scale of individual variables must be adequately addressed in calculations. Since heteroscedastic variances ($\sigma_i2$) are unknown, Equations 2 and 3 were estimated using a FGLS technique. In addition, because of the different nature of the two types of factors analysed (i.e., infrastructural and geographical), the use of two separate equations facilitated effective estimation. Nevertheless, the synergy of information from all explanatory variables directed that the equations be estimated simultaneously.

# 4 Analysis of Findings

## 4.1 Basic Characteristics of the Rural Sector

Study estimates of the annual income of rural households sampled by the TRCIS averaged around TZS 480,000 per household. Dividing this figure by the household labour force yielded a per capita income of roughly TZS 152,000 for rural working Tanzanians in the surveyed areas. In comparison, the two most recent Household Budget Surveys estimated per capita income in rural Tanzania (from the expenditure side) to be TZS 110,532 in 2000/01 and TZS 111,199 in 2007 (NBS, 2002 and 2009). The disparity can be attributed to differences in the surveys' scopes, scale, per capita definition adopted here and computational methods. Remittances to the rural localities (from urban centres and abroad) amounted to TZS 14,358 per household. The dependency ratio in households was approximately 41%. Even before income distribution to all household members, the average per capita income of less than US$150 is extremely low and signals abject rural poverty in the country.

The level of education among respondent household heads was also low. TRCIS data showed that 16.2% of household heads had no formal education, 69.5% had a primary education, and 14.3% had attended school to secondary level or higher. The proportion of household heads who had not attended school compares closely with the national rate of male illiteracy of 20% estimated by HBS 2007. Among respondents who owned non-farm rural enterprises, about 75% had primary education. The remaining 25% had attained a higher level of education, but most ended at secondary school level.

Around 50% of the households indicated that at least one family member had been engaged in non-farm economic activities in the year preceding the survey. About half of those enterprises had been in operation for less than five years. In comparison, HBS 2000/01 data showed that around 42% of households had a member engaged in rural non-farm activities; in 2007 this ratio had increased to approximately 52%. A majority of the non-farm enterprises surveyed in the TRCIS were operated by only one person for most of the year. When enterprises employed workers, they mostly used part-time or casual labour. By sector, the majority of non-farm activities were engaged in wholesale or retail trade. Approximately 40% of the enterprises bought and sold unprocessed agricultural products and roughly 30% were engaged in the trade of processed products. Less than 3% of all trading firms in rural areas dealt solely in agricultural inputs.

Lack of access to markets was the other main constraint cited by the rural households surveyed, as lack of adequate roads holds back the marketing process. More than 40% of respondents cited lack of transport infrastructure as a severe constraint on the investment climate. In most of the communities surveyed, roads were only passable seasonally. Approximately 70% of rural roads were dirt (mud in the rainy season), 20% were gravel and 10% had other surfaces. As a result, most non-farm rural enterprises buy and sell locally with little access to outside markets, and competition in crop purchasing remains low, which keeps prices of rural producers low. As shown in Table 3, revenues to rural households and enterprises were generated largely within the ward; less than a third of revenue was derived from export of products or services to districts and regional markets.

**Table 3: Sources of Revenue for Rural Households and Enterprises, by Sector (% of revenue)**

|  | Trade | Services | Production |
|---|---|---|---|
| From the ward market | 70 | 77 | 76 |
| From the district market | 19 | 17 | 16 |
| From the regional market | 8 | 4 | 4 |
| Elsewhere in the country | 3 | 2 | 4 |
| Average market share | 24 | 22 | 19 |

Source: TRICS 2005

Nearly 40% of surveyed communities were electrified, but even in those communities most households lacked access to power. On average, public electricity supply was interrupted 71 times in 2004. Moreover, many enterprises and households did not have access to telecommunications. For example, scarcely 13% of all surveyed enterprises had fixed or mobile phones. This communication barrier is a major impediment in accessing market information. Lack of reliable sources of clean water (piped water or drilled wells) was also cited by 47% of respondents as a hindrance to domestic and productive activities. Although Tanzania has large water bodies, a big proportion of rural households are without a dependable water supply, which affects production in those communities. Effects are both direct (through lack of water for irrigation and production processes) and indirect (through the impact of unsafe drinking water on the health of the workforce).[3]

## 3.2    Results of the Econometric Analysis

### Determinants of Income at the Household Level

The linear model of income determinants for individual households, included 946 data points. Specification tests showed no significant problem of omitted variables bias (see the Appendix for detailed results of these tests). The model was thus log-linearised to appropriately scale up the variables and simplify interpretations.[4]  Table 4 presents FGLS estimates of Equation 1. The majority of hypothesised variables were statistically significant.

**Table 4: Determinants of Income in Rural Households**

| Variable | Coefficient | Std. error | z-value | P > z |  | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|---|
| Education of household head | 0.326 | 0.116 | 2.80 | 0.01 | * | 0.098 | 0.554 |
| Household labour force | 0.522 | 0.196 | 1.35 | 0.07 | *** | 0.188 | 4.729 |
| Acreage of land used | 0.362 | 0.175 | 2.07 | 0.04 | ** | 0.018 | 0.705 |
| Dependency ratio | 0.117 | 0.131 | 0.90 | 0.37 |  | - 0.139 | 0.373 |
| Ownership of non-farm activity | 6.188 | 0.638 | 9.70 | 0.00 | * | 5.938 | 7.439 |
| Gender of household head | - 0.548 | 0.249 | - 2.20 | 0.03 | ** | - 1.035 | - 0.059 |
| Constant | 3.182 | 0.372 | 8.56 | 0.00 | * | 2.453 | 3.910 |

Log likelihood = -2151.404145, No. of obs. = 946, AIC = 4.563222, BIC = -1201.001,

* Significant at the 1% level,** Significant at the 5% level, *** Significant at the 10% level.

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[3]    Note that in developing countries like Tanzania, electricity and water supply in rural areas are mostly used for domestic consumption rather than economically productive activities.

[4]    As Chendroyaperumal (2008) explained, even by resolving the contradiction between Hume and Hicks principles of causality by re-phrasing Hume's principle to state that "in any causality, the cause always necessarily takes a non-zero and positive amount of time to give the effect", measuring causality for cross sectional data remains controversial and so we did not attempt do it in this study.

Education of the household head was significant at the 1% level and, as hypothesised, its coefficient had a positive sign. This indicated that the higher the level of education of the household head, the higher the household per capita income. Indeed, if the education of a rural household head was raised by one level, per capita household income would rise by approximately one-third.[5] The corollary of this finding is that education leads to proficient household management and, crucially, improves economic performance of the household as a whole.[6] In addition to agricultural activities, household heads with relatively higher education are more likely to have skills and opportunities to successfully diversify into other, more lucrative, income-generating activities. Moreover, the productivity of individuals with higher levels of education who are engaged in agricultural activities is also likely to be higher than that of less educated farmers.

The next variable, size of the household labour force, had a positive sign and was significant at the 10% level. These results denote that rural household per capita income increased as the size of the household labour force increased (i.e., the proportion of active working household members aged 15-71 years). Statistically, a 1% increase in the household labour force could increase household per capita income by around 0.5%. The skilfulness of labour is not directly taken into account in the construction of this variable as the influence of knowledge and skills is better captured by the modelled education variable.

The extent of land used had a positive impact on household income and was significant at the 5% level. Expansion of household land use by 1% raised per capita income by 0.4%, largely as a result of increased agricultural production. The upshot of this finding is that rural incomes can be improved by expanding activities to unused or under-utilised land. Presumably however, increasing acreage is more effective if complemented by improvements in inputs, such as the mechanisation of agriculture.

With respect to household structure, the estimates of the dependency ratio were found to be statistically insignificant. However, in regard to the gender of the household head, the variable's coefficient had a negative sign and was significant at the 5% level, which indicated that per capita household income was higher for male-headed households than female-headed ones. This suggests that the empowerment of women will be fundamental in achieving improvements in rural incomes.

Ownership of non-farm economic activities was also significant to income generation and thus poverty reduction. The coefficient of rural non-farm activities had a positive sign and was significant at the 1% level. Results indicated that expansion of rural non-farm activities by 1% would raise household per capita income by 6%.

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[5] Statistically speaking, it would seem easy to increase education but, in practice, it requires sustained long-term investment to increase the quantity and quality education. Educating more Tanzanians to a higher level is necessary but not sufficient. Raising the standards of education is equally important.

[6] Notice that the type of education captured in the surveys is formal school education that can be adequately substantiated.

### Determinants of Income at the Community Level

As described in the methodology, Equations 2 and 3 were used to capture the impacts of infrastructure/market factors and geographical conditions on community per capita income. The goodness of fit of these equations was poor if estimated with a constant term, but was good when the constant term was suppressed. This means that the values of the fitted regression line start close to the origin and so inclusion of the constant imposes a biased shift of the line. In total, 42 communities (data points) were included in the analysis, and community responses were available for all of the equations' variables. Table 5 presents FGLS estimates of the determinants of rural community per capita income.

**Table 5: Determinants of Income in Rural Communities**

| Variable | Coefficient | Std. error | Z-value | P > Z | | [95% conf. interval] | |
|---|---|---|---|---|---|---|---|
| **Equation 2** | | | | | | | |
| Distance to market | 0.255 | 0.357 | 0.72 | 0.47 | | 0.443 | 0.955 |
| Water availability | 0.638 | 0.319 | 2.00 | 0.05 | ** | 0.124 | 1.263 |
| Use of telecommunications | 4.701 | 1.409 | 3.34 | 0.00 | * | 1.939 | 7.463 |
| Electricity supply | - 0.255 | 1.366 | 0.19 | 0.85 | | - 2.421 | 2.931 |
| Passable roads – frequency | 1.991 | 0.718 | 2.77 | 0.01 | * | 0.583 | 3.398 |
| Time to reach market by road | 0.392 | 0.517 | -0.76 | 0.45 | | - 0.621 | 1.406 |
| **Equation 3** | | | | | | | |
| Rainfall | 2.177 | 1.116 | 1.95 | 0.05 | ** | - 0.088 | 4.365 |
| Temperature | - 2.949 | 1.295 | - 2.28 | 0.02 | ** | - 5.487 | - 0.411 |
| Floods | - 3.206 | 1.219 | - 2.63 | 0.01 | * | - 5.595 | - 0.817 |

No. of obs. = 42; equation 2 Ch2 = 351.58 & P= 0.0000; equation 3 Ch2 = 564.37 & P= 0.0000

* Significant at the 1% level, ** significant at the 5% level.

Estimates of Equation 2 show that the distance from the community to the market, electricity supply and time taken to reach the market by road (which is another reflection of distance to market, but is indicative of road conditions as well as length) were insignificant.

The variable for availability of water supply in the community had a positive sign and was significant at the 5% level. Although this variable was significant, careful interpretation is needed given that water in rural areas of Tanzania is predominantly used for domestic consumption rather than as an input for productive activities. Tanzania has several large water bodies but most rural areas lack irrigation schemes and depend on rainfall. Nonetheless, this analysis showed that communities that were well supplied with water had higher per capita incomes than those with water shortages. Few places had piped water; the majority of villages depended on either drilled wells or canals off the main streams of rivers. Canals were the major sources of water for irrigation, drinking and other domestic uses.

The variable, use of telecommunications (which helps to capture the strength of a community's market linkages) was statistically significant at the 1% level and had a positive sign. This result indicates that rural communities having a large number of people with efficient means of communications were better linked to the market and had higher per capita incomes than those who were constrained by information asymmetry. Information

barriers impact the investment climate in all LDCs and this finding reveals the significant association of these constraints with income deficiency.

The analysis also found that the variable on how frequently roads were passable over the year was significant at the 5% level and had a positive sign. This shows that the less often roads were passable, the lower the community's per capita income, mainly because of market inaccessibility. One of the critical problems faced by rural communities in Tanzania, like those of other developing countries, is the lack of efficient means of transport, including road infrastructure. As a consequence, lots of products in rural areas can remain unsold or are sold at low prices due to lack of market competitors.

For climatic factors that affect income, the current analysis focused on rainfall, temperature and floods as these are the most common weather-related constraints in Tanzania. These variables were estimated against rural community per capita income as specified in Equation 3. Results show that the association between income and perceived rainfall amount received over the 12 months preceding the survey was statistically significant at the 1% level and had a positive sign. In the absence of water for irrigation, a lack of rain meant that agricultural output was likely to be less which, in turn, led to lower rural per capita income.

The variable, perceived location temperature, aimed to approximate the drought intensity in the surveyed communities. Whether temperature levels can be utilised as a proxy indicator for drought may be open to debate since the spatial distribution of temperature across geographical zones is always different. Mindful of this limitation, the survey question asked respondents whether temperatures were high, normal or low in the year preceding the survey based on their community's experience. The coefficient for this variable had a negative sign and was significant at the 5% level, which implies that drought incidence negatively affected rural community per capita income.

Floods are another common natural calamity in rural areas of Tanzania. The coefficient for this variable was negative and significant at the 1% level, which implies that episodes of flood in the year preceding the survey reduced per capita income in the affected communities.

# 5 Conclusions and Policy Implications

## 5.1 Conclusions

Causes of low income in rural areas are diverse, ranging from those confined to individual households to those extending to the community at large. In some instances, households may be able to avoid or overcome household-level constraints to improve income. These improvements act to increase the private benefits that accrue to individual households, but personal efforts alone may not suffice.

Based on the study's econometric analysis, the following variables were found to be significant in determining household income in rural Tanzania: level of education of the household head, size of household labour force, acreage of land used, ownership of non-farm rural enterprise and gender of the household head. Education of the household head had a positive impact on per capita income, implying that investment in education is income improving. Increased use of resources by households, particularly land and labour force, also increased per capita household income. Challenges remain, however, on how to facilitate expanded land use and to overcome the lack of adequate inputs for land development, such as capital, machinery and modern agricultural know-how and methods. Rural households headed by women were also found to have lower per capita income than those headed by men, most probably because of unequal distribution of resources. Rectifying this situation necessitates empowerment of women in all respects.

Another factor that showed a clear connection with rural per capita income was the availability of water. Rural areas with adequate access to clean water benefit both in terms of domestic consumption and for irrigation and other productive uses. Not surprisingly, the incidence of drought and flood were found to be major obstacles to better per capita rural income. Communities and the government have roles to play to alleviate calamities, especially those largely related to man-made environmental degradation, through improved prevention and control mechanisms.

## 5.2    Policy Implications

Based on findings from the analysis, the following policy implications come to light for improving rural incomes and reducing poverty in Tanzania:

1) Greater investment in education and training in rural areas to improve the capacity of the labour force, and to equip young people with the knowledge and skills to secure good livelihoods and break the cycle of poverty;

2) Empowerment of women through adequate education and legal reforms to ensure equal opportunities;

3) Expansion of access to modern farming equipment and other inputs at affordable prices so as to facilitate greater and more efficient use of land resources;

4) Promotion of both agricultural and rural non-farm economic activities to accelerate income improvement;

5) Increased investment in rural road infrastructure, telecommunications and water supply (especially irrigation schemes); and

6) Strengthening of government capacity to combat natural calamities, particularly in areas prone to droughts and floods.

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# **Appendix:** Model Specification Tests

**Table A1: Breusch-Pagan/Cook-Weisberg Test for Heteroscedasticity**

Ho: Constant variance

**Equation 1**

| Variable | Chi2 | Df | P |
|---|---|---|---|
| Education of household head | 15.37 | 1 | 0.0001 |
| Household labour force | 22.69 | 1 | 0.0000 |
| Acreage of land used | 03.70 | 1 | 0.1001 |
| Dependency ratio | 15.14 | 1 | 0.0001 |
| Ownership of non-farm activity | 97.52 | 1 | 0.0000 |
| Gender of household head | 07.75 | 1 | 0.0054 |
| All variables simultaneously | 125.27 | 6 | 0.0000 |

**Equation 2**

| Variable | Chi2 | Df | P |
|---|---|---|---|
| Distance to the market | 0.02 | 1 | 0.8835 |
| Water availability | 0.00 | 1 | 0.9454 |
| Use of telecommunications | 18.45 | 1 | 0.0000 |
| Electricity supply | 1.31 | 1 | 0.2523 |
| Passable road-frequency | 9.22 | 1 | 0.0024 |
| Time to reach market by road | 0.02 | 1 | 0.8986 |
| All variables simultaneously | 27.25 | 6 | 0.0024 |

**Equation 3**

| Variable | Chi2 | Df | P |
|---|---|---|---|
| Rainfall | 5.92 | 1 | 0.0150 |
| Temperature | 7.42 | 1 | 0.0065 |
| Floods | 0.13 | 1 | 0.7172 |
| All variables simultaneously | 11.77 | 3 | 0.0082 |

Overall, all three equations are heteroscedastic.

**Table A2: Ramsey Reset Test**

Ho: Model has no omitted variables

| | | | |
|---|---|---|---|
| **Equation 1** | $F(3, 936)$ | = | 1.3400 |
| | Prob > F | = | 0.2584 |
| **Equation 2** | $F(3, 33)$ | = | 0.6600 |
| | Prob > F | = | 0.5850 |
| **Equation 3** | $F(3, 35)$ | = | 2.51 |
| | Prob > F | = | 0.0749 |

Equations 1 and 2 have no evidence of significant omitted variables, but Equation 3 shows, at least weakly, the omitted variables bias.

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