Market access and rural poverty in Tanzania

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Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

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1 Introduction

In the late 1980s, the government of Tanzania launched a program of reforms to reduce the role of the state in managing the economy and promote a greater role for the decisions of individual farmers, entrepreneurs, and consumers. The government removed extensive controls on consumer prices, liberalized agricultural markets, devalued the exchange rate (eventually allowing it to float), removed many import restrictions, lowered import tariffs, and closed or privatized a large majority of the state enterprises, which had been established in almost every sector of the economy.

In macroeconomic terms, the reforms have been relatively successful. After stagnation in the 1980s, the Tanzanian economy grew at 4-5 percent per year in the second half of the 1990s and 5-6 percent over the past few years. Budget deficits have been brought under control, and inflation has been reduced to less than 5 percent.

The impact of the economic reforms on standards of living remains controversial. Some observers argue that that the reforms have increased unemployment, widened the gap between the poor and the rich, and hurt farmers by removing price guarantees and input subsidies. Even many of those that believe the economic reforms have had a generally positive impact on Tanzanian standards of living doubt that the benefits have reached poor farmers in remote rural areas (see Eele et al., 2000).

The objective of this paper is to examine the trends in poverty and inequality over the 1990s. In particular, we address the following questions:

- Has poverty increased or decreased since the early 1990s, a period of extensive market liberalization?
- What types of households have gained or lost as a result of these changes?
- Have households in poor, remote areas been "left behind" other rural areas in terms of growth?

2 Data and methods

In the last five years, a new approach has been developed to estimate poverty for small areas (such as districts) by combining data from a household expenditure survey and a census (Hentschel et al, 2000; Elbers et al, 2003; Minot, 2000). The idea is to use the household survey to estimate the relationship between poverty and a set of household characteristics, and then apply this relationship to the same household characteristics in the census data. This method has been applied in a growing number of countries (Henninger and Snel, 2003).

This paper uses a new method for estimating trends in poverty in the medium term that draws from both the asset index approach and small-area estimation methods. We begin by selecting household characteristics that are available in both the 1991-92 Tanzania Household Budget Survey (HBS) and the four Demographic and Health Surveys (DHS) carried out in Tanzania. These variables include the size and composition of the household, the education of household members, the sex of the head of household, housing characteristics, source of water, type of toilet, whether or not the house has electricity, and ownership of consumer durables such as radios, bicycles, and motor vehicles.

In Stage 1, we use the HBS to estimate per capita expenditure (y_i) as a function of these household characteristics (X_i^{HBS}). We follow the convention of using a semi-log functional form:

$$\ln(y_i) = X_i^{HBS}\beta + e_i \quad (1)$$

In Stage 2, the regression coefficients are applied to the same household characteristics in the Demographic and Health Surveys (DHS) carried out in 1991/92, 1996, 1999, and 2003 (see Table 1)[1]. Hentschel et al. (2000) show that the expected value of the probability that household i is poor (P_i) can be described as follows:

$$E\left(P_i \mid X_i^{DHS}, \beta, \sigma\right) = \Phi\left[\frac{\ln(z) - X_i^{DHS}\beta}{\sigma}\right] \quad (2)$$

and that a consistent estimate of the incidence of poverty for a set of households is simply the average of these household probabilities[2]. Although we lose the spatial resolution available from the census data, we gain a temporal dimensions from the fact that DHS surveys have been carried out four times in Tanzania. Furthermore, the surveys employed almost identical questions for the variables used in this analysis and very similar sampling methods.

An important assumption of this approach is that the model for predicting income based on household characteristics is valid over the range of years covered by the DHS surveys. In other words, we assume that the regression coefficients (β) are constant over the 1990s and that any changes in poverty are reflected in changes in the household characteristics (X_i).

[1] Although the 1999 and 2003 surveys have different titles, they were carried out by the same organization (Macro International) and follow the same standards. For convenience, we refer to all four as DHS surveys.

[2] Typically, this is a weighted average, taking into account the sampling weights (if any) and the size of the households, giving an estimate of the headcount poverty rates.

In what could be called Stage 3 of the analysis, the results from Stage 2 are then combined with geographic information system (GIS) data to explore the relationship between rural poverty and various types of market access in Tanzania and whether this relationship changed over the 1990s.

3 Results

The results are divided into three sections. First, we describe the regression analysis used to predict per capita expenditure using the HBS. Then, we present estimates of Tanzanian poverty between 1991 and 2003 derived from applying the regression models to the household characteristics in the four DHSs. Finally, these poverty estimates are used to analyze econometrically the relationship between poverty and market access.

3.1 Predictors of household welfare

In this section, we describe the estimation of the logarithm of per capita expenditure as a function of household characteristics, using data from the 1991/92 HBS (see equation (1)). In selecting explanatory variables, we are limited to those that are also available in the four DHSs. A Chow test indicates that the coefficients in the four strata in the HBS (Dar es Salaam, large towns, small towns, and rural areas) are significantly different from each other, so separate regressions were run for each stratum. Ordinary least squares (OLS) models were used to carry out diagnostic tests. Then, the four models were run using the *svyregress* command in Stata which takes into account the stratification and clustering of the HBS sample and, as mentioned above, calculates Huber/White/sandwich standard errors. Individual variables and sets of dummy variables were removed if they were not statistically significant at the p=0.20 level. We are not concerned about likely endogeneity of some of the explanatory variables (e.g. ownership of consumer goods) because we are only interested in generating a model to predict per capita expenditure.

Table 2 gives the results of the final version of the models. All of the statistically significant variables have the expected sign and some are significant in all four models. The overall fit of the four models is relatively good, with the value of R^2 ranging from 0.42 to 0.53. This is toward the upper range of similar models from poverty mapping analyses in other countries (see Henninger and Snel, 2003).

3.2 Poverty estimates for different types of households

The regression equations described in the previous section are then applied to the same household characteristics in the Tanzanian Demographic and Health Surveys (DHSs) of 1991/92, 1996, 1999, and 2003. The result is an estimate of the per capita expenditure for each household in the four DHS surveys. This estimate is transformed into the probability that the household is poor using equation (2) and averaged over groups of households to obtain estimates of the incidence of poverty. Throughout this paper, the "poverty rate" refers to the share or percentage of the population living below the poverty line.

Figure 1 presents the overall poverty estimates for each year of the DHS. The most notable finding is that the overall poverty rate in mainland Tanzania has fallen almost 9 percentage points, from almost 47 percent in 1991/92 to 38 percent in 2003 (see **Error! Reference source not found.**). This contrasts with the 2.9 percent decline in poverty estimated by comparing the 1991-92 and 2000-01 Household Budget Surveys. How credible is our finding? We examine four possible questions regarding the plausibility of these findings.

First, are the estimated poverty rates for 1991/92 consistent with the measured poverty rates from the 1991/92 HBS? Our poverty estimate for 1991/92 is 46.8 percent, which is less than 0.5 percentage points from the poverty rate (47.1 percent) estimated directly from the

1991/92 HBS (NBS and OPM, 2000). Stratum-level results are within 3 percentage points of the HBS results.

Second, is the change in poverty statistically significant? Using formulas developed by Hentschel et al (2000), we calculate that the standard errors of the poverty estimates. Based on these standard errors, the change in overall poverty in mainland Tanzania between 1991/92 and 2003 is statistically significant at the 1% confidence level.

Third, is the decline in poverty derived from improvements in a small number of household indicators or a broad set of indicators? The latter would be a more credible sign of improved living conditions. Of the 20 indicators with an unambiguous relationship with poverty, only one suggests deteriorating living conditions, three show no change, and 16 suggest improved living conditions. Thus, our estimate of poverty reduction in Tanzania is based on improvement in a broad range of household indicators.

Fourth, are these results consistent with the trends in GDP per capita over the same period? Per capita GDP growth between 1991-92 and 2003 was 1.47 percent, with much of the growth occurring since 2000. Two recent studies have estimated the elasticity of poverty with respect to per capita GDP growth to be about -1.7 (Chen and Ravallion, 2001; AFD et al., 2005). This would imply a 12-percentage-point decline in Tanzanian poverty over this period. Our estimate of a 9-percentage-point decline in poverty is certainly not exagerated given GDP growth in Tanzania.

According to our analysis, poverty declined 7.2 percentage points in urban areas and 7.9 percentage points in rural areas. This contradicts the widespread view that the benefits of

growth have been concentrated in urban areas. The increase in the share of the population living in urban areas contributed to poverty reduction, in addition to the poverty reduction within urban and rural areas.

Interestingly, the poverty reduction in urban areas does not come from gains in Dar es Salaam, where poverty was essentially unchanged over the period under consideration. Rather the urban poverty reduction is due to declines in poverty in small towns, along with migration toward larger centers (see Figure 2). One hypothesis is that during the 1990s, economic reforms resulted in a more geographically decentralized pattern of growth, now that the public sector and state enterprises (most of which were based in Dar es Salaam) play a smaller role in economic decisions.

Figure 3 shows the poverty trends by the educational level of the head of household. The results confirm the strong negative relationship between education and poverty. The results also suggest that the gains in poverty reduction have been greater among less educated households. The poverty reduction among households with a head with no education or some primary schooling was 4 and 9 percentage points, respectively. However, households in which the head had completed primary school had virtually unchanged poverty rates.

3.3 Relationship between market access and poverty

Are remote rural households left behind by economic growth? We define "remote" in terms of market access, that is distance or travel time to roads or urban centers. The focus is on *rural* poverty because urban areas have, almost by definition, good market access. This analysis is limited to the DHS surveys in 1991/92, 1996, and 1999 because the geo-reference

data for the 2003 survey was not available at the time of the analysis. We use six measures of market access:

- Straight-line distance to a primary or secondary road
- Straight-line distance to a regional center
- Travel time to Dar es Salaam
- Travel time to the closest of eight large towns with municipality status,
- Travel time to the closest of 11 secondary towns,
- Travel time to the closest of 22 tertiary towns.

As an example of the patterns formed by these variables, Figure 4 shows the travel time to the closest secondary town.

To examine these relationships, we run six regression models estimating the probability that a household is poor as a function of each of the six types of market accesss. Each model combines the data from 1991-92 and 1999 with seemingly unrelated regression (SUR) analysis, which allows us to test the statistical significance of any changes in the market access coefficient between 1991-92 and 1999[3]. The hypothesis that remote rural areas are poorer than areas with better market access would be confirmed by positive coefficients, and the hypothesis that remote rural areas have lost more (or gained less) than rural areas with better market access would be indicated by a statistically significant *increase* in the market access coefficient.

[3] This procedure is implemented with the *suest* command in Stata, which calculates Huber/White/sandwich estimates of the standard errors, which are heteroskedasticity consistent and take into account the stratification and clustering in the data.

The results, shown in Table 3, reveal that the market access coefficient are statistically significant at least at the 10 percent level in most cases[4], but they explain a very small proportion (1-2 percent) of the variation in rural poverty. Remote rural areas are poorer than rural areas with better market access, but the difference is not large. For example, the lowest and highest quartile of travel time to a secondary town have average travel times of 65 and 497 minutes, respectively. The model predict an interquartile difference in the headcount poverty rate of just 7 percentage points.

Furthermore, the difference between the 1991-92 coefficient and the 1999 coefficient is not statistically significant at the 5 percent level for any of the six measures of market access (in one case, it is significant at the 10 percent level but the coefficient *decreased* over the period). Thus, although there is evidence of a weak positive relationship between poverty and market access, there is no evidence that remote areas have gained less in terms of poverty reduction over the period from 1991-92 to 1999.

4 Conclusions

In Tanzania, as in many other developing countries, the conventional wisdom is that economic reforms may have stimulated economic growth, but the benefits of this growth have been uneven, favoring urban households and farmers with good market access. This idea, although quite plausible, has rarely been tested. In this paper, we develop a new approach to measuring trends in poverty and apply it to Tanzania in order to explore the distributional aspects of economic growth and the relationship between rural poverty and market access.

[4] Of the twelve coefficients, six are significant at the 5 percent level and two more at the 10 percent level.

According to this analysis, between 1991/92 and 2003, the incidence of poverty fell by almost 9 percentage points. The 9 percentage point decline is statistically significant, it is supported by improvement in a broad range of indicators of living conditions, and it is roughly what would be expected based on GDP growth.

The degree of poverty reduction was similar between rural and urban areas (7-8 percentage points), though some poverty reduction was due to rural-urban migration. Poverty did not decline in Dar es Salaam, so all of the gains were due to poverty reduction in smaller cities and in rural areas (and migration). The gains in poverty reduction were greater among less educated households than among more educated households. This suggests that economic growth has not favored the educated elite over others.

In order to look at the relationship between poverty and remoteness, we use GIS analysis to define six measures of market access. We find that rural poverty is associated with remoteness, but the relationship is surprisingly weak and it varies depending on the definition used. Although poverty is somewhat higher in more remote rural areas, we find no evidence that remote areas are being "left behind" in the sense of gaining less from economic growth than other areas.

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Table 1. Household surveys used in analysis

Year	Name	Sample size (households)	Survey collected expenditure data
1991-92	Household Budget Survey	4,750	Yes
1991-92	Demographic and Health Survey	8,327	No
1996	Demographic and Health Survey	7,969	No
1999	Reproductive and Child Health Survey	3,615	No
2003	HIV/AIDS Indicator Survey	6,499	No

Table 2. Regression models of per capita expenditure based on the 1991/92 HBS

	Dar es Salaam		Large towns		Small towns		Rural areas	
	N = 1107		N = 794		N = 664		N = 2171	
	R^2 = 0.5034		R^2 = 0.4279		R^2 = 0.5268		R^2 = 0.4178	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Household size	-0.25492	-8.91***	-0.224030	-2.79***	-0.252674	-5.74***	-0.159395	-10.27***
Households size squared	0.00972	4.54***	0.011910	2.20**	0.011629	4.38***	0.004886	6.59***
% males under 5 yrs	0.00539	3.30***	0.001294	0.32	0.002042	0.64	0.003574	1.91*
% females under 5 yrs	0.00555	3.02***	0.000240	0.07	0.001382	0.33	0.001045	0.75
% males 5-15 yrs	-0.00012	-0.09	-0.012338	-1.73*	-0.002905	-0.93	-0.001735	-1.23
% females 5-15 yrs	0.00028	0.25	-0.003835	-1.1	-0.005580	-2.38**	-0.001598	-1.03
% males 16-30 yrs	-0.00059	-0.66	-0.002234	-1.18	-0.000363	-0.17	0.000734	0.71
% females 16-30 yrs	0.00092	1.26	-0.003077	-1.54	-0.002251	-1.14	0.000172	0.12
% females 31-55 yrs	-0.00030	-0.22	-0.002818	-2.67***	-0.002908	-1.23	-0.000399	-0.25
% males over 55 yrs	0.00243	1.15	-0.001686	-0.44	-0.005041	-2.15**	0.003162	2.48**
% females over 55 yrs	0.00233	1.24	-0.001034	-0.42	-0.001228	-0.36	0.000748	0.54
Female head								
Age of head	-0.00357	-2.61**	-0.001256	-0.53				
Head has some primary	0.01550	0.24	0.279551	2.34**	0.243244	2.69***	0.086257	2.39**
Head finished primary school	-0.10593	-1.32	0.527486	3.57***	0.391461	3.04***	-0.012855	-0.18
Head has some second.	0.04493	0.57	0.237551	1.48	0.386034	3.87***	0.230773	1.93*
Head finished upper sec	0.19154	2.51**	0.321873	2.24**	0.401873	3.32***	0.042039	0.65
Spouse has some primary							0.052134	1.52
Spouse finished primary							0.358541	2.64***
Spouse has some second							0.177469	1.11

Spouse finished upper sec							-0.019249	-0.33
Floor of house made of earth	-0.17159	-3.99***	-0.288577	-2.67***			-0.205615	-3.76***
Water from indoor pipe	0.28188	4.82***			0.193219	1.05		
Water from outdoor pipe					0.148876	1.44		
Water from well					-0.154783	-1.19		
Flush toilet					0.246282	1.44		
Latrine					0.240432	2.24**		
House has electricity							0.121323	1.51
Radio ownership	0.08130	1.87	0.127064	1.49	0.304930	2.90**	0.293940	7.62***
Television ownership	0.23464	2.02**	0.345648	1.22				
Refrigerator ownership	0.30908	5.88***	0.191551	1.80*	0.368204	2.57**	0.426404	1.48
Motorbike ownership							0.149271	1.50
Car ownership	0.33038	2.75***	0.434943	2.45**	0.263515	1.66	0.240083	1.97**
Constant	10.99431	85.61***	10.56714	38.72***	9.823588	29.81***	-0.34683	-1.81*

Source: 1991 Tanzanian HBS

* = significant at the 10 percent level, ** = significant at the 5 percent level, *** = significant at the 1 percent level

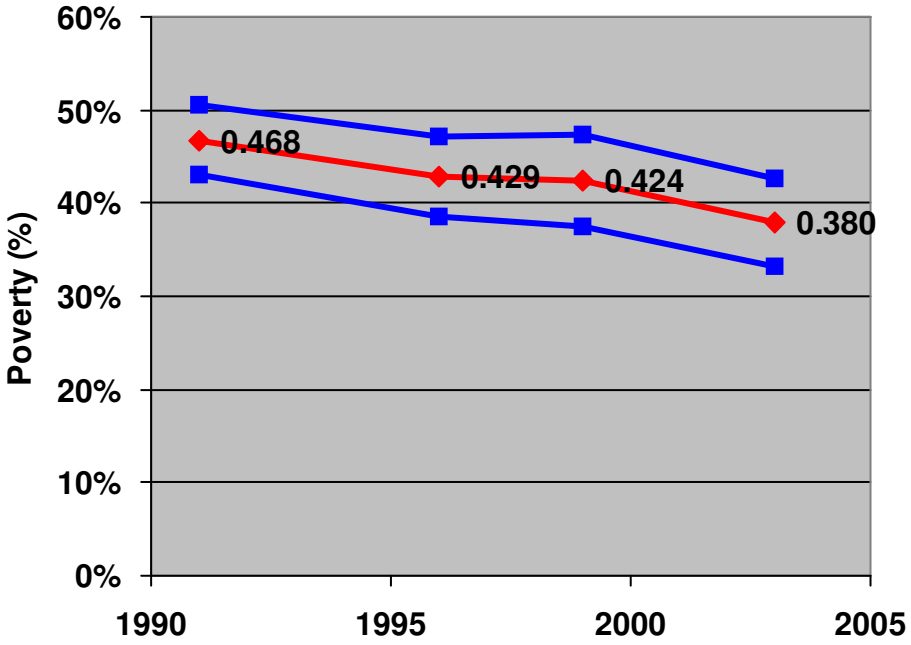
Note: Dependent variable is log of per capita expenditure. Coefficients of regional dummy variables omitted to save space.

Table 3. Relationship between rural poverty and each measure of market access

	Year	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	1991-92	N = 5668	N = 5668	N = 5668	N = 5668	N = 5668	N = 5668
		R^2 = 0.002	R^2 =0.023	R^2 = 0.008	R^2 = 0.017	R^2 = 0.023	R^2 = 0.002
	1999	N = 1813	N = 1813	N = 1813	N = 1813	N = 1813	N = 1813
		R^2 = 0.012	R^2 =0.018	R^2 =0.007	R^2 =0.014	R^2 =0.023	R^2 =0.008
Constant	1991-92	.47347***	.40451***	.41783***	.42057***	.41822***	.45270***
	1999	.43104***	.35920***	.36697***	.37534***	.36543***	.38554***
Distance to	1991-92	-.00033					
nearest road	1999	-.00089**					
Distance to	1991-92		.00080***				
regional center	1999		.00070*				
Travel time to Dar	1991-92			.00004**			
es Salaam	1999			.00004			
Travel time to	1991-92				.00009***		
primary town	1999				.00001*		
Travel time to	1991-92					.00016***	
secondary town	1999					.00015***	
Travel time to	1991-92						.00006
tertiary town	1999						.00012
Test of hypothesis	F-statistic	F = 3.05	F = 0.08	F=0.01	F=0.07	F=0.00	F=0.61
that $\beta_{1991\text{-}92} = \beta_{1999}$	Prob	p = .0819	p = .7795	p=.9185	p= 0.7852	p=0.9745	p=0.4340

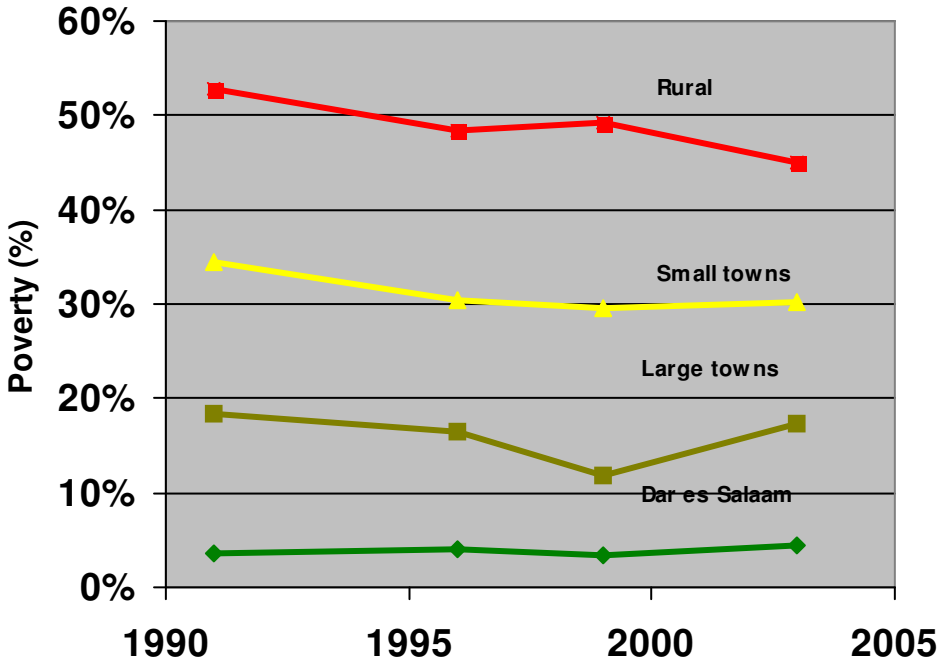
Source: Seemingly unrelated regression analysis of rural poverty rates as a function of six measures of market access defined at the cluster-level.

Figure 1. Poverty trends in mainland Tanzania (with 95% confidence intervals)



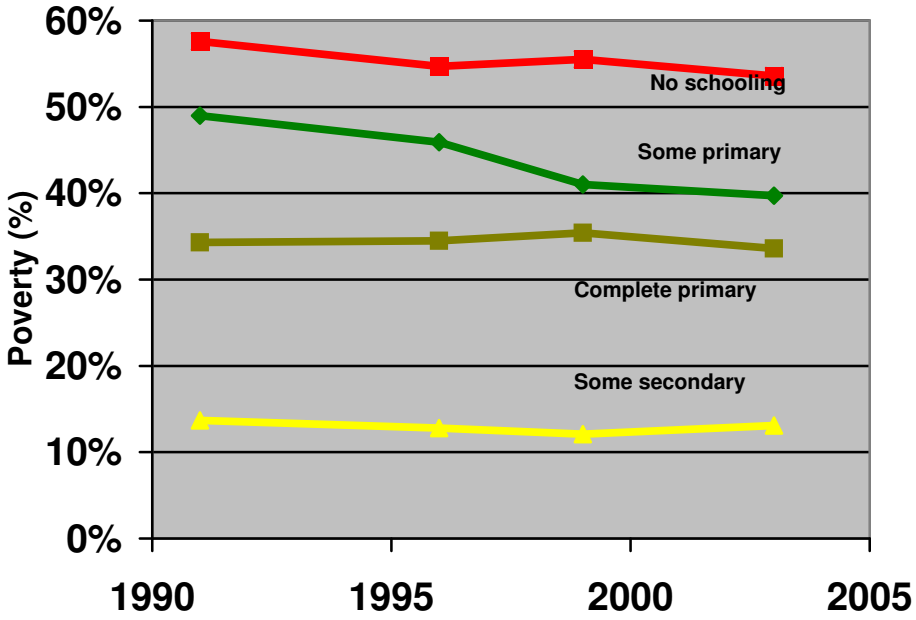
Source: Analysis of HBS and four DHS surveys.

Figure 2. Poverty trends in urban and rural areas



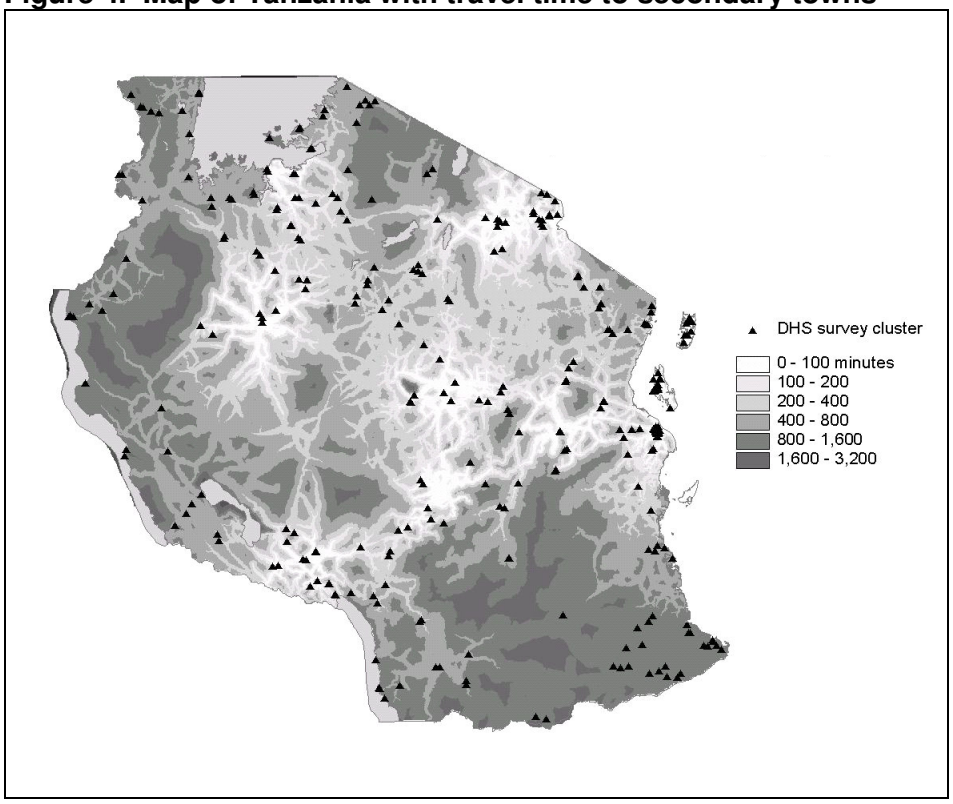
Source: Analysis of HBS and four DHS surveys.

Figure 3. Poverty trends by education of head of household



Source: Analysis of HBS and four DHS surveys.

Figure 4. Map of Tanzania with travel time to secondary towns



Source: Generated from GIS data on roads and population centers.