Food Security and Malnutrition in Tanzania

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Abstract

The primary objective of this study is to evaluate the impact of income, capital, natural shocks and other individual and household attributes on food security and stunting. A recursive bivariate probit models is estimated using household survey data from Tanzania. Results show that factors such as ownership of cattle and education help in reducing food insecurity. On the other hand, more targeted programs to educate mothers and increase awareness of health and sanitary practices are likely to be more effective in reducing the incidence of stunting.

Introduction

This study examines the role of household income, capital endowments, natural shocks, and other factors on food security and stunting in Tanzania. Ensuring a consistent supply of safe, nutritious, and gratifying food to a widely dispersed and diverse populace is one of the complex challenges faced by humanity. Despite the substantial improvements in food production and distribution technologies, a significant increase in per capita food supply, and a concerted effort from various national and international agencies to alleviate poverty and enhance food security for many years, one in eight people are still suffering from chronic hunger (FAO, 2013, p 8).

Food insecurity has multiple dimensions and may manifest in many ways - malnutrition, starvation, chronic hunger, wasting, and stunting (Misselhorn, 2005; Tanumihardjo, *et al.*, 2007; Barrett, 2010). Recent studies show that even a few sporadic occurrences of food insecurity can seriously damage health (Kirkpatrick, *et al.*, 2010; Van Den Berg, *et al.*, 2012). Moreover, the impact of prolonged hunger on infants and kids would be much more severe than on adults as it can cause devastating physical, emotional, and mental damages (Binagwaho, *et al.*, 2011). Furthermore, this hunger induced health and cognitive development problems are irreversible and may lead to poor behavioral, academic, and economic outcomes in later life of affected child (Weinreb, *et al.*, 2002).

Recent studies show that a wide range of factors including household income (Coleman-Jensen, *et al.*, 2013), agricultural commercialization, market shocks (Yamano, *et al.*, 2005; D'souza and Jolliffe, 2013), farm production (Wheeler and Von Braun, 2013), initial endowment of production input (Hagos and Holden, 2013), quality of human (Knueppel, *et al.*, 2010; Seligman, *et al.*, 2010), social (Gundersen, *et al.*, 2011), and natural (Di Falco and Chavas, 2009; Sasson, 2012) capitals play a critical role in determining the level of food security and health outcomes. Since each society or region is endowed with a different combination of these resources, it is hard to find a common set of factors that are equally effective in achieving food security under all possible scenarios (Wheeler and Von Braun, 2013). Therefore, it is important to evaluate each case empirically to understand the situation and identify policy instruments that are likely to be most effective in enhancing food security and nutritional status of the population. In this light, this study aims to evaluate food security and its impact on stunting in Tanzania.

Initial results indicate that factors such as household income, access to financial and natural capital, and other socioeconomic factors pay a critical role in determining household food security. Moreover, factors such as household income, mother's education, quality of health, sanitation, and age, and the level of household food security significantly affect nutritional outcomes of young children who are less than five years old.

Foods Security and Child Health in Tanzania

Tanzania is one of the least developed sub-Saharan African country where nearly thirty percent of the population falls under the nationally recognized poverty line. Moreover, about 29 percent of the households are classified as highly food deficit (World Food Program 2013). In terms of per capita calorie intake, one in four people consume less than recommended levels. Moreover,

the overall diet quality is poor and primarily comes from the starchy foods such as maize, cassava, rice, wheat, and sweet potatoes.

Agriculture is the major source of income for the most low-income household. Since most of the farm production is rainfed, Tanzanian farmers are highly susceptible to increasing variability in weather conditions – i.e., frequent droughts and occasional flooding (Nelson, 2009 #142938). These extreme weather events have substantially impacted the domestic food production and supply (see Table 1 on the next page). These frequent weather shocks create a shortage in the food supply and negatively affect the nutritional status of weak and vulnerable populations including young children. For instance, the incidence of wasting, underweight, and stunting among less than five years old children in 2010 was about 4.9, 16.2 and 42.5 percent respectively.

Table 1. Incidence of Unemployment and Food Shortage in Tanzania

Description	**2007-09**	**2008-10**	**2009-11**	**2010-12**	**2011-13**
Undernourishment (%)	35.7	36.5	35.5	34.7	33.0
Food Deficit (kCal)	246	253	243	236	221
Food Inadequacy (%)	43.2	44.0	43.0	42.2	40.5

Source: FAOSTAT, http://www.fao.org/economic/ess/ess-fs/ess-fadata/en

Empirical Model

Malnutrition, particularly among less than five years old child, is primarily caused by a combination of factors including poor diet, health, sanitation, and care (Alderman, et al., 2006, Deolalikar, 1996, Yamano, et al., 2005). An individual's access to these health inputs depends on various environmental and socioeconomic factors including household income, capital endowments, and another individual, household, and community attributes. Accounting for these factors, we specify the child nutritional outcome function as follows:

$$Stn = b_o + b_1Y + b_2C + b_3I + b_4HH + b_5Com + b_6H + b_7S + b_8FS + e_i \qquad (1)$$

where *Stn*=a dummy variable that takes a value of one if height-for-age Z-score is less than -2 and zero otherwise, *Y*=total household income, *C*=human and animal capital endowments (1. father's eduction=number of school years, 2. mother's education=number of school years, and 3. number of cattle owned by the household), *I*=individual attributes (1. age in month and 2. gender of the child), HH=household attributes (1. fhead=a dummy variable that takes a value of one if the household head is female and zero otherwise) *Com*=Community attributes (1. rain= a dummy variable that takes a value of one if the household is in bimodal rainfall region and zero otherwise and 2. nine regional dummies), *H*=is a health dummy that takes a value of one if the child had diarrhea and zero otherwise, *S*=sanitation that takes values from 0-3 based on whether the household has safe water supply, toilets, and dwelling facilities, FS=a dummy that takes the value of one if the household is food secure and zero otherwise, and e_i is a random error term.

The reduced-form household food security model is generally specified as a function of household income, capital endowments, access to financial resources, market and natural shocks, and other household and community attributes. Since income plays a crucial role in providing access to food, we exclude from the model. Since animal are often used as farm production resources, animal capital should reflect the impact of income on food security.

$$FS = a_o + a_1C + a_2HH + a_3Com + a_4CA + a_5SK + a_{76}DF + v_i \qquad (2)$$

where *FS*=a dummy variable that takes a value of one if the household is food secure and zero otherwise, *C*=human and animal capital endowments (1. father's eduction=number of school years, 2. mother's education=number of school years, and 3. number of cattle owned by the household), HH=household attributes (1. fhead=a dummy variable that takes a value of one if the

household head is female and zero otherwise) *Com*=Community attributes (1. rain= a dummy variable that takes a value of one if the household is in bimodal rainfall region and zero otherwise, 2. rural=a dummy that takes a value of one if the household is in rural area and zero otherwise, and 3. nine regional dummies), *CA*=is a credit access dummy that takes a value of one if the household is a member of a savings banks and zero otherwise, *SK*=are agricultural and market shock dummies, *DF*=is a family shock variable that takes a value of one if there was a recent death in the family and zero otherwise, and v_i is a random error term.

Since food security is expected to have a significant effect on child nutrition outcome, the food security and stunting equations are estimated as recursive bivariate probit model (Greene, 1998 #142937). The data used in this study comes from the Tanzania National Panel Survey conducted in 2010-2011. The basic statistics of the variable included in the model are reported in Table 2. The summary statistics show that 45 percent of the sample households are food insecure, and about 35 percent of less than five-year-old children are stunted. On average, mMothers (4.6 years) are slightly more educated than fathers (4.3 years). About 18 percent of the households are headed by females and about 36 percent of the household are in a region with two rainy seasons.

Empirical Results

The estimated results for both food security (equation 1) and stunting (equation 2) are reported in Table 1. Since the dependent variables are defined as food insecurity and stunting, coefficient signs should be interpreted accordingly (i.e., a negative impact of animal capital on food insecurity would imply positive impact on food security).

As expected, ownership of cattle has significantly positive impact on food security. Similarly, the impact of human capital (number of schooling years of father and mother) has significantly positive impact on food security. Moreover, households in the rural area, bimodal rainfall regions, and headed by females are likely to be more food insecure than others.

The results from the stunting model show that household income, bimodal rainy season, female household head, education of mother, and better sanitary conditions help in reducing stunting. The gender variable coefficient is also negative implying that girls are more likely to be stunted than boys in Tanzania – a clear indication of gender disparity in nutrition outcome. On the other hand, the incidence of stunting increases as the age of the child in months increases. Moreover, the impact of food insecurity on stunting is significantly positive implying that food insecurity increases the incidence of stunting among children younger than five years old.

Conclusions and Recommendations

We examined the impact of income, capital, education, credit, and other factors household and community factors on food security and child health. Results show that while both father's and mother's education helps in reducing food insecurity, only mother's education has significantly positive impact in child's nutrition outcome. These results are consistent with previous studies.

The bimodal rainy season variable also has opposite but interesting impact on food security and nutritional outcomes. While it has positive impact on food insecurity, it has negative impact on stunting implying that bimodal rainy season may not help in enhancing food security as such but it helps in reducing the severe impact of food shortage by making it possible to produce food in both seasons.

The policy implication of these results is that while programs like income support and human capital formation through education can be effective in enhancing food security, more targeted programs to increase mother's education, promotion of health and sanitary practices are likely to be effective in reducing the incidence of stunting in Tanzania.

Table 2. Basic Statistics for Variables Included in the Model

Variable	Mean	Std. Deviation	Minimum	Maximum
Stunting	0.3477	0.4763	0	1
Food Insecurity	0.4510	0.4977	0	1
Income	11.4962	41.7023	0	1350
Number of Cattles Owned	17.0208	38.2378	0	615
Bimodal Rainy Season	0.3631	0.4810	0	1
Rural Area	0.7775	0.4160	0	1
Female Headed Household	0.1755	0.3804	0	1
Household Size	7.5795	5.1239	2	55
Father's Education	4.3964	3.7668	0	19
Mother's Education	4.6083	3.8724	0	28
Child's Age in Months	29.1468	17.5606	0	60
Gender of Child	1.5009	0.5001	1	2
Diarrhea	0.1471	0.3543	0	1
Sanitation	1.0057	0.7788	0	3
Member of Savings Cooperative	0.0739	0.2617	0	1
Agricultural Shock	0.9132	1.0762	0	5
Market Shock	0.9153	0.9634	0	3
Death in the Family	0.4543	0.5481	0	2
Regional Dummies				
Central	0.0524	0.2228	0	1
Lake	0.1561	0.3630	0	1
Western	0.1884	0.3911	0	1
North	0.1145	0.3184	0	1
East	0.0542	0.2264	0	1
South	0.1044	0.3059	0	1
Highland	0.1044	0.3059	0	1
Dar e Salam	0.1026	0.3035	0	1

Table 3. Bivariate Probit Model Results for Food Security and Stunting

	Food Security		Stunting	
Variable	Coefficient	t-Value	Coefficient	t-Value
Intercept	-0.37635***	-3.11	-0.40034***	-2.68
Household Income			-0.00179**	-2.49
Number of Cattles Owned	-0.01249***	-10.81		
Bimodal Rainy Season	0.46013***	4.41	-0.41919***	-3.98
Rural Area	0.33036***	4.75		
Female Headed Household	0.20912***	2.66	-0.26607***	-3.51
Father's Education	-0.03569***	-4.13	-0.011	-1.24
Mother's Education	-0.01672**	-2.44	-0.01670**	-2.28
Member of Savings Cooperative	-0.027	-0.30		
Agricultural Shock	-0.008	-0.30		
Market Shock	-0.022	-0.73		
Death in the Family	-0.065	-1.45		
Child's Age in Months			0.00540***	3.75
Gender of Child			-0.09462**	-2.01
Diarrhea			0.108	1.58
Sanitation			-0.07263**	-1.97
Regional Dummies				
Central	0.153	1.12	0.106	0.84
Lake	0.47595***	3.37	0.161	1.09
Western	0.46926***	4.48	-0.149	-1.50
North	0.014	0.10	0.233	1.58
East	-0.038	-0.28	0.077	0.58
South	0.32675***	3.07	0.058	0.55
Highland	0.013	0.12	0.031	0.30
Dar e Salam	0.56433***	4.84	-0.31664***	-2.74
Food Insecurity			0.86817***	4.24
ρ (1,2)|			-0.46779***	-3.48

***,**,* Denote statistically significant at one, five, and ten percent level.

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