Chapter 8

Nigeria

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Nigeria, whose export earnings are heavily oil dependent, has experienced rapid economic growth in recent years. In 1990–99 the economy grew at 2.6–3.0 percent annually, whereas the annual gross domestic product (GDP) growth rate rose to 7.3 percent during 2000–07 (Nigeria, NBS 2007a). Notably, the agricultural sector has been the key driver of the economy, growing at 6.3 percent and contributing 42 percent to the country's total GDP in 2008. Hence, despite the high dependence of government revenues and national export earnings on the oil sector, the agricultural sector remains the country's mainstay (Sanyal and Babu 2010). Furthermore, because agriculture is the largest employer among all sectors (70 percent of the labor force) (Nigeria, NBS 2006) and labor is the main (and sometimes only) asset for the poor (Agenor Izquierdo, and Fofack 2003), the agricultural sector has the greatest potential for reducing poverty.

Nigeria has undergone a painful process before it recently recognized the importance of the agricultural sector in its development process. Although the agricultural sector received some policy attention immediately after the country's independence, the oil boom in the early 1970s eventually pushed the country toward a development crisis, with many years of civil conflict and economic stagnation (and even recession). During this period, agriculture and rural development were largely ignored, poverty rose, food insecurity and malnutrition worsened, and the country turned from being a net agricultural exporter to a food importer by the end of the 1970s (World Bank 2010). By 1996, two-thirds of the country's population lived in poverty, and the poverty rate almost tripled in the 15 years between 1980 and 1996 (World Bank 2010).

Drawing lessons from its troubled economic history, the Government of Nigeria has since recognized the importance of the agricultural sector. Its promotion is an essential ingredient of the country's development strategy, given the country's rich, favorable agroecological conditions and the fact that most of the population lives in rural areas. A series of strategies has recently been designed that aim to accelerate agricultural growth, strengthen food security, and reduce poverty. These strategies include the National Economic Empowerment and Development Strategies (NEEDS) (Nigeria, NPC 2004, 2007) and the National Food Security Program (NFSP) (Nigeria, FMARD 2008). Such programs as the presidential initiatives on cassava, rice, and other crops have also been implemented. Moreover, the country is a signatory to the Comprehensive Africa Agriculture Development Programme (CAADP), which commits the government to targeting 6 percent agricultural GDP growth rate and allocating at least 10 percent of public resources to the agricultural sector. Despite these commitments, further efforts are needed to lift more people out of poverty and to meet the first Millennium Development Goal (MDG) of halving the proportion of the people living on less than US$1 a day.

In this chapter we analyze the agricultural growth and public investment options for Nigeria. This study provides evidence-based analysis to support the formation of a more comprehensive rural development component under the NEEDS that is also in alignment with the objectives collectively defined by African countries as part of the CAADP agenda. As with other chapters in this volume, the analysis makes use of a spatially disaggregated recursive dynamic computable general equilibrium (DCGE) model (described in Chapter 2). We also estimate the overall cost to the government of the investments needed to accelerate agricultural growth.

The chapter is structured as follows. We first describe the structure of the Nigerian DCGE model and the data sources used to calibrate it. The model results are then presented for the baseline growth scenario and the accelerated agricultural growth scenarios. This is followed by the results from the investment analysis. The final section draws together our findings and summarizes their implications for future national and agricultural development strategies in Nigeria.

The Nigerian DCGE Model

The Nigerian DCGE model includes 62 production subsectors that cover the entire agricultural and nonagricultural components of the country (see Table 8A.1 in the appendix to this chapter). More than half of the subsectors are in agriculture, which falls into six broad groups: cereal crops, root crops, other foodcrops, higher value export-oriented crops, livestock sectors, and other agricultural activities (that is, forestry and fisheries). The model also captures regional heterogeneity in agriculture by disaggregating agricultural production into six zones, wherein representative farmers produce different crops and livestock across zones. In terms of nonagricultural activities, there are 10 agroprocessing activities, including 8 concerning food processing. On the demand side, the Nigerian DCGE model includes 12 household groups defined for the six zones and by rural and urban location. Each of the 12 household groups is aggregated from the Nigeria Living Standards Survey (NLSS) 2003/04 (Nigeria, NBS 2003) such that all sample households in NLSS are linked directly to their corresponding representative households in the DCGE model via the microsimulation module described in Chapter 2.

The data used to represent the base year of the model are drawn from a variety of data sources. The core dataset underlying the DCGE model is a 2006 social accounting matrix (SAM) constructed using national accounts and trade data, both of which were published by Nigeria's National Bureau of Statistics (2008b), and balance-of-payment information, which was published by the Central Bank of Nigeria (CBN 2009). National and state agricultural production and yield data and market price data are obtained from the Federal Ministry of Agriculture and Rural Develoment (2009). When production data are unavailable for certain sectors (for example, horticulture), information is taken from FAO (2010). Agricultural production was disaggregated across zones by mapping individual states to the six zones. The DCGE model is therefore consistent with official agricultural production levels and yields at the zonal level. Nonagricultural production, employment, and other value-added components of sectoral GDP at the national level were compiled from national accounts. On the demand side, information on industrial technologies (for example, intermediate and factor demand) is taken from an earlier SAM for Nigeria developed by Iyaniwura et al. (1992) for a UNDP project, while the income and expenditure patterns for the various household groups are taken from NLSS 2003/04. The DCGE model is therefore based on the most recent data available for Nigeria and represents the country's economy in 2006.

Baseline Growth Scenario

The DCGE model is first used to simulate a baseline scenario that captures current trends in growth and poverty reduction. History shows that the Nigerian economy is vulnerable to oil price shocks through impacts on the country's effective exchange rate, government expenditure, money supply, trade, and inflation (Akpan 2009). Given that the global financial crisis and declines in world crude oil prices are expected to last for some time, a modest targeted economic growth of 6.5 percent per year for total GDP was assumed for the baseline during 2008–17. Although this targeted baseline growth rate is lower than Nigeria's recent growth performance (for example, it was 7.6 percent annually during 2002–07), it is comparable with growth over a longer period (for example, the average annual GDP growth rate was 5.5 percent during 1995–2007). Similarly, a relatively modest growth rate of 5.7 percent for the agricultural sector was assumed for the baseline, which is comparable to the historical growth rate during 2000–07.

Factors Determining Growth in the Model

To model a realistic baseline, it is important to pay attention to the sources of growth across sectors and for different input factors. In the model, economic growth results from increases in labor supply, land expansion, capital accumulation, and productivity changes. We assume that growth in total labor supply is consistent with projected growth in the population (that is, 3.0 percent annually). By taking into account more rapid growth in the nonagricultural sector's labor demand, growth in the economywide labor categories (unskilled and skilled labor) is assumed to be 3.3 percent and 3.4 percent, respectively. A much slower growth rate of 2.0 percent annually is assumed for rural family labor supply. Total agricultural land expansion was also exogenously imposed on the model, based on recent trends reported by the National Planning Commission (2007) (that is, 5.2 percent per year). Land expansion is assumed to eventually fall to 4.2 percent after 2011, and thus the average annual growth rate of land expansion is 4.8 percent (Table 8.1). Because of a lack of information on the potential for land expansion at the zonal level, we assumed a uniform growth rate across the six zones.

Capital accumulation is an endogenous outcome of savings and investments, which are modeled recursively in our model (see Chapter 2). Investment is financed through private savings determined by (1) a fixed proportion of the total income (an endogenous variable) received by each of the 12 representative households and (2) government savings, which is a residue term between government income (an endogenous variable) and total noninvestment spending (an exogenous variable). Both private and public savings rates are calibrated to the 2006 SAM. Investment is also affected by the foreign capital flows. Because Nigeria has run a trade surplus in recent years, net foreign capital inflows are negative in the model (which indicates capital outflows). In the DCGE model, such outflow is an exogenous variable, and growth of the outflows is assumed to decline from the expected slow growth in oil exports. Using this assumption, more oil revenues are expected to be used in financing domestic investment instead of purchasing foreign bonds or investing in foreign capital markets in the current situation. In the baseline, capital accumulates at 4.6 percent each year in real terms after 5.0 percent depreciation (see Table 8.1).

Although total factor supply grows either exogenously (labor and land) or endogenously (capital), demand at the sector level is endogenous. Factor demand is determined by the competiveness in factor markets and the profitability of each individual sector. The third part of Table 8.1 reports the growth rate in aggregate labor and capital demand by agriculture and nonagriculture. The model results show that total agricultural labor demand grows at 2.2 percent annually, but it is 3.7

Table 8.1—Growth decomposition in model scenarios (percent)

Indicator/sector	Total GDP		Agricultural GDP		Nonagricultural GDP	
	Baseline scenario	Agriculture scenario	Baseline scenario	Agriculture scenario	Baseline scenario	Agriculture scenario
Annual output growth	6.5	8.0	5.7	9.5	6.8	7.4
Share of total/sector GDP	100.0		100.0		100.0	
Land	11.0		37.0			
Labor	45.7		59.4		39.9	
Capital	43.3		3.6		60.1	
Contribution to growth	100	100	100	100	100	100
Land	9.5	9.8	33.3	24.7		
Labor	20.2	16.2	21.2	12.4	21.7	20.1
Capital	31.6	25.9	5.0	3.3	41.2	38.6
TFP	38.7	48.1	40.6	59.6	37.1	41.2
Annual input/TFP growth						
Land	4.8	5.7				
Labor	3.0	3.0				
Agriculture	2.2	2.1				
Nonagriculture	3.7	3.7				
Capital	4.6	4.7				
Agriculture	6.7	7.1				
Nonagriculture	4.5	4.6				
TFP	2.5	3.8				
Agriculture	2.3	5.6				
Nonagriculture	2.5	3.0				

Source: The Nigerian dynamic computable general equilibrium model results.
Note: GDP = gross domestic product. TFP = total factor productivity. Blank cells = not applicable.

percent for the nonagricultural sector. The growth rate of total agricultural capital demand is higher than that of total nonagricultural capital demand (6.7 percent versus 4.5 percent). However, because agricultural capital accounts for a tiny portion of total capital input, even with such rapid growth, the share of capital in agricultural GDP is still very small, accounting for less than 5.0 percent of agricultural GDP (whereas capital accounts for more than 60 percent of nonagricultural GDP; see the top part of Table 8.1).

It is impossible to have sustainable growth without productivity improvements. The model assumes that total factor productivity (TFP) grows exogenously at the sector level across the six zones. The TFP growth rate is based on the yield growth (in the case of crop sectors) and value-added growth (in the case of the noncrop sectors) drawn from historical data (Nigeria, NBS 2007a; Nigeria, FMARD 2009). Although productivity growth is a driving force of growth at the sector level, growth is also affected by product demand. If the supply of a specific commodity is not met with sufficient demand (either in domestic or foreign markets), then the price of this commodity in the domestic market will fall, resulting in reduced factor demand by producers of this commodity (and hence a lower GDP growth rate).

We calculate the contribution of factors and productivity to the overall economic growth in Table 8.1. Factor contributions to GDP growth depend on the growth rate of each factor and the share of these factors in value-added. For the economy as a whole, land accounts for 11.0 percent of GDP, whereas labor and capital account for 45.7 percent and 43.3 percent, respectively. In terms of growth in GDP in the baseline scenario, 61.3 percent of growth is due to factor accumulation, whereas 38.7 percent comes from TFP growth (see the second part of Table 8.1). Growth contributions for agricultural and nonagricultural GDP are also reported in the table. In the baseline, almost 60 percent of agricultural growth is due to land expansion, increased labor supply, and capital accumulation, whereas productivity only explains 40 percent of growth. Within crop sectors, productivity gains come both from improvement in yields and a more efficient allocation of land to crops with higher returns.

Growth at the Subsector Level

Overall growth in the baseline total and agricultural GDP is targeted at 6.5 percent and 5.7 percent, respectively, annually between 2009 and 2017, the growth rate is very different across individual subsectors. This is because the input allocation across sectors differs over time as a result of different sectoral productivity growth and changes in relative prices. For example, although agricultural GDP grows at 5.7 percent annually, growth in total cereal value-added is 5.4 percent (Table 8.2). It is 5.1 percent and 7.3 percent for rice and maize production, respectively, whereas growth in Irish potatoes is 8.8 percent annually. The table also presents baseline GDP growth by subsector, as well as for some sector groupings. All growth rates are endogenous results of the model. The first column of the table reports the size of each sector as a share of total GDP in 2006.

Poverty-Reduction Outcome in the Baseline Simulation

The poverty-reducing impact of economic growth is analyzed using a microsimulation module. Before the simulation exercise was started, the impact of growth on poverty reduction using historical poverty data available for 1980, 1985, 1992, 1996, and 2004 at the national level was assessed. However, because the poverty rate of 65.6 percent in 1996 is much higher than that in 1992 (42.7 percent), it makes the trend analysis difficult over a long period. For this reason, we focus on the poverty rate between 1996 (during which the poverty rate was 65.6 percent) and 2004 (54.4 percent) and compare the rates with actual per capita GDP growth over the same period. Although the annual growth rate of GDP per capita is 2.5 percent (calculated from an annual growth in GDP of 5.5 percent and population annual

Table 8.2—GDP growth rates in model scenarios (percent)

Sector	GDP share	Annual growth	
		Baseline scenario	Agricultural scenario
Total GDP	100	6.5	8.0
Agriculture	29.7	5.7	9.5
Cereals	7.7	5.4	9.5
Root crops	9.4	6.0	8.9
Other foodcrops	7.6	5.7	8.1
High-value crops	1.5	5.6	17.6
Livestock	1.9	5.4	6.9
Forestry	0.5	4.2	5.7
Fisheries	1.0	6.5	12.9
Mining	34.6	3.7	3.7
Manufacturing	6.9	6.7	7.4
Beef	0.6	6.2	7.6
Goat and sheep meat	2.2	6.0	7.2
Poultry meat	0.2	8.2	13.3
Eggs	0.03	7.3	10.7
Milk	0.01	7.5	9.9
Other meat	0.02	5.7	5.9
Beverages	0.3	7.3	7.7
Other food	0.4	8.1	8.6
Textiles	0.5	7.8	8.3
Wood processing	0.3	7.9	8.8
Electronics	0.9	6.4	5.4
Other	1.1	6.5	6.0
Oil refining	0.3	6.2	6.2
Other industries	4.3	8.5	8.8
Services	24.5	9.6	10.7

Source: The Nigerian dynamic computable general equilibrium model results.
Note: GDP = gross domestic product.

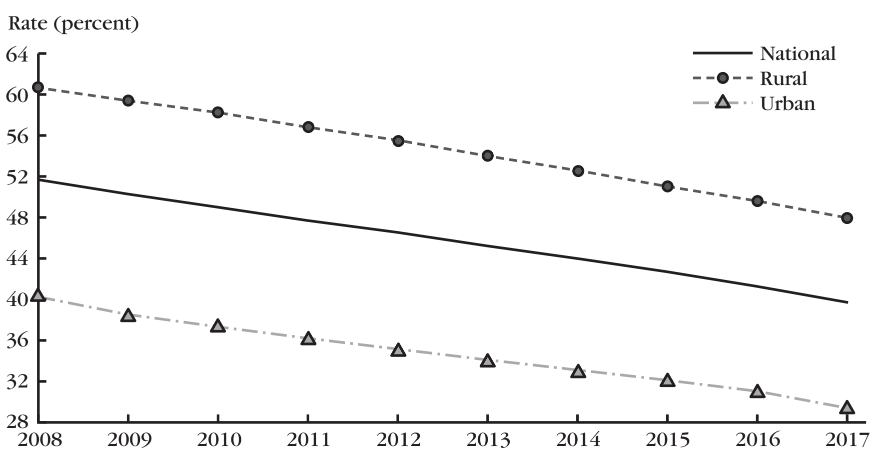
growth of 3.0 percent), the total decline in the poverty rate was only 11.2 percentage points over these seven years (or 2.3 percentage points per year). By comparing the total decline in the national poverty rate (that is, 2004's poverty rate is 17 percent [not percentage points] lower than that in 1996) with the total growth in per capital GDP (22 percent) in the same seven years, we derive a poverty-reduction–growth elasticity equal to –0.78. This value indicates that 1.00 percent growth in per capita GDP between 1996 and 2004 caused poverty to fall by 0.78 percent. Although the elasticity is affected by the initial level of the poverty rate (which was high in 1996) and the pattern of income distribution around the poverty line, the elasticity is comparable with that obtained for other African countries.

The poverty–growth elasticity was also calculated using the results of the model simulation for the baseline using the same formula. A similar elasticity of –0.85 was obtained. Given this elasticity value, the poverty analysis shows that, with 6.5 percent of annual growth in total GDP and 5.7 percent of agricultural GDP growth during 2008–17 (together with 3.0 percent of population annual growth in the same period), Nigeria's national poverty rate would fall from 51.6 percent in 2008 to 39.4 percent by 2017 (Figure 8.1). Although this final poverty rate is already lower than the rate in 1992, in which the national poverty rate is 42.7 percent, given the 3.0 percent population growth per year, the number of the poor would still increase over time. The baseline scenario shows that by 2017, there will be 287,000 more poor people than there were in 2008.

Rural and urban poverty rates are also calculated for the baseline (Figure 8.1). Poverty rates from NLSS data provide starting points in the model and are used to determine the poverty rates in 2008 and subsequent years in the simulation. As shown in the figure, with 6.5 percent annual growth in total GDP and 5.7 percent of growth in agricultural GDP, the rural poverty rate falls to 47.9 percent and the urban poverty rate to 29.4 percent by 2017. Because the percentage point decline in rural areas is slightly higher than in urban areas (12 versus 11 percentage points between 2008 and 2017), the difference in poverty rates between rural and urban areas becomes smaller (20.1 in 2008 versus 18.5 percentage points in 2017).

The spatial pattern of poverty distribution in Nigeria shows a north–south disparity, as the three southern regions have poverty rates ranging from 27–43 percent, whereas the range is 67–72 percent for the three northern regions in 2004. This regional divergence in poverty will continue over the next 10 years. The base-

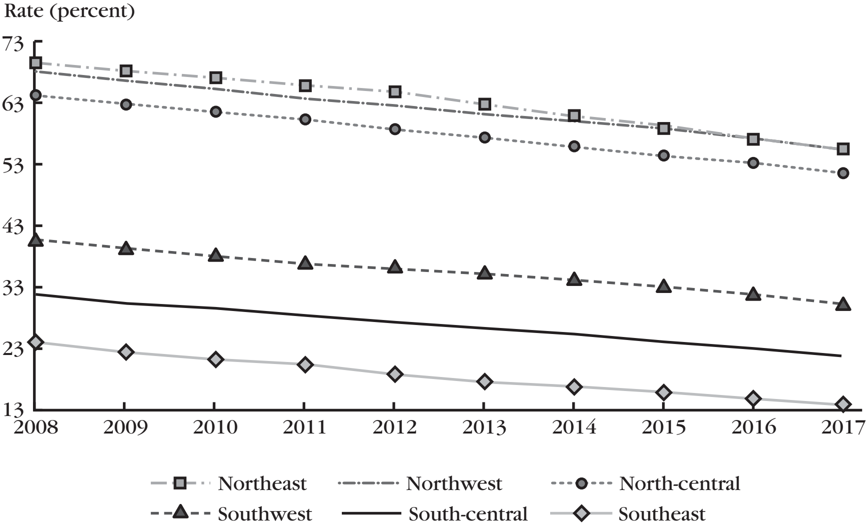
Figure 8.1—Poverty rate in the baseline scenario



Source: The Nigerian dynamic computable general equilibrium model results.

Note: The poverty rate is the proportion of the population with per capita consumption below the poverty line.

Figure 8.2—Regional poverty rate in the baseline scenario



Source: The Nigerian dynamic computable general equilibrium model results.

Note: The poverty rate is the proportion of the population with per capita consumption below the poverty line.

line shows that the poverty rate of the southern regions will fall to 13.4–30.0 percent by 2017, but it will remain high at 51.5–55.6 percent in the northern regions (Figure 8.2).

Accelerated Growth Scenarios: Going Beyond the 6 Percent Agricultural Growth Target

By committing to the CAADP agenda, the Government of Nigeria has set itself the target of achieving 6 percent annual agricultural growth. Considering that recent agricultural growth in Nigeria is close to this target, the government has set an even higher growth target of 10 percent. To meet this higher agricultural growth, a set of sector-specific growth targets has been identified in the NFSP for major crops and livestock sectors (Nigeria, FMARD 2008). Given the large gaps between current and potential yields for most crops, the potential for faster agricultural growth in Nigeria is high. However, considering the short period planned for achieving the NFSP targets, the required growth seems to be unrealistic for most food crops, especially if such growth is primarily achieved via improvements in productivity. For example, in the NFSP, cassava yield and production are both targeted to double within a four-year period (2008–11), which implies an annual growth rate of 19.5 percent. Although we design an "Agriculture" scenario based on the targets set in NFSP, we apply its growth targets to the longer period 2009–17.

For the 29 crops in the model, there are only 10 crops for which production targets are available in NFSP. There are also targets for five livestock products and the fishery sector. To model accelerated growth, additional land expansion is assumed for some crops (rice, wheat, cocoa, sugar, and oil palm). For the other crops, livestock, and fishery, additional growth is assumed to come via productivity improvements only (yield increases in the case of crops). Although production targets are not available for many other crops included in the model, and given that many of them are large agricultural subsectors (for example, maize, sorghum, yams, pulses, and oilseeds), additional productivity growth is also assumed for these crops in the Agriculture scenario. However, changes in land and labor supply are not targeted at the subsector level, because they are endogenous to the model. Table 8.3 describes the current and targeted productivity growth rates for different subsectors in the DCGE model.

Results from the Agriculture scenario show that if the targets for individual crops and agricultural subsectors are achieved over the next nine years, then agricultural GDP will grow at 9.5 percent annually. This rate is more than four percentage points higher than the baseline (see Table 8.2). Through economywide linkages, additional growth also occurs in the nonagricultural sectors that have close linkages with the agricultural sector. As shown in Table 8.1, accelerated agricultural growth is mainly driven by productivity. TFP in the agricultural sector grows at 5.6 percent annually in this scenario instead of 2.3 percent in the baseline. The contribution of TFP to agricultural GDP growth also rises, which attracts more capital into the agricultural sector (capital demand in the agricultural sector grows at 7.1 percent annually in this scenario compared to 6.7 percent in the baseline). However, less labor is employed in agriculture (the growth rate falls from 2.2 to 2.1 percent). Productivity-led agricultural growth also benefits the nonagricultural sectors. TFP growth in the nonagricultural sector rises to 3.0 percent per year, from 2.5 percent in the baseline. Capital accumulation rates also rise, which allows capital employment in the nonagricultural sector to grow more rapidly than in the baseline.

Sector-level growth is further shown in Table 8.2. Overall, the Agriculture scenario results in an increase in total GDP's annual growth rate from 6.5 to 8.0 percent. More than 75 percent of additional GDP growth is a direct outcome of accelerated agricultural growth; the other 25 percent comes from an increase in nonagricultural growth via linkages effects.

Subsector Contributions to Agricultural Growth

Table 8.4 reports the contribution of each agricultural subsector in reaching the 10 percent agricultural GDP growth goal (see the last column in the table). The table shows that accelerated growth in cereal crop production, particularly in rice, contributes the most to the overall agricultural growth in the Agriculture scenario.

Table 8.3—National crop yields, harvested area, and production levels in model scenarios

Sector	Crop yields				Harvested area			Production quantity		
	Yields (mt/ha)		Growth rate (percent)		Share of total (percent)			Quantity (1,000 mt/ha)	Growth rate (percent)	
	Initial, 2008	Target, 2017	Baseline scenario, 2008–17	Agricultural scenario, 2008–17	Initial, 2008	Baseline scenario, 2017	Agricultural scenario, 2017	Initial, 2008	Baseline scenario, 2008–17	Agricultural scenario, 2008–17
Rice	1.5	2.4	1.1	5.1	8.6	4.5	5.0	9,436	5.6	10.3
Wheat	1.1	1.3	0.1	1.8	0.1	5.5	20.9	80	5.6	23.1
Maize	1.4	1.8	0.3	2.9	12.4	6.8	8.2	12,540	7.1	11.3
Sorghum	1.4	1.7	0.6	2.8	12.4	3.7	2.9	12,208	4.3	5.8
Millet	1.5	1.9	0.3	2.6	7.8	4.0	3.0	8,584	4.2	5.7
Cassava	13.0	18.2	1.1	3.8	4.7	4.9	4.9	44,630	6.1	8.9
Yams	8.3	11.2	1.2	3.4	5.8	5.5	5.8	34,726	6.7	9.4
Cocoyams	0.6	0.8	2.5	3.4	7.0	4.2	4.7	3,047	6.8	8.2
Potatoes	8.9	18.8	5.7	8.7	0.3	2.6	2.7	2,003	8.5	11.6
Sweet potatoes	3.4	4.3	0.7	2.7	1.6	4.4	4.3	3,832	5.2	7.2
Plantains	6.9	9.7	2.0	3.7	0.6	2.5	1.6	3,055	4.5	5.4

(*continued*)

Table 8.3—Continued

	Crop yields				Harvested area			Production quantity		
	Yields (mt/ha)		Growth rate (percent)		Share of total (percent)			Quantity (1,000 mt/ha)	Growth rate (percent)	
Sector	Initial, 2008	Target, 2017	Baseline scenario, 2008–17	Agricultural scenario, 2008–17	Initial, 2008	Baseline scenario, 2017	Agricultural scenario, 2017	Initial, 2008	Baseline scenario, 2008–17	Agricultural scenario, 2008–17
Beans	0.5	0.7	1.5	3.4	14.2	4.0	4.0	5,328	5.6	7.5
Groundnuts	1.2	1.6	1.3	3.6	5.1	4.3	4.0	4,258	5.7	7.7
Soybeans	0.7	0.9	1.2	3.4	3.8	4.5	4.9	1,834	5.7	8.5
Other oilseeds	1.8	2.2	0.9	2.1	0.1	4.3	4.7	141	5.3	6.9
Vegetables	7.6	10.0	1.2	3.0	1.1	4.6	4.9	5,873	5.9	8.0
Fruits	5.2	6.8	1.6	3.2	2.1	4.5	5.0	7,634	6.2	8.3
Cocoa	0.3	0.5	5.3	6.5	1.5	3.0	3.6	277	8.4	10.3
Coffee	0.5	0.6	1.7	3.2	0.8	4.6	5.4	267	6.3	8.8
Cotton	0.8	0.9	0.4	1.5	1.4	5.8	10.0	778	6.2	11.7
Oil palm	1.4	2.0	2.5	4.1	7.2	1.8	2.2	7,194	4.4	6.4
Sugar	19.2	30.0	1.4	5.1	0.2	6.0	25.1	2,893	7.5	31.5
Tobacco	8.7	11.8	1.9	3.4	0.0	5.1	6.4	33	7.0	10.1
Nuts	0.8	1.0	1.3	2.7	0.2	5.0	5.5	107	6.4	8.4
Cashew nuts	4.2	5.5	2.0	3.1	0.0	5.2	5.5	25	7.4	8.8
Rubber	0.6	0.6	–0.1	0.4	0.7	6.9	6.6	305	6.8	6.9
Other crops	0.5	0.7	1.8	3.3	0.3	6.9	9.3	134	8.8	12.9

Sources: Federal Republic of Nigeria (2009) and the Nigerian dynamic computable general equilibrium model results.
Note: mt/ha = metric tons per hectare.

Table 8.4—Sector contributions to agricultural growth in model scenarios

Sector	Share of agricultural GDP, 2008 (percent)	Baseline growth rate (percent)	Additional growth in Agriculture scenario (percentage points)[a]	Contribution to agricultural GDP (percentage points)[b]
Cereals	25.9	5.4	4.1	30.9
Rice	8.9	5.1	5.2	14.5
Wheat	0.1	5.0	20.9	0.8
Maize	7.3	7.3	4.7	10.8
Sorghum	5.4	4.0	1.7	2.8
Millet	4.2	4.2	1.5	2.0
Root crops	31.6	6.0	2.9	29.1
Cassava	14.7	5.6	3.1	14.1
Yams	13.2	6.4	2.9	12.2
Cocoyams	0.7	4.7	1.3	0.3
Potatoes	1.0	8.8	3.6	1.1
Sweet potatoes	1.9	4.7	2.2	1.4
Other foodcrops	25.7	5.7	2.4	18.4
Plantains	2.1	3.8	1.2	0.8
Beans	3.4	5.3	2.3	2.5
Groundnuts	3.6	5.5	2.2	2.5
Soybeans	3.8	5.7	2.9	3.4
Other oilseeds	0.4	4.5	1.8	0.2
Vegetables	6.2	6.1	2.5	4.9
Fruits	5.5	6.4	2.4	4.1
High-value crops	4.9	5.6	12.0	10.9
Cocoa	0.3	3.9	0.9	0.1
Coffee	0.5	6.1	2.7	0.5
Cotton	0.3	5.2	6.0	0.5
Oil palm	1.5	3.8	1.9	0.9
Sugar	1.02	7.3	25.8	8.3
Tobacco	0.49	6.8	3.2	0.5
Nuts	0.1	5.7	2.2	0.1
Cashew nuts	0.01	5.7	1.9	0.0
Rubber	0.5	6.1	0.0	0.0
Other export crops	0.1	8.5	4.4	0.1
Livestock	6.5	5.4	1.4	2.8
Cattle	2.1	5.5	0.6	0.4
Goats and sheep	3.1	5.1	1.4	1.3
Poultry	1.2	5.9	2.8	1.1
Other livestock	0.2	6.1	0.9	0.0
Other agriculture	5.3	5.8	5.1	7.9
Forestry	1.8	4.2	1.5	0.9
Fisheries	3.5	6.5	6.4	7.0

Source: The Nigerian dynamic computable general equilibrium model results.

Note: GDP = gross domestic product.

[a]This column is the difference between the growth rates in the baseline scenario and those in the Comprehensive Africa Agriculture Development Programme's Agriculture scenario.

[b]The sectoral contribution to agricultural GDP growth is roughly equal to the multiplication of columns 1 and 3 normalized by the additional growth of overall agricultural GDP.

Cereal crop production as a whole contributes 30.9 percent to accelerated agricultural growth, and rice contributes 14.5 percent. These large contributions are to be expected, because cereal crops constitute the second largest agricultural subsector after root crops (accounting for 25.9 percent of initial agricultural GDP in 2006). They also have the highest growth targets in NFSP. For example, targeted rice production by 2017 requires almost 10 percent annual growth during 2009–17. Among the five cereal crops, wheat has the highest growth rate in the Agriculture scenario because of the self-sufficiency target in NFSP. To meet such an ambitious target, wheat must grow at 26 percent per year over the next nine years. However, because this sector is only a small share of total agriculture, even such extremely rapid growth contributes little to overall agricultural growth (0.8 percent in total).

After cereals, root crops are the second most important group contributing to agricultural growth, even though this group is the largest agricultural subsector, currently composing 31.6 percent of agricultural GDP. Among the five root crops, it is only cassava for which a national target has been set in NFSP. We assume modest additional growth in the other four roots and tubers. However, because their growth is lower than for most cereal crops, root crops as a whole only account for 2.9 percent of additional growth in the Agriculture scenario and 29.1 percent of agricultural growth. Given its large share of agricultural GDP, cassava is still the second most important contributor to growth, accounting for 14.1 percent of accelerated agricultural growth. Yams rank third with a contribution of 12.2 percent.

The diversity of diets and food production in Nigeria means that there are many foodcrops that are important for food security and poverty reduction. We group these into "other foodcrops," which in total accounts for 25.7 percent of agricultural GDP—the third largest subsector after roots and cereals. Consistent with its large size, this group of crops is the third most important contributor to growth, generating 18.4 percent of additional agricultural growth.

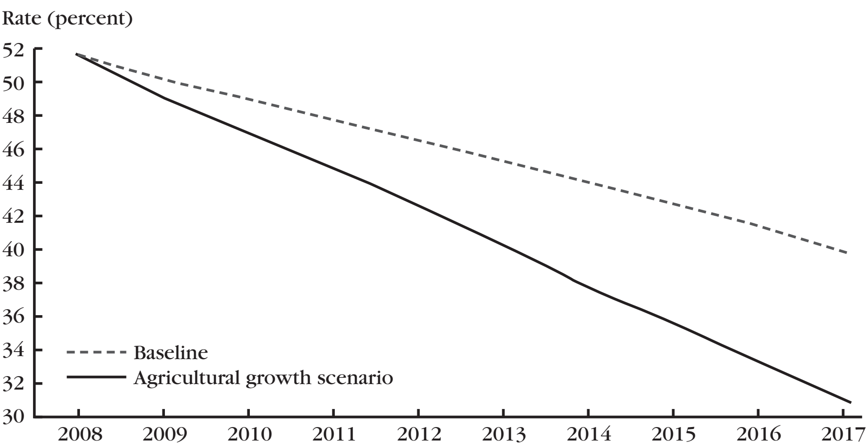
There are 10 high-value crops in the model, namely, cashew nuts, cocoa, coffee, cotton, nuts, oil palm, rubber, sugar, tobacco, and other export crops. Most of these are export-oriented and are either currently important export crops or were in the past. The 10 crops together account for 4.9 percent of agricultural GDP and constitute the smallest agricultural subsector in the economy. High growth is assumed for these crops, driven by the extremely high growth in sugar to meet the target set in NFSP. As a group, the additional annual growth rate in the Agriculture scenario is 12 percent, rising from the baseline of 5.6 percent to 17.6 percent. However, their small share of the agricultural economy means that these crops' contribution to accelerated agricultural growth is less important than foodcrops' contribution. What contribution there is due primarily to sugar production.

Primary livestock production currently accounts for 6.5 percent of agricultural GDP. Targets for most livestock products are available in NFSP. Consistent with these targets, a rapid growth is assumed in the Agriculture scenario for poultry production, rising from 5.9 percent per year in the baseline to 8.7 percent. However, the targets for cattle and goat and sheep products are quite modest, which implies annual growth rates of 6.1 and 6.5 percent, respectively. Because of this, livestock in total only contributes 2.8 percent to additional agricultural growth. In contrast, NFSP assigns fisheries a high target. The Agriculture scenario models rapid growth in fisheries at 12.9 percent each year. With such growth, fisheries, which account for 3.5 percent of agricultural GDP, contribute 7 percent of accelerated agricultural growth. Finally, forestry is the smallest agricultural subsector. With modest growth, it contributes less than 1 percent to total additional agricultural growth.

Accelerated Agricultural Growth and Poverty Reduction

The joint effect of 9.5 percent per year agricultural growth in the Agriculture scenario and its spillover effects into nonagriculture cause poverty to decline by 20.8 percentage points by 2017. This level is 8.9 percentage points lower than the baseline's 2017 poverty rate. As shown in Figure 8.3, the proportion of the population living below the poverty line falls to 30.8 percent in this scenario, compared with the baseline scenario's 39.7 percent. More poverty reduction occurs in rural areas as the rural poverty rate declines to a level that is more than 10.6 percentage points lower than that obtained in the baseline. If the 1996 national poverty rate of 65 percent is chosen as the target for the first MDG, the results show that the national poverty rate will indeed be halved by 2017, that is, reduced to 30.8 percent by 2017 (and to 35.5 percent in 2015).[1] Although the speed of poverty reduction in rural

Figure 8.3—National poverty rate in the agricultural growth scenarios



Source: The Nigerian dynamic computable general equilibrium model results.

Note: The poverty rate is the proportion of the population with per capita consumption below the poverty line.

areas is faster than in urban ones, the poverty rate in the Agriculture scenario will remain high at 37.3 percent and will not achieve the first MDG in rural areas. In contrast, the urban poverty rate will fall to 22.6 percent by 2017 (and 26.2 percent in 2015), thus declining more than 50 percent from its 1996 value. Although faster agricultural growth reduces the divide between rural and urban areas, the country still faces the challenge of how to accelerate poverty reduction in rural areas.

Achieving the targets in the Agriculture scenario will lift an additional 16.5 million people above the poverty line by 2017, thereby reversing the current rising trend in the number poor people. Even with 3.0 percent of annual population growth, the absolute number of the poor will still fall to 59.7 million by 2017 (from the current 77 million, and 78.7 million in the baseline's 2017). Food security would also improve, with an additional 140 kilograms of cereals and 300 kilograms of root products available per capita by 2017 compared to current per capita availability. Furthermore, although Nigeria will continue to import some cereal products, such as wheat and rice, the ratio of imports in domestic consumption will be substantially lower than that in the baseline scenario.

Faster agricultural growth benefits a majority of households. However, not all households will benefit equally from achieving the crop and livestock growth targets in the Agriculture scenario. For this reason, we also investigate the poverty impact at the zonal level for the six regions. Results are reported in Table 8.5. The first two columns of the table report poverty rates in 1996 and 2004. The third and fourth columns report the poverty rates for 2017 from the baseline and Agriculture scenarios. To make the comparison across regions easy to read, we also report the reduction in poverty rates as both percentage points and percent changes, both relative to 1996 and the baseline scenario's 2017. These numbers are found in the final four columns of the table. Finally, the national poverty rates are included for the country as a whole and for the rural and urban areas separately in the first part of the table (rows 1–3).

As seen in Table 8.5, there exists significant spatial disparity in Nigeria's poverty distribution. NLSS 2003/04 indicates that the three northern regions have higher poverty rates than do the southern regions, although this disparity was less significant in 1996 (see the second and third columns in the table). The regional differences in poverty do not change in the baseline and Agriculture scenarios. For example, the highest regional poverty rate in 2004 was in the Northeast (72.2 percent). This situation will continue until 2017 in both scenarios. The spatial poverty gap, measured by the difference between the highest regional poverty rate in the Northeast and the lowest poverty rate that is in the Southeast, was 45.5 percentage points in 2004 (the most recent year for which the poverty information is available). By 2017, this gap is smaller in both scenarios but will still be 43.8–35.2 percentage points. Measured by the percentage change from the level of poverty in 1996, it is reason-

Table 8.5—Regional poverty reduction in model scenarios

Region	1996	2004	Poverty rate, 2017 (percent)		Change (percentage points)		Change (percent)	
			Baseline	Agriculture scenario	From 1996	From baseline scenario, 2017	From 1996	From baseline scenario, 2017
National	65.6	54.4	39.7	30.8	–34.8	–8.9	–53.0	–22.4
Rural	69.8	63.3	47.9	37.3	–32.5	–10.6	–46.6	–22.1
Urban	58.2	43.2	29.4	22.6	–35.6	–6.8	–61.1	–23.1
South-central	58.2	35.1	21.5	14.0	–44.2	–7.4	–75.9	–34.6
Southeast	53.5	26.7	13.4	8.5	–45.0	–4.9	–84.1	–36.5
Southwest	60.9	43.0	30.0	24.7	–36.2	–5.3	–59.4	–17.6
North-central	64.7	67.0	51.5	41.9	–22.8	–9.6	–35.2	–18.7
Northeast	70.1	72.2	55.6	42.2	–27.9	–13.4	–39.8	–24.1
Northwest	77.2	71.2	55.4	43.7	–33.5	–11.7	–43.4	–21.1

Source: The Nigerian dynamic computable general equilibrium model results.
Note: The poverty rate is the proportion of the population with per capita consumption below the poverty line.

able to expect that accelerated high agricultural growth will allow the southern regions to achieve the first MDG of halving the 1996 poverty rate by 2015. However, this will not be the case for the three northern regions.

Because there are no growth targets at the state or regional level, we have assumed a uniform target for each crop or livestock subsector across the six regions. Initial conditions and growth potentials are very different between the north and south. Analysis of NLSS 2003/04 and Core Welfare Indicator Survey (Nigeria, NBS 2007b) data shows that initial production conditions, such as access to fertilizer, are far worse in the north than in the south. Without special attention paid to the northern regions in terms of public investment, modern input access, and other input and output market development, the growth opportunities may be further biased toward the south. Unless this issue is given priority by the government, poverty reduction goals will be more difficult to achieve in the north.

Growth Multipliers and Subsector Contributions to Poverty Reduction

We now design a series of scenarios in which growth in some major crops or group of crops or livestock products are individually simulated, while assuming that productivity in other crops and subsectors remains at baseline levels. Although productivity growth in a subsector can be assumed exogenously, it does not imply that there is no growth impact on any other subsectors. Other sectors' growth is affected through linkage effects captured in the DCGE model. These effects include competition (and reallocation) over factors and inputs across subsectors, changes in relative prices, and changes in domestic demand and international trade. Because of these complex linkages, growth in subsectors other than the targeted subsector can be affected positively or negatively. For example, if increased maize supply can easily find demand (domestically or internationally) and the maize price does not fall significantly, then maize production will compete with other crops for additional resources (land or labor) and intermediate inputs (for example, fertilizer). Thus, growth in some crops, such as sorghum or millet, could be negatively affected. In contrast, if there are demand constraints stemming from low income elasticity of demand or a lack of export/import substitution opportunities, then domestic maize prices will fall. In this case, even if maize yield rises, maize output could increase by less than the growth in yields. Resources will then be released from maize production, and production of other crops could increase. These linkage effects imply that the realization of growth targets is jointly determined by supply and demand in the market. Therefore, policies affecting demand (including market development and access) are equally important for accelerating agricultural growth.

Understanding the magnitude of poverty reduction led by a specific sector's growth is important when designing pro-poor growth strategies. We analyze these linkages by calculating poverty–growth elasticities and growth multipliers. The latter allows us to compare spillover effects from growth in different subsectors. The poverty–growth elasticity measures the responsiveness of the poverty rate to changes in per capita GDP growth. Table 8.6 shows the calculated poverty–growth elasticities in the subsector scenarios. The value of the poverty-reduction elasticities from growth led by different subsectors are all greater in magnitude than the baseline elasticity of –0.851, the only exception being growth led by export crops. Thus, growth in agriculture, particularly in staples, is indeed pro-poor. The table also shows that growth driven by cereals is more effective at reducing poverty than growth in other crops and livestock subsectors.

More important is that the model results show that the poverty–growth elasticity significantly increases in the Agriculture scenario (rising to –1.144), indicating the strong synergy effects in poverty reduction across growth from different agricultural subsectors. For comparison, we report the poverty–growth elasticity for overall growth led by nonagriculture (see the final row of the table). It shows that the elasticity in this case is much lower (–0.73). These results indicate that for the same level of economic growth measured by total GDP, the poverty-reduction effect can be 57 percent higher if growth is led by the agricultural sector rather than by the non-

Table 8.6—Poverty–growth elasticity and growth multipliers

Sector driving growth	Poverty–growth elasticity	Growth multipliers	
		Total GDP	Agricultural GDP
Baseline scenario	–0.851		
Rice	–0.928	1.033	1.036
Wheat	–0.853	1.013	1.037
Maize	–0.914	1.282	1.146
Millet and sorghum	–0.915	3.642	2.786
Cereals	–1.024	1.305	1.184
Cassava	–0.893	1.286	1.120
Roots	–0.923	1.246	1.088
Pulses	–0.892	1.857	1.518
Exports	–0.814	0.700	0.974
Livestock	–0.858		
Fish	–0.896	1.084	1.027
Forestry	–0.861		
CAADP	–1.144		
Nonagriculture	–0.730	1.012	

Source: The Nigerian dynamic computable general equilibrium model results.
Notes: Poverty–growth elasticity is the change in poverty rate (the proportion of the population with per capita consumption below the poverty line) divided by the change in per capita GDP. A growth multiplier is the increase in total or agricultural GDPs divided by the increase in GDP in the sector leading overall GDP growth. CAADP = Comprehensive Africa Agriculture Development Programme. GDP = gross domestic product. Blank cells = not applicable.

agricultural sector. These results have strong implication for Nigeria's development strategy and for the allocation of public funds. This issue is discussed later in this chapter.

Growth multipliers are another important indicator for measuring the differential contribution of agricultural growth at the subsector level to economywide growth. We omit the multiplier results for the cases in which growth is led by livestock and forestry, because we also exogenously assume additional productivity growth in their relevant processing sectors in these scenarios. For example, in the livestock-led growth scenario, additional productivity growth in meat and milk processing is considered; in the forestry-led growth scenario the wood-processing growth is considered. Because additional productivity growth from these nonagricultural subsectors is assumed in these scenarios, it makes them difficult to compare with growth led by the crop subsectors and fisheries.

Among the three groups of crops, the highest growth multiplier is for pulses. This is true for the multipliers measured against both total and agricultural GDP. The results indicate that a unit increase in pulses production (real value-added) causes a 1.857-unit increase in total GDP or a 1.518-unit increase in agricultural GDP (in real terms). This high multiplier indicates strong linkages between pulse production and other economic activities. Similarly, cassava has a high growth multiplier among root crops.

At the individual crop level, millet and sorghum have the strongest multiplier effects. Economic linkages on the supply side come from (1) increased demand in intermediate inputs (that is, backward linkages); (2) provision of more low-cost inputs to other agricultural or food processing production (that is, forward linkages); and (3) release of resources (land and labor) to be used by other crops (that is, factor mobility linkages). Demand-side linkages are also strong and arise through increased demand for other agricultural and nonagricultural commodities as the result of increased farmer incomes from the additional growth of production in some agricultural subsectors. However, in the case of millet and sorghum, for which the highest growth multiplier is obtained in the simulation, the main reason is the effects of factor mobility linkages. Millet and sorghum are income-inelastic commodities: at higher income levels, households spend less income to consume additional millet and sorghum and prefer to allocate more income into consumption of other foods, such as rice, wheat, or livestock products. Growth in millet and sorghum supply from increased productivity is not necessarily the same as growth in the two crops' yields, which implies less land and labor are needed to produce these two crops when their yields increase. When fewer resources are used to produce millet and sorghum without lowering the supply level of these two crops (that is, when part of the land and labor initially used for millet and sorghum production can be released and reallocated into production of other crops, such as rice, maize, and wheat), the strong growth multiplier occurs. Thus, in the case of millet and sorghum, the model result seems to indicate that resources (primarily land) allocated to the production of these two crops are excessive when these two crops' productivity is low. Thus, when millet and sorghum become more productive, many other agricultural subsectors and the economy as a whole benefit through the multiplier effect of the two crops with the rest of economy.

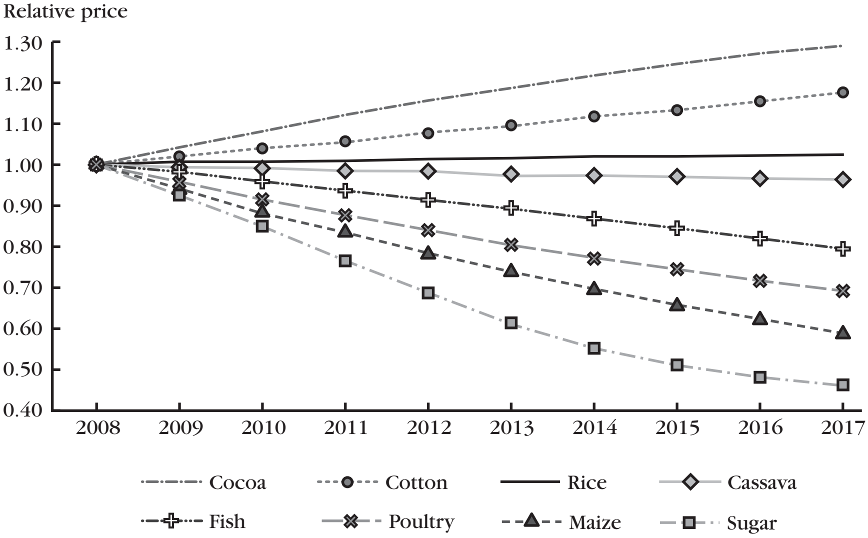
However, the value of the growth multiplier measured by gains in GDP in the case of growth led by export crop is smaller than one (see Table 8.6). When the growth multiplier is less than one, it indicates that, at the given level of resources, growth in some other sectors is negatively affected by the growth in the targeted subsectors (export crops in this case). The main reason is that domestic prices for export-oriented commodities are mainly determined by the international markets. With such price advantages, export-oriented sectors will compete with other sectors for resources (land, labor, capital, and other inputs). At the given resource level, competition affects the factor prices, which in turn makes it difficult for many other sectors to increase production. Of course, with fewer resources allocated, production in the other sectors falls. This result has important policy implication. Although developing export-oriented agricultural production is often high on the agenda of the government, growth in such production will have weak linkages with the domestic economy if there are no additional resources (land and labor) available in the country, or if export-oriented production cannot create domestic demand for such products (either through development of agroprocessing or through consumer demand). Focusing on export-oriented crops may also have negative effects on growth outside export-oriented production, which results in smaller economywide gains from such a strategy.

Price Effects from Accelerated Agricultural Growth

Even if productivity-led agricultural growth benefits a majority of households in both rural and urban areas, negative price effect from such growth can hurt some farmers. For those farmers who are unable to adopt the high-yield technology and still use traditional farming technology, lowered output prices caused by increased production from other, more productive, farmers implies that their revenues from producing the same amount of products fall. In contrast, for those farmers who have adopted the high-yield technology but are facing increased input prices (for example, higher fertilizer price), lowered output prices together with increased input prices might make them less profitable despite using modern technology. Thus, it is necessary to assess the possible price effect from accelerated agricultural growth in the Agriculture scenario.

Figure 8.4 shows the price trends for selected agricultural products in the Agriculture scenario. In Figure 8.4 prices for individual agricultural commodities

Figure 8.4—Agriculture price changes in the Agriculture scenario



Source: The Nigerian dynamic computable general equilibrium model results.
Note: Price changes are relative to baseline prices.

are normalized by the consumer price index (CPI), giving the change in a commodity's price relative to CPI, which represents the overall price level. It can be seen that in most cases, change in the prices is closely related to the magnitude of the growth in production of these products. Maize, sugar, poultry, and fish have annual growth rates between 9 and 32 percent, and prices for these products fall the most. The figure also shows that the price for rice, an import-substitutable crop with annual growth rate of 10.3 percent in the simulations, actually rises over time relative to CPI. As for export crops (cocoa and cotton) with annual growth rates higher than 10 percent in the simulation, their prices (relative to the CPI) also rise over time.

The price trends are also affected by the market demand for different commodities. If a commodity has higher income elasticity, can be substituted by imports, or can be exported in increased amounts, its price will be less affected by the increased supply. The high income elasticity implies that with increased income generated from growth (both in agricultural and nonagricultural activities), consumers prefer to allocate more of their incomes to consume such commodities. The income elasticity for primary agricultural goods is relatively high only in countries with an average per capita income just barely able to meet the basic needs. However, in the case of Nigeria, whose average per capita annual income is close to US$1,000, it is unlikely that most primary agricultural products will have high income elasticities. Although the income elasticities for the foods consumed by the poor in rural and urban areas are higher than that for the country as whole, they are unlikely to become the driving force in determining market demand, given the current income distribution in the country.

However, besides import substitution (such as in the case of rice and wheat), there are market opportunities for agriculture by developing agroprocessing industries in the country and by expanding the export market. Nigeria has the largest agroprocessing industry in West Africa. Promising export opportunities for many staple commodities do exist in both regional and global markets. An example is cassava, which accounts for the largest land allocation and highest agricultural value-added of any sector in the country. Cassava chips and flours are excellent inputs for both the feed and agroprocessing sectors and are in high demand in international markets as well. For instance, Thailand, which accounts for 10 percent of the world cassava production, exports 80 percent of its cassava products. Currently with around 22 million metric tons of cassava traded mostly as chips and flour, this country controls 70–80 percent of the world cassava market. In contrast, cassava in Nigeria is mainly for domestic food consumption. It is therefore reasonable to think that with the adoption of high-yield varieties, cost-effective processing technologies, and improved market access conditions, Nigeria could successfully export cassava to the rest of the world. In such a scenario, Nigeria could become one of the dominant cassava exporters in the world, and both the growth multiplier and poverty-reduction–growth elasticity of cassava-led growth would further increase.

Another example is the poultry sector. The results of our model show that poultry prices fall significantly when a high growth in poultry is targeted. However, current domestic poultry prices are not competitive, and without border protection in imports, domestic poultry prices would not be as high as they currently are. The model result actually shows that only through improving the poultry sector's productivity can the country eventually get rid of its import restriction, so that poultry could become an export commodity to the neighborhood countries in West Africa. Development of a modern poultry industry would provide the country not only with great export opportunities in poultry products but also would create more domestic demand for maize and other crops as poultry feed, which would further enhance the linkage and multiplier effects in the entire economy. The successful experience of Thailand becoming a large poultry exporter since the late 1980s illustrates such possibilities. The rapid growth in poultry exports has created a big market for maize in the country. Before that, feed demand in Thailand accounted for only a small portion of maize production (3–7 percent), similar to the situation in Nigeria today. With the development of the poultry industry, feed demand in Thailand now accounts for 70–80 percent of maize production (a tenfold increase over two decades). It is therefore reasonable to believe that development of the poultry sector in Nigeria offers an opportunity for maize production to grow, making it not only an important staple commodity for human consumption but also an important cash crop for many smallholder farmers. Table 8.7 summarizes the findings of our analysis in this section.

Agricultural Investment Analysis

Based on the DCGE model results, we estimate the required public investments in agriculture for 2009–17 in this section. In Nigeria supporting the agricultural sector is a joint responsibility of the three tiers of governments, federal, state, and local, as mandated by the 1999 constitution. To quantitatively estimate the required agricultural spending, the availability of time series data for the three tiers of government expenditure is critical. Unfortunately, we are unable to obtain spending data by different items (for example, spending on research and extension or on fertilizer subsidies) for any tier of government, and local government total spending data are also limited to a few recent years. Thus, we only consider federal and state total spending in the analysis. The methodology introduced in Chapter 2 is used here. It is based on an estimated elasticity relating agricultural TFP to public agricultural spending (a growth–spending elasticity). An agricultural TFP time series was obtained from Nin Pratt and Yu (2008).

The results of our investment analysis show that the growth–spending elasticity for Nigeria is 0.24. Although this elasticity is used in the analysis, to further analyze the sensitivity of required spending with respect to the choice of elasticity (which partially reflects the efficiency of spending), we also consider a case in which the elasticity increases to 0.41, which is close to the one obtained for cross-country estimations treating Sub-Saharan Africa as a whole. Agricultural growth is also affected by nonagricultural investment, and hence, the latter is also needed to estimate the agricultural growth response to nonagricultural spending. The estimated result is 0.46, rather high compared with the elasticity with respect to the agricultural spending. Given that most public good provision, including investment in infrastructure and spending on education and health, is counted as part of nonagricultural spending, the estimation result is not surprising, because such spending definitely benefits the entire economy, including the rural economy and the agricultural sector. However, measured as returns to the amount of spending, nonagricultural spending is not necessarily more effective than agricultural spending in terms of promoting agricultural growth. The size of nonagricultural spending is 20–25 times that of agricultural spending in Nigeria, which implies that a 1 percent increase in nonagricultural spending is equivalent to a 20–25 percent increase in agricultural spending. Thus, the dollar-to-dollar comparison still indicates that

Table 8.7—Summary of factors affecting priority setting in an agricultural strategy

	Size in the economy		Growth multiplier		Pro-poorness		Negative price effect		
Sector driving growth	**Qualitative assessment**	**Rank**	**Qualitative assessment**	**Rank**	**Qualitative assessment**	**Rank**	**Qualitative assessment**	**Rank**	**Opportunity**
Cereals	Large	2	Large	3	Large	1			
Rice	Large	4	Large	8	Large	2	Small	7	Import substitution
Maize	Large	7	Large	5	Large	5	Large	2	Feed industry development
Millet and sorghum	Large	5	Large	1	Large	3	Small	6	Food processing
Wheat	Small	13	Small	9	Large	11	Large	1	Import substitution
Roots	Large	1	Large	6	Large	3			
Cassava	Large	3	Large	4	Large	7	Small	5	Exports through processing
Pulses	Large	6	Large	2	Large	8			Domestic processing and exports
Export-oriented crops	Small	9	Small	10	Small	12	Small	9	Scale up possible
Livestock	Small	8			Large	9			
Poultry	Small	12					Large	3	Competitiveness and exports
Fishery	Large	10	Large	7	Large	6	Large	4	Food processing
Forestry	Small	11			Large	10	Small	8	Wood processing

Source: Authors' assessment based on the Nigerian dynamic computable general equilibrium model results.
Note: Blank cells = not applicable.

agricultural spending is more effective than nonagricultural spending for agricultural productivity growth.

But we are skeptical of using this nonagricultural spending elasticity in the analysis for the following reasons. First, constrained by the data availability, we have to define nonagricultural spending as the difference between total spending and agricultural spending. Thus, part of spending that is classified as nonagricultural may directly target agricultural and rural development (for example, rural road and rural electrification). Second, the quality of data for agricultural spending is relatively poor compared with the total spending data, and agricultural spending is a small portion of total spending (less than 4 percent in most years). As a result, the data are likely to produce a biased estimate by not fully distinguishing between the direct and indirect effects of nonagricultural spending. Furthermore, the estimated nonagricultural elasticity is inconsistent with growth in both agricultural and nonagricultural spending if we use it to calibrate the historical data. For these reasons, a calibration method is applied in this study for the nonagricultural elasticity using the historical data for agricultural and nonagricultural spending and growth in agricultural TFP, together with the estimated elasticity for the agricultural spending. The calibrated nonagricultural spending elasticity is 0.14.

We consider four scenarios in assessing the growth in agricultural spending required to support the 5.62 percent agricultural TFP growth rate obtained from the Agriculture scenario of the DCGE model. In the first scenario, the elasticity of agricultural TFP with respect to agriculture spending as our estimation result (0.24) is applied. We assume that the growth rate of nonagricultural spending is the same as that of the current trend (which is the same as in the baseline). Combining this value with an elasticity of 0.14 with respect to the nonagricultural spending, our analysis shows that 23.8 percent of annual growth in agricultural spending is required in 2009–17 to support the target of 9.45 percent agricultural growth (and 5.62 percent agricultural TFP growth). This result is consistent with the estimation of Fan, Yu, and Saurkar (2008), in which 25.1 percent of annual growth is required for agricultural spending to achieve the first MDG in Nigeria. However, when the agricultural spending is assumed to be more efficient in the second scenario of our analysis (that is, the value of elasticity is increased from 0.24 to 0.41), required agricultural spending only needs to grow at 13.6 percent per year (Table 8.8).

Using the additional growth in agricultural spending and given the growth in the nonagricultural spending, the share of agricultural spending in government total expenditure rises gradually. Currently, agriculture accounts for 4.2 percent of total government expenditure; this share will eventually rise to 14.6 percent by 2015 and 18.6 percent by 2017 using the low elasticity in the first scenario. In the second scenario with a high elasticity (that is, assuming improved spending efficiency), the share of agricultural expenditure in total spending will be 7.3 percent

Table 8.8—Estimated government resource allocation under investment analysis (percent)

Indicator/sector	Baseline scenario	Agricultural TFP growth due to PAE growth only: Low elasticity	Agricultural TFP growth due to PAE growth only: High elasticity	Agricultural TFP growth including effects of faster PNE growth: Low elasticity	Agricultural TFP growth including effects of faster PNE growth: High elasticity
Real annual growth rates					
Total GDP	6.5	8.0	8.0	8.0	8.0
Agriculture	5.7	9.5	9.5	9.5	9.5
Nonagriculture	6.5	8.0	8.0	8.0	8.0
National TFP	2.5	3.8	3.8	3.8	3.8
Agriculture	2.3	5.6	5.6	5.6	5.6
Nonagriculture	2.5	3.0	3.0	3.0	3.0
Total public spending	7.0	8.6	7.4	9.1	8.5
Agriculture	4.7	23.8	13.6	17.5	8.5
Nonagriculture	7.1	7.1	7.1	8.5	8.5
Government expenditure shares					
PAE/total expenditure					
2008	4.2	5.8	4.9	5.1	4.4
2015	3.6	14.6	7.3	8.6	4.4
2017	3.5	18.6	8.1	9.9	4.4
PAE/agricultural GDP					
2008	2.9	3.8	3.2	3.5	2.9
2015	2.7	9.1	4.2	5.7	2.8
2017	2.7	11.7	4.5	6.5	2.7
Total expenditure/total GDP					
2008	21.3	21.0	20.8	21.5	21.3
2015	22.1	21.6	19.9	22.8	21.8
2017	22.3	22.2	19.7	23.3	22.0

Source: The Nigerian investment analysis results.
Notes: GDP = gross domestic product. PAE = public agricultural expenditure. PNE = public nonagricultural expenditure. TFP = total factor productivity.

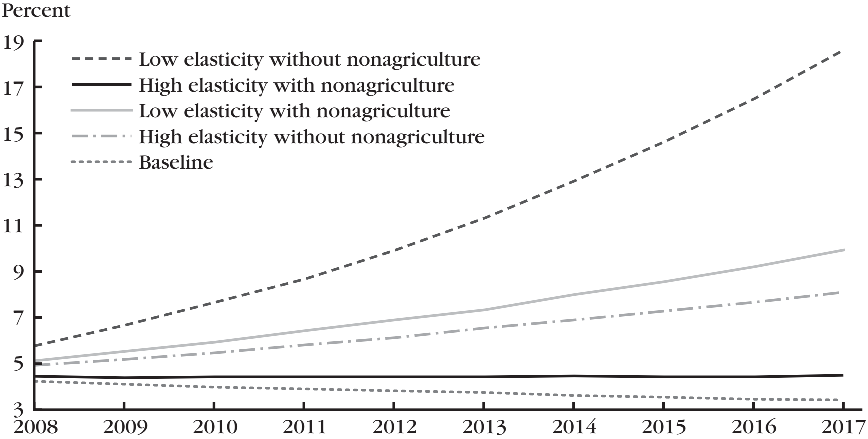
in 2015 and 8.1 percent in 2017 (see Table 8.8). It is necessary in practice to emphasize how to improve the spending efficiency to better support agricultural growth with limited resources. This issue is also important when the CAADP target of allocating 10 percent of the government's budget to the agricultural sector is considered. If the government can significantly improve its efficiency in agricultural investment, much less spending is required to support the same amount of agricultural and economic growth, and hence the share of agriculture in total spending does not necessarily need to be 10 percent.

In the first two scenarios, we assume the growth in nonagricultural spending is at its baseline level, and required agricultural spending is the only driver to support accelerated agricultural growth. In other words, we ignore the indirect effect of additional growth in nonagricultural spending on agricultural growth. In the third and fourth scenarios, we consider this factor and re-estimate the required agricultural spending using the low and high elasticities, respectively. Increased nonagricultural spending is assumed to be proportional to the nonagricultural sector's TFP growth, which increases to 2.98 percent per year from 2.47 percent in the baseline. Such growth in the DCGE model is primarily a result of growth linkages between agriculture and nonagriculture, that is, improvement in the agricultural economy benefits the nonagricultural sector. Consistent with increased nonagricultural TFP growth, annual growth in nonagricultural spending needs to rise from 7.06 percent in the baseline scenario to 8.52 percent in the accelerated agricultural growth scenario. Additional nonagricultural spending indirectly affects growth in agriculture. Using an elasticity of 0.14 with respect to nonagricultural spending, part of agricultural growth can be indirectly supported by additional government spending on the economy as whole. This lowers required annual growth in the agricultural spending from 23.8 percent to 17.5 percent (in scenario 3) using the low elasticity of agricultural spending (0.24), and from 13.6 percent to 8.5 percent using the high elasticity (0.41, in scenario 4).

Translated into monetary terms, the analysis shows that without taking into account the change in government nonagricultural spending and in the low elasticity scenario (scenario 1), the government will need to increase its investments in agriculture from 185 billion Nigerian nairas (NGN185 billion) currently (2008) to NGN1,265 and NGN1,940 billion (in 2006 prices) by 2015 and 2017, respectively. In contrast, in the baseline scenario, which follows the current growth trend in government spending, additional agricultural spending will be much lower—only NGN278 and NGN305 billion in 2015 and 2017 (Figure 8.5). When a more optimistic spending efficiency is assumed in the second scenario (that is, the high elasticity is used), agricultural spending will be NGN583 billion by 2015 and will reach NGN753 billion by 2017, implying that the improvement in investment efficiency allows the government to save more than NGN4,300 billion in total between 2009 and 2017 or more than NGN400 billion per year on average.

Improvement in agricultural spending efficiency also reduces the required total government spending. In scenario 1 with the low elasticity, the annual growth in total government expenditure will rise to 8.6 percent (see Table 8.8) and will reach NGN10,452 billion by 2017 (Figure 8.6), in contrast with 7.0 percent annual growth in the baseline and NGN8,817 billion in the baseline's 2017 prediction. Using the high elasticity in scenario 2, the annual growth in total government spending will be 7.4 percent. As a result, total government expenditure by 2017 stands at NGN9,265 billion, which is only NGN448 billion more than the baseline's 2017 estimation (see Figure 8.6).

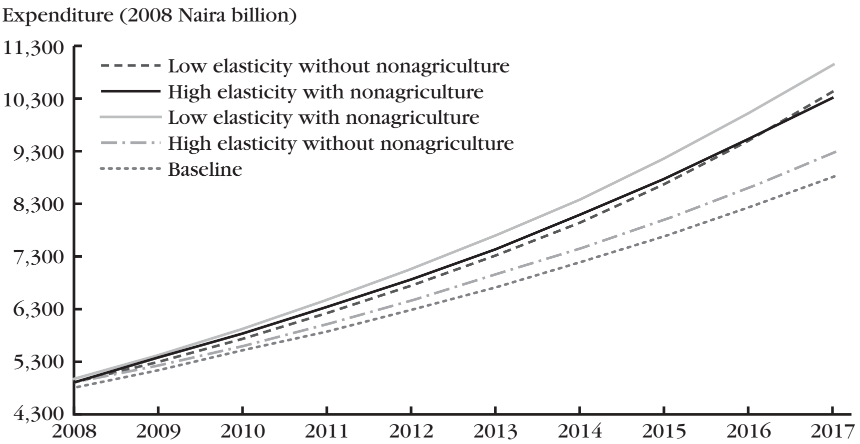
Figure 8.5—Additional agricultural spending required in the Agriculture scenario



Source: The Nigerian investment analysis results.

Note: Spending changes are relative to baseline spending.

Figure 8.6—Total spending required in the Agriculture scenario



Source: The Nigerian investment analysis results.

In the third and fourth scenarios when additional growth in nonagricultural spending and its indirect effect on agricultural growth are taken into consideration, a relatively slow growth in the required agricultural spending implies a reduced level of such spending over time. Using the low elasticity (scenario 3), the value of agricultural spending will reach NGN788 billion and NGN1,087 billion by 2015 and 2017, respectively, whereas the high elasticity in scenario 4, it will be NGN356 billion and NGN455 billion by 2015 and 2017, respectively. However, as additional spending on the nonagricultural sector is taken into account, total government spending will not decline from that in the previous two scenarios. In fact, with either low or high efficiency in agricultural spending, the total government spending rises over time (see Figure 8.6). That is to say, because nonagriculture accounts for a much larger share of total spending than does agriculture, even with very rapid growth in agricultural spending, the driving force of growth in the government total spending will still be the nonagricultural economy.

Conclusions

Several key messages emerge from our analysis. First, the size of an agricultural subsector is important for determining the importance of this subsector in stimulating overall growth. Although a high growth goal for a small subsector can be set, the economywide impact of this subsector is often small. Growth in a relatively large subsector generally creates more growth for the economy as a whole. The analysis in this chapter shows that even with double-digit growth in a small subsector (for example, wheat or sugar), its growth contribution to the agricultural sector as a whole could be insignificant. In contrast, a large agricultural subsector, such as rice or cassava, can create more growth in the whole economy, so that the sector can become the leading force in the growth process.

Second, priority setting needs to consider the linkage effect of a subsector to the rest of economy (for example, measured as a growth multiplier). A subsector with strong linkages to the rest of the economy can generate more gains as a whole than can a subsector with weak linkages. A subsector that can stimulate domestic demand either through agroprocessing or through generating income for a majority of farmers (for example, cassava or poultry) often has stronger multiplier effects for overall growth than does a subsector that is only exported as primary unprocessed products.

Third, the market opportunities of a subsector must be considered when setting priorities. Negative price effect is often an indicator of weak market opportunities or other types of market-access constraints. Growth is not only determined by productivity in the production process of a targeted agricultural subsector. It is also constrained by the market opportunities and conditions for accessing markets.

Often, both domestic and export (or import-substitution) market opportunities are interrelated with the development of the agroprocessing industry, trade policies in both domestic and international markets, and market-access conditions faced by producers. Thus, agricultural growth needs to be supported by pro-agriculture investments and interventions outside agriculture. This support is key for successful implementation of an agricultural strategy.

Finally, the pro-poorness of an agricultural subsector's growth should be a top consideration for any agricultural strategy. Even though agricultural growth is generally pro-poor, different types of agricultural growth can lift varying numbers of people out of poverty (in total and in different locations), depending on a country's poverty distribution across regions and among households. Carefully assessing the linkages between subsector agricultural growth and poverty reduction at both national and regional (state) levels and taking advantage of such linkages are important steps to ensure that agricultural growth is pro-poor.

Given Nigeria's size and constitutional structure, agricultural performance in the country is dependent not only on strategies set by the federal government. The state governments are also equally important players in determining the direction of agricultural development. Constrained by the lack of information on state-level policies and other economic data, our study discusses only the agricultural growth options for the country as a whole. Although more studies are necessary at the state level, some of our results in terms of priority setting in an agricultural strategy at the national level may also be useful for a state-level study. Moreover, the linkages between strategies at the state and at federal levels are an important aspect of strategic analysis for agricultural development.

We also estimated the required public investment to support accelerated agricultural growth and poverty reduction. Our analysis showed that the required growth in agricultural spending and the share of such spending in government total spending depend critically on two important factors: (1) the efficiency of agricultural investment and (2) the interaction of agriculture and nonagriculture in both broad economic activities and government investments. Growth in the agricultural sector and the rural economy depends on public investment in both agriculture and nonagriculture, and it is necessary to take into account possible increases in nonagricultural spending (on infrastructure, education, and health) when estimating the required agricultural spending. Estimated results of required agricultural spending will be quite different when possible impacts of increased nonagricultural spending on agricultural growth are taken into account. With the current inefficient agricultural spending patterns, required growth in the agricultural spending is extremely high (between 17.5 and 23.8 percent), and the resources the government has to mobilize to support accelerated agricultural growth will reach 18 percent of total spending by 2017. Considering the recent spending trends, it is obviously unlikely that the Nigerian government will increase agricultural spending to such levels before 2015. The increase in required agricultural spending growth will, in turn, drive rapid growth in total spending. Even if we take into account the indirect effect of nonagricultural spending on agricultural growth without improving spending efficiency, the required growth in total spending increases. Clearly, improving investment efficiency is the most important challenge for the Nigerian government to effectively support accelerated agricultural growth and help meet the first MGD. Increasing agricultural investment efficiency by 75 percent (so that the marginal effect of spending rises to 0.41 from its current value of 0.24), which is the average value for Sub-Saharan Africa as a whole, would significantly reduce required growth in both agricultural spending and total spending. It would then become more realistic to achieve the first MDG by mobilizing additional resources generated from economic growth.

Appendix

Table 8A.1—Structure of the Nigerian social accounting matrix

Agricultural sectors	Rice; wheat; maize; sorghum; millet; cassava; yams; cocoyams; potatoes; sweet potatoes; plantains; beans; groundnuts; soybeans; other oilseeds; vegetables; fruits; cocoa; coffee; cotton; oil palm; sugar; tobacco; nuts; cashew nuts; rubber; other export crops; cattle; goats and sheep; poultry; other livestock; forestry; fisheries
Industrial sectors	Crude oil; other mining; beef; goat and sheep meat; poultry meat; eggs; milk; other meat; beverages; other foods; textiles; wood processing; electronic manufacturing; other manufacturing; oil refining; construction; utilities
Service sectors	Road transportation; other transportation; trade; hotels and restaurants; communications; finance and other business services; real estate; education; health; public services; other private services
Factors	Agricultural land by region; agricultural labor; nonagricultural labor; agricultural capital; nonagricultural capital
Households	Rural and urban households by six regions (12 household groups)
Regions	South-central; Southeast; Southwest; North-central; Northeast; Northwest

Source: Authors.

Note

1. The rural poverty rate was 69.8 percent in 1996.

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