Agricultural Growth, Poverty, and Nutrition in Tanzania

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ABSTRACT

Rapid economic growth has failed to significantly improve poverty and nutrition outcomes in Tanzania. This raises concerns over a decoupling of growth, poverty, and nutrition. We link recent production trends to household incomes and caloric availability using a dynamic computable general equilibrium and micro-level poverty and nutrition modules. Results indicate that the structure of economic growth—not the level—is currently constraining the rate of poverty reduction in Tanzania. Agricultural growth has been driven by larger-scale farmers that are less likely to be poor. Growth has further been concentrated in crops grown in only a few regions of the country. Slow expansion of food crops and livestock also explains the weak relationship between agricultural growth and nutrition outcomes. Additional model simulations find that accelerating agricultural growth, particularly in maize, greatly strengthens the growth–poverty relationship and enhances caloric availability at the household-level.

Keywords: *economic growth, poverty, nutrition, computable general equilibrium modeling, Tanzania*

1. INTRODUCTION AND CONTEXT

After a poor performance during the 1990s, the economy of Tanzania expanded rapidly since 2000. National gross domestic product (GDP) grew at 6.6 percent per year during 1998–2007, almost double the rate achieved during the preceding decade (MOFEA, 2008). Economic growth also appears to have been relatively broad-based. Although the newly established gold-mining sector recorded the highest growth rates during this period, the large agriculture and manufacturing sectors contributed the most to national growth.

However, despite strong economic growth the national poverty headcount rate fell only 2.1 percentage points from 35.7 percent in 2001 to 33.6 percent in 2007, with equally modest declines in rural and urban areas (World Bank, 2009). This is comparable to the decline in poverty between 1992 and 2001 when growth was significantly lower (Treichel, 2005). Economic growth therefore, whether moderate or strong, appears to have had little effect on poverty in Tanzania. Moreover, its impact on poverty seems to have become weaker over time. Nutrition outcomes have been equally disappointing in Tanzania: although the share of underweight children under the age of five fell from 25 to 17 percent between 1999 and 2005, the rate of child stunting—an indication of chronic malnutrition—has remained virtually unchanged at about 40 percent (Alderman et al., 2006; World Bank, 2008). Estimates from the two latest household surveys in Tanzania further show that the share of people who had insufficient calories available to them fell only slightly, from around 25 percent in 2001 to 23.5 percent in 2007 (measured at 2,550 kilocalories per day per adult equivalent; World Bank, 2009).

Tanzania's development outcomes over the last decade raise several questions. The first concerns the level and structure of the current economic growth path and whether this is consistent with the slow decline in national poverty and only modest improvement in caloric availability? In this regard, evidence shows that growth generally reduces poverty (see Dollar and Kraay, 2002), but the extent to which this happens depends both on the impact growth has on average incomes *and* on inequality (i.e., its incidence) (Kakwani, 1993). A more pointed analysis of growth and poverty therefore requires a shift in focus toward the relationship between *sectoral* growth and poverty, and also an understanding of how the poor are linked to various sectors or sub-sectors via consumption and employment (Ravallion and Datt, 1999; Mellor, 1999).

Growth, insofar as it raises household incomes, is also expected to increase the availability of calories. Surveys by Strauss and Thomas (1995) and Hoddinott et al. (2000) that calorie-income elasticities in developing countries mostly range from 0.3–0.5. For Tanzania, Abdulai and Aubert (2004) estimate a calorie–income elasticity ranging from 0.49–0.53. However, nonparametric analyses suggest strong nonlinearities in this relationship, with households at the lower end of the income distribution typically displaying higher calorie–income elasticities than wealthier households. This is also true in Tanzania (see Figure 1), where the calorie-income curve becomes noticeably flatter beyond the median per capita income level and above a daily caloric level of 2,550 kilocalories per adult equivalent.

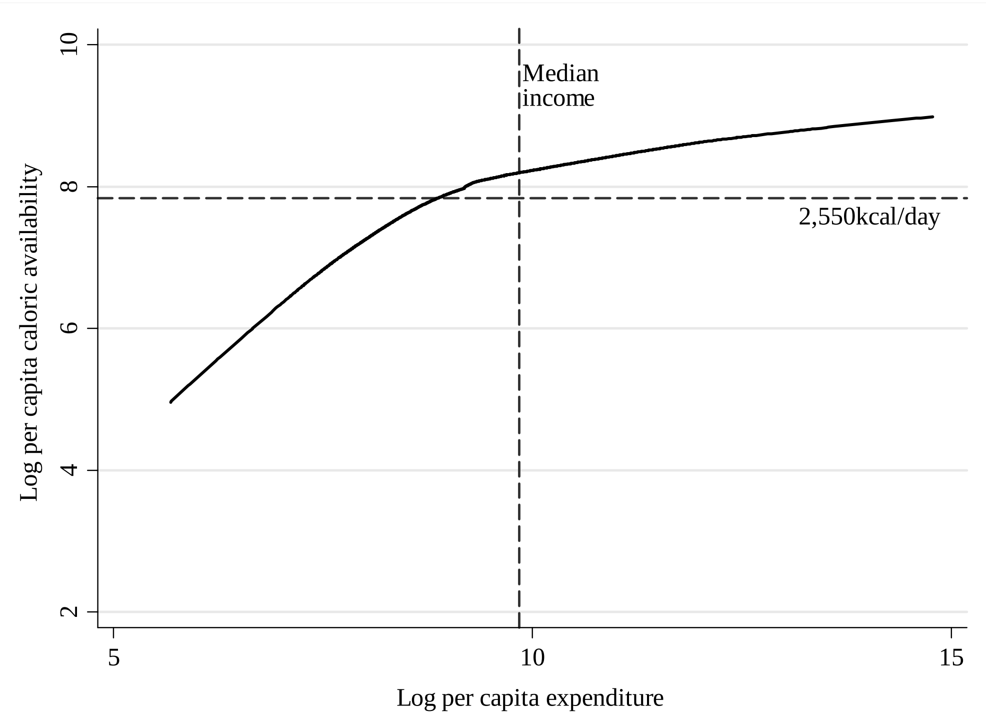

Figure 1. Nonparametric estimates of income–calorie curve for Tanzania (2001)

Source: Authors' estimates using the HBS 2000/01 (NBS, 2002).

The above implies that just as the *structure* of growth matters for poverty, it also matters for nutrition insofar as it has implications for how growth affects incomes of households across the welfare spectrum. The agricultural sector is central in both these growth-poverty and growth-nutrition debates: the sector still contributes significantly to output and employment in developing countries, while the Asian green revolution serves as an example of how accelerated agricultural growth can greatly reduce poverty among small-scale farmers (Rosegrant and Hazell, 2000).

Higher household incomes also improve households' ability to pay for food. Food security, however, is not only about the ability to pay (demand-side), but also about the availability of food (supply-side). Increased agricultural (food) output is therefore important for caloric availability. Moreover, if increased production is achieved through increased agricultural productivity, producer prices and hence food prices will invariably decline, which is important for poor consumers that allocate a large share of their income to food purchases, and especially to food types with high calorie contents (Timmer, 2000).

Domestic food prices are therefore also central in the growth-nutrition debate. Table 1 compares calorie contents across different food types in Tanzania. It is evident from this that poorer households typically acquire more calories from those food types that represent a cheaper source of calories.

Table 1. Calorie contents, prices, and caloric availability across population groups

	Average calories per 100 gram serving (∗)	Mean price (Tsh) per 100 kilo-calories (†)	Average per capita caloric availability by population subgroups				
			Urban	Rural	Poor (‡)	Non-poor	All
Cereals	319	6.3	1412	1752	1390	1885	1687
Maize	*288*	*4.7*	*1069*	*1382*	*1112*	*1461*	*1322*
Sorghum & millet	*287*	*7.1*	*82*	*220*	*194*	*194*	*194*
Rice & wheat	*305*	*17.2*	*261*	*150*	*85*	*230*	*172*
Root crops	178	5.5	194	477	424	423	423
Pulses & oilseeds	443	10.9	395	308	196	411	325
Horticulture	49	19.8	141	197	106	240	186
Plantains & fruits	*68*	*8.6*	*97*	*162*	*78*	*197*	*149*
Vegetables	*43*	*65.2*	*45*	*35*	*27*	*43*	*37*
Livestock & processed meat	266	26.0	278	232	125	318	241
Sugar	222	13.2	215	106	50	178	127
Purchased meals (restaurants)	91	23.5	133	63	25	111	76
Other foods	231	33.9	168	82	44	135	98
Average/Total	*217*	*10.5*	*2938*	*3217*	*2358*	*3699*	*3163*

Source: Authors' calculations using HBS 2000/01 (NBS, 2002) and Lukmanji et al. (2008).
Notes: (*) Calorie estimates derived from Lukmanji et al. (2008). No consumption weights were applied in estimating average calorie contents. (†) National averages based on consumption data in HBS 2000/01.. (‡) The poverty line is the 40th percentile of per capita expenditure.

This brings us to a second question that we wish to answer in this study, namely what is the contribution of accelerated agricultural growth in reducing poverty and raising caloric availability? The analysis also hopes to shed some light on a third pertinent question, namely that of which agricultural subsectors are most effective at achieving national growth, poverty, and nutrition objectives?

We address these questions using a regionalized and dynamic computable general equilibrium (DCGE) model. Poverty and nutrition microsimulation modules are linked sequentially to the DCGE model to measure how changes in economic growth affect poverty and caloric availability at the household level. Section 2 briefly describes the DCGE and micro-level poverty and nutrition modules developed for this study, while in section 3 the DCGE model is used to simulate the economywide outcomes under Tanzania's current growth path as well as under a hypothetical accelerated and broad-based agricultural growth path. Based on these findings, agricultural subsectors that are most effective at generating economic growth, reducing income poverty, and improving caloric availability in households are identified. Section 4 summarizes the findings and highlights their policy implications.

2. MODELING GROWTH, POVERTY, AND HOUSEHOLD NUTRITION

General Equilibrium Model and Data

The general equilibrium model used in this study is recursive dynamic and therefore includes a static *within-period* component as well as a dynamic *between-period* component. In the static component producers maximize profits subject to a constant elasticity of substitution (CES) production function, which allows for factor substitution based on relative factor prices. Intermediate demand is determined by Leontief fixed technology coefficients. All factors are assumed to be fully employed, and capital is immobile across sectors. Factor incomes are distributed to households using fixed income shares based on households' initial factor endowments. Households maximize a Stone–Geary utility function (linear expenditure system). Income elasticities were econometrically estimated using the Household Budget Survey (HBS) 2000/01 (NBS 2002). The household factor income shares and income (demand) elasticities are important in determining poverty and nutrition outcomes in the model (see below).

International trade is captured by allowing production and consumption to shift imperfectly between domestic and foreign markets, depending on the relative prices of imports, exports, and domestic goods. Since Tanzania's economy is small, world prices are assumed to be fixed, and the current account balance is maintained by a flexible real exchange rate. The various other macroeconomic constraints are also maintained; e.g., savings are collected in a national savings pool and used to finance investment demand; prices equilibrate demand and supply in national product markets; and a flexible government budget deficit ensures that revenues match outlays.

In the dynamic component various parameters are adjusted over time to reflect demographic and economic changes, in this instance for the period 2007–2015. These include changes in land and labor supply, capital accumulation, and technical change. New capital from past investment is allocated to sectors according to profit rate differentials under a *putty-clay* specification. For a more general model discussion, the reader is referred to Löfgren et al. (2001), while Pauw and Thurlow (2010) provide further details on the Tanzania model used here.

The model's variables and parameters are calibrated to observed data from a regional social accounting matrix (SAM) that captures the initial equilibrium structure of the Tanzanian economy in 2007. The full model identifies 58 sectors, including 26 agricultural, 22 manufacturing (of which 10 in agroprocessing), and 10 services sectors. Agriculture is further disaggregated across 20 subnational regions representing agro-ecological zones in Tanzania. Households are disaggregated across rural/urban and farm/nonfarm groups and by per capita expenditure quintiles. Farm households are further split across the 20 subnational regions, thus giving a total of 110 household groupings in the full DCGE model. Labor markets are segmented across four skill groups, including illiterate/uneducated workers, workers with primary education, workers with some secondary schooling, and workers with secondary or higher schooling. Agricultural land and livestock capital in each region is further disaggregated across small-scale and large-scale farms.

Poverty and Nutrition Modules

Each of the approximately 22,000 households questioned in HBS 2000/01 are linked top-down to their corresponding representative household in the DCGE model. This permits an evaluation of changes in poverty and nutrition (i.e., caloric availability) at the household level. While this approach to micro-level modeling assumes constant within-group income distributions, it still permits a more nuanced interpretation of income/nutrition changes within household groups than is possible with a CGE model alone.

The *poverty module* applies percentage changes in representative households' real consumption levels of each expenditure item to the corresponding individual households in the survey. Thus, for each simulation, a new per capita expenditure level is estimated for individuals (income is assumed to be distributed uniformly among household members), which then serves as a welfare measure in standard poverty analysis. For our analysis we assume a per capita poverty line equal to the 40th percentile of the per capita expenditure.

The *nutrition module* is similar to the poverty module in that consumption changes in the DCGE model are linked top-down to micro-level model. The nutrition module, however, measures changes in consumption quantities (as opposed to values). Also, whereas the poverty module considers changes in food and nonfood expenditures, the nutrition module only considers demand for food products. The CGE model results are then used to calculate changes in caloric availability for each household in the survey. Caloric contents for standard 100 gram or 100 milliliter portions of different food types are obtained from Lukmanji et al. (2008) (see Table 1) and applied to consumption quantities derived from or reported in the HBS 2000/01.

A comparison of caloric availability levels against a measure of the daily energy requirement of each household reveals which households and their members are *calorie deficient*. Following the World Bank (2009) study for Tanzania, a calorie line of 2,550 kilocalories per male adult aged 19–59 is used. This line is adjusted using the age and gender equivalence scales proposed in UNU, WHO, and FAO (2004). The size and demographic structure of households therefore determine the minimum amount of calories required by each household.

The estimation of caloric availability on the basis of household expenditure surveys (as opposed to nutrition surveys) has various limitations. Incorrect reporting may, among other things, relate to incorrect valuation of goods consumed, incorrect estimation of weight or volume measurements, and purchased foods not necessarily being consumed by household members themselves (see detailed discussion in Smith and Subandoro, 2007). Various consistency checks were performed to identify outliers in the food consumption data, and, where necessary, new caloric availability levels were imputed.

Simulations

The simulations evaluate growth, poverty and nutrition outcomes under current and accelerated agricultural growth scenarios. Agricultural production targets in the simulations are achieved by increasing the rate of technical change in a particular subsector. This increases production, as well as factor demand and returns depending on relative factor intensities of production.

Household incomes also rise at differing rates, depending on their relative factor endowments. The resulting increase in consumer demand depends on the composition of household consumption, while the overall increase in demand is moderated in product markets through changing prices. Similarly, increased factor demand is constrained by total factor availability through factor returns. The results of the model are therefore largely determined by the structural characteristics of the economy, which are empirically estimated from industrial and household surveys. Given these characteristics, the model determines how production affects market quantities, prices and household incomes within a consistent economywide framework. This in turn influences poverty levels and nutrition status of individuals in the economy.

3. POVERTY AND NUTRITION OUTCOMES UNDER CURRENT AND ACCELERATED AGRICULTURAL GROWTH PATHS

Tanzania’s Current Growth Path

Tanzania’s agricultural sector growth performance has been volatile and relatively weak compared to the rest of the economy, with growth fluctuating between 3 and 6 percent per annum since 2000 (Joint Government and Development Partners Group, 2009). Many blame the structural adjustment policies introduced in the 1980s. This policy shift led to a gradual withdrawal of government support for agriculture, declining investments, and deregulation. In the absence of price controls and agricultural subsidies, and with a rapidly depreciating exchange rate, producers faced a cost-price squeeze during the 1990s. Fertilizer use declined rapidly as a result, farmers failed to adopt modern technologies, and underinvestment in irrigation systems, machinery and infrastructure led to an overall ‘demechanization’ of the agricultural sector (see Meertens, 2000; Morris et al., 2007; Putterman, 1995; Wiig et al., 2009).

The resulting declining yields, coupled with weak infrastructure and bottlenecks in agricultural supply, reduced the profitability of agriculture, with those supplying the domestic market facing particularly weak prospects (Danielson, 2002). Thus, although the structural adjustment program strengthened the role of markets and brought about price stability and higher levels of overall macroeconomic growth, the gains did not extend to the agricultural sector as much as was hoped for. In fact, agricultural output per capita stagnated or even fell throughout the 1990s (Danielson, 2002; Treichel, 2005).

Closer consideration of the structure of crop production in Tanzania provides a better understanding of the recent agricultural growth performance. As shown in Table 2, more than half of total harvested land area is allocated to cereals. Cereals production growth varies greatly by crop (FAO, 2009). Maize, for example, is the country's dominant staple food crop, but yields are low (0.88 tons per hectare) for this crop produced mainly by subsistence smallholders, such that maize production expanded slower than the overall population during 2000–2007. Wheat production, on the other hand, grew rapidly. This crop is produced almost exclusively by large-scale commercial farmers in the Northern zone using modern inputs. Rice performed equally well and is becoming a particularly important crop for smallholder farmers in the Western and Lake zones of Tanzania (MINAG, 2006). However, despite the rapid expansion of rice and wheat and despite overall favorable agro-ecological conditions, Tanzania remains a net importer of cereals as production has failed to keep pace with rising consumer demand.

Roots, such as cassava and potatoes, are also important food sources in Tanzania and account for almost 15 percent of harvested land. Root crops performed well during 2000–2007 with more than four percent annual growth. By contrast, higher-value pulses and vegetables stagnated, with pulses production declining by more than four percent each year. This was offset by rapid fruit production growth in the Northern and Eastern zones, and by oilseed crops grown in most parts of the country. Non-cereal food crop production has therefore been characterized by slow growth in the more widely-produced pulses and vegetables crops, and fast growth in more regionally-concentrated fruits.

Some of the fastest growth rates during 2000–2007 were for export-oriented crops. Traditional export crops, such as cotton, sugarcane and tobacco, grew at almost ten percent per year. These crops are highly concentrated in specific regions. Cotton is mostly produced by smallholders in the Western and Lake zones (81.5 percent of output). Tobacco, another smallholder crop, is mainly produced in the Western and Highlands zones (82.8 percent).

Finally, sugarcane is mostly produced by larger-scale commercial farmers in the Eastern and Northern zones (83.8 percent). Together these three crops generated 17.4 percent of total merchandize exports in 2007. Coffee and tobacco are also major export crops, but their production has declined in recent years. Export agriculture therefore grew rapidly during 2000-2007 driven by the strong performance of a few regionally-concentrated crops.

Table 2. Agricultural production statistics for Tanzania (2000-2007)

	Harvested land area, 2007			Production quantities		Yields, 2007 (mt/ha)
	Level (1,000 ha)	Share of total (%)	Large-scale farm share (%)	Level, 2007 (1,000 mt)	Growth, 2000–2007 (%)	
Total	*8,209*	*100.00*				
Cereals						
Maize	2,690	32.77	0.82	2,354	2.08	0.88
Sorghum	649	7.91	0.00	486	3.31	0.75
Millet	256	3.12	0.00	139	0.17	0.54
Rice	546	6.65	0.00	1,084	6.24	1.99
Wheat and barley	80	0.97	100.00	95	8.49	1.18
Root crops						
Cassava	660	8.04	0.00	5,284	3.54	8.01
Other roots	539	6.57	0.00	1,168	5.26	2.17
Pulses and oilseeds						
Pulses	792	9.64	1.37	516	–4.32	0.65
Coconuts	310	3.78	100.00	370	0.00	1.19
Oilseeds	380	4.62	0.00	238	5.01	0.63
Horticulture	*647*	*7.89*	*0.00*			
Plantains	308	3.75	0.00	565	0.12	1.83
Fruits	167	2.03	8.15	671	11.98	4.02
Vegetables	172	2.10	0.00	1,163	0.22	6.74
Export-oriented crops						
Coffee	137	1.67	40.90	53	–0.03	0.39
Cashews	80	0.97	11.23	75	–2.12	0.94
Cotton	295	3.59	0.00	181	9.49	0.61
Sisal	46	0.56	100.00	24	3.60	0.51
Sugarcane	17	0.21	60.88	273	8.47	16.06
Tea	19	0.23	69.51	30	3.80	1.59
Tobacco	34	0.41	27.21	18	11.39	0.52
Other crops	33	0.40	0.00	17	1.76	0.51

Source: Authors' calculations using Tanzania DCGE model and poverty/nutrition modules, FAOSTAT (FAO, 2009), and the 2002–2003 Agricultural Sample Survey (MINAG, 2004).

Livestock and fisheries are key subsectors, accounting for almost a third of agricultural GDP. Fisheries kept pace with overall agricultural production during 1998–2007, growing at 5.1 percent per year. However, livestock has lagged behind crop agriculture, growing at only 3.3 percent per year. Incomes from cattle and poultry are important for farm livelihoods in many parts of the country, and especially for lower-income households (World Bank, 2009). Thus, their slow growth will have implications for households' incomes, especially for the poor.

The examination of recent production trends suggests the source of recent agricultural growth has been concentrated among a few crops. Rice and wheat, for example, dominated cereals production trends, while cotton, tobacco and sugar grew at almost ten percent per year. These well-performing crops are more heavily concentrated in the northern and eastern periphery of the country, and are more often produced by larger-scale commercial farmers. Agricultural growth has therefore not benefited subsistence farmers that are more likely to be poor.

We now use the DCGE model to produce a *baseline scenario* on the assumption that observed production trends for 2000–2007 will continue over the period 2009–2015. Growth, poverty and nutrition outcomes under this baseline scenario are reported in this subsection. The following subsection then considers results under an *accelerated agricultural growth scenario* (or *agriculture scenario*).

Columns 6 and 7 in Table 3 show observed production growth rates for 2000–2007, as well as the modeled growth rates in the baseline scenario. Using maize as an example, national production in the baseline scenario grows at 2.11 percent per year during 2009–2015, which is similar to the 2.08 percent annual growth rate observed during 2000–2007. This is partly achieved by allowing total harvested land area in Tanzania to expand at 2 percent per year during 2009–2015. The model endogenously allocates available land in each of the 20 regions across crops in order to maximize returns. We then exogenously increase total factor productivity (TFP) for each crop and region in order to achieve the targeted production growth rate. This causes crop land yields to change. For example, maize yields rise from 0.91 to 1.02 tons per hectare during 2009–2015 (i.e., the annual yield growth rate of 1.45 percent shown in column 2). This process of targeting production trends is repeated for each crop and livestock subsector. We also target nonagricultural sector GDP growth rates using trends from national accounts for 1998–2007 (MOFEA, 2008).

Table 3. Crop yields and area and production outcomes under the baseline and accelerated agricultural growth scenarios

	Crop yields (exogenous: imposed on the model)				Production quantity (endogenous: results from the model)				
	Initial Level	Baseline scenario growth rate	Agriculture scenario target level	Agriculture scenario growth rate	Initial Level	Observed growth trends	Baseline scenario growth rate	Agriculture scenario target level	Agriculture scenario growth rate
	mt/ha	%	mt/ha	%	1,000 mt	%	%	1,000 mt	%
	2009	2009–2015	2015	2009–2015	2009	2000–2007	2009–2015	2015	2009–2015
Cereals									
Maize	0.91	1.45	1.24	3.94	2,508	2.08	2.11	3,593	4.60
Sorghum	0.78	1.57	0.93	2.19	534	3.31	3.35	751	4.36
Millet	0.50	–2.85	0.50	0.08	144	0.17	1.02	186	3.23
Rice	2.20	4.00	3.09	4.30	1,251	6.24	5.55	1,974	5.86
Wheat & barley	1.40	7.08	2.47	7.36	116	8.49	8.68	231	8.97
Root crops									
Cassava	8.57	2.52	11.13	3.32	5,737	3.54	3.07	7,972	4.20
Other roots	2.47	5.16	3.72	5.25	1,296	5.26	3.87	1,887	4.81
Pulses & oilseeds									
Pulses	0.53	–6.97	0.38	–4.05	482	–4.32	–1.90	498	0.42
Coconuts	1.15	–1.41	1.18	0.31	372	0.00	0.07	429	1.81
Oilseeds	0.70	4.49	0.98	4.33	272	5.01	4.88	432	5.94
Horticulture									
Plantains	1.74	–1.54	1.79	0.30	580	0.12	0.89	706	2.49
Fruits	5.58	12.41	13.59	11.76	787	11.98	6.94	1,388	7.35
Vegetables	6.55	–0.80	7.55	1.79	1,180	0.22	0.37	1,485	2.92
Export crops									
Coffee	0.37	–2.41	0.51	4.05	53	–0.03	–0.95	82	5.61
Cashews	0.81	–5.97	0.81	0.00	68	–2.12	–4.56	76	1.49
Cotton	0.73	7.71	1.34	7.88	225	9.49	9.33	465	9.50
Sisal	0.52	1.89	0.69	3.48	25	3.60	3.41	37	5.03
Sugarcane	19.22	7.66	36.04	8.18	340	8.47	9.27	718	9.80
Tea	1.73	2.21	2.34	3.82	34	3.80	3.74	52	5.37
Tobacco	0.66	10.33	1.46	10.38	23	11.39	11.98	58	12.03
Other crops	0.51	–0.27	0.59	1.82	17	1.76	1.22	22	3.34

Source: Results from the Tanzania DCGE model and poverty/nutrition modules. Observed trends are from FAO (2009) and MINAG (2006). Initial yields and production quantities are results from the DCGE model after applying observed production trends for 2000–2007 to the model's 2007 base year.

Table 4 shows the average annual agricultural GDP growth after replicating crop-level production trends. The agricultural GDP growth rate is 4 percent under the baseline scenario for 2009–2015, which is broadly consistent with the growth experienced between 1998 and 2007 (4.4 percent). Modeled growth rates are also largely consistent at a subsector level. In line with recent trends, agricultural growth in the baseline scenario is driven by strong growth in crop agriculture and more modest growth in livestock. National economic growth, however, continues to be driven by a rapid expansion of industry and services. Total GDP grows at 6.17 percent per year under the baseline scenario, which is again broadly consistent with the 6.57 percent annual growth experienced during 1998–2007.

Table 4. GDP growth rates in the baseline and accelerated agricultural growth scenarios

	Share of total (%)		Average annual growth rate (%)			Change from baseline (% point)
	Total GDP	Agricultural GDP		Baseline scenario	Agriculture scenario	
	2009	2009	2015	2009–2015	2009–2015	2015
Total GDP	100.00		6.57	6.17	6.83	0.66
Agriculture	31.84	100.00	4.40	3.97	5.87	1.90
Crop agriculture	22.28	69.99	4.76	4.23	6.33	2.10
Cereals	8.32	26.12	-	4.95	6.91	1.96
Root crops	3.27	10.28	-	4.42	5.87	1.45
Pulses & oilseeds	2.71	8.51	-	0.64	3.05	2.41
Horticulture	5.20	16.32	-	2.62	5.02	2.41
Export crops	2.79	8.76	-	7.24	9.75	2.51
Livestock	5.54	17.39	3.30	3.24	4.76	1.51
Other agriculture	4.02	12.62	4.12	3.47	4.75	1.28
Mining	3.93		14.39	12.36	12.34	-0.02
Manufacturing	8.84		7.60	6.93	7.71	0.78
Food processing	4.03		-	4.44	6.58	2.14
Other agroprocessing	2.65		-	8.63	8.77	0.14
Other industry	10.39		8.25	7.05	7.02	-0.03
Services	45.01		7.07	6.51	6.63	0.12

Source: Results from the Tanzania DCGE model and poverty/nutrition modules. Observed trends from MOFEA (2008).

In order to assess the poverty and nutrition effects of growth, two concepts are defined here. The *poverty–growth elasticity* is defined as the percentage decline in poverty from a 1 percent increase in per capita GDP. This elasticity may be sensitive to whether the per capita GDP estimate is derived from household survey data or from the national accounts. Private consumption, a key component of GDP, is typically larger in national accounts compared to household surveys because it includes a wider range of products and also because surveys are less likely to sample households at the top of the income distribution. National accounts estimates are further prone to error because private consumption is treated as a residual between GDP at factor cost and other components of GDP at market prices rather than measured directly (see Ravallion, 2001). Over time, discrepancies may widen, and so household surveys can provide a check on consumption trends in national accounts.

Tanzania's national accounts reports 3.99 percent annual growth in per capita GDP during 2001–2007. This is well above the 1.32 percent annual growth in per capita consumption levels estimated from the household surveys. The poverty rate as estimated from the household surveys declined by 1.01 percent per annum over the same period; hence the poverty-growth elasticity may have been anywhere within the range 0.25–0.76. The national accounts-based estimate suggests a deterioration of the growth–poverty relationship from the 0.82 during the 1990s to the 0.25 during the 2000s, whereas the household surveys suggest an increase from 0.57 to 0.76. Understanding these differences is important because they imply different trends in the effectiveness of economic growth to reduce poverty in Tanzania.

Under the baseline scenario the DCGE model predicts an average annual per capita GDP growth rate of 3.59 percent. The poverty module indicates a decline in the national poverty headcount rate from 40 percent in 2007 (recall the poverty line is set at the 40th percentile) to 31.1 by 2015 (see Table 5). This is a 3.09 percent annual decline in the poverty rate and so implies a poverty–growth elasticity of 0.86 (i.e., 3.09/3.59). This is slightly above the upper-limit of 0.76 estimated by the household surveys for 2001–2007. The model's results are, however, reasonably consistent with the distributional changes observed for this period. This implies that the current growth trend is somewhat overestimated in national accounts and/or that the rate of poverty reduction is underestimated in the household surveys.