

**PROMOTING SUSTAINABLE PRO-POOR GROWTH IN RWANDAN AGRICULTURE:
WHAT ARE THE POLICY OPTIONS?**

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INTRODUCTION

In 2000, as part of its strategy for growth and poverty reduction, the Government of Rwanda set a goal to increase per capita income from US\$230 to US\$900 and halve the incidence of poverty by 2020. Two years after those targets were established Rwanda's first Poverty Reduction Strategy Paper (PRSP) projected that GDP growth in the range of 6 to 7 percent would be needed over the long term for those targets to be realized. The principal sources of growth in the short to medium term were to be the agriculture and manufacturing sectors, with agriculture projected to start at 5.2 percent and accelerate over the period due to productivity improvements. Manufacturing growth was projected to rise sharply to 11.5 percent, based on the expansion of manufacturing capacity in agro-processing, and then slow to a more sustainable level of 7 percent.

Between 1995 and 2005, real GDP grew at an average annual rate of 10 percent as the economy recovered from the effects of the 1994 genocide. Real GDP growth is now slowing, however. Between 2001 and 2005, average annual GDP growth averaged only 5.2 percent. If growth continues below 6 percent, this will be insufficient to reach the national development targets. The Government therefore needs quickly to put in place policies to accelerate growth. Transforming the agriculture sector will be a critical element of any growth strategy. Agriculture accounts for 35-40 percent of GDP, and employs around 80 percent of the population. It is also the main source of foreign exchange and the primary source of inputs for the manufacturing sector. Yet agricultural growth has been disappointing. Between 2001 and 2005, agricultural growth averaged 4.2 percent per year, below the target range of 5 to 8 percent set out in the PRSP. In recognition of the need to stimulate further sustained growth in agriculture, the government is now poised to identify and prioritize the key interventions.

This paper summarizes the findings of a recent study undertaken to help the Government of Rwanda prioritize the key measures by examining how the level of agricultural growth needed to achieve the national policy objectives can be achieved (see World Bank 2007). Some in Rwanda advocate the promotion of export crops, both traditional export crops (e.g., coffee, tea, pyrethrum, hides and skins) and non-traditional export crops (e.g., cut flowers, fruits, vegetables, essential oils, vanilla, silk, macadamia). Others argue that agricultural growth can best be stimulated in the short- to medium-term by increasing productivity in food staples, both crops and livestock. This debate mirrors those ongoing in many other developing countries, in sub-Saharan Africa and elsewhere.

AGRICULTURE IN THE ECONOMY OF RWANDA

Agriculture is the most important sector in the economy of Rwanda in terms of contribution to GDP, employment, and foreign exchange earnings. Agriculture's contribution to growth is even larger when strong multiplier effects are taken into account. Agriculture also contributes significantly to national food self-sufficiency, as over 90 percent of all food consumed in the country is domestically produced.

The agricultural sector currently accounts for about 42 percent of GDP in real terms. This figure is likely an underestimate, because it is difficult to measure the large amount of food that is produced and consumed at home. The sectoral share of agriculture in the national economy has fluctuated in recent years around a modest upward trend. Between

2001 and 2005, agricultural growth averaged 4.2 percent per year, below the target range of 5 to 8 percent set out in the Poverty Reduction Strategy Paper (PRSP) and Vision 2020 document. Considerable year-to-year variability around this trend was caused mainly by climatic fluctuations.

In 2005, approximately 90 percent of the economically active population was employed in agriculture. Despite government efforts to encourage migration of labor out of agriculture to relieve pressure on the country's severely constrained land resources, agriculture remains by far the main source of employment.

Extent and distribution of poverty

Rwanda is one of the poorest countries in the world, with an average annual per capita income of only US\$245. Results from the most recent Rwanda Integrated Household Living Conditions Survey (EICV, 2001) show that more than one-half of all Rwandans (52 percent) live in extreme poverty as measured by the international standard of US\$1 per day in income, and more than three-quarters of all Rwandans (84 percent) live in moderate poverty of less than US\$2 per day in income. Poverty in Rwanda is concentrated in the countryside: the rural poverty rate is 67 percent. Poverty is also strongly associated with working in agriculture, especially for wage laborers and female- or widow-headed households.

Rwanda's development strategy

The Government's strategy for reducing poverty and stimulating rapid and sustainable economic growth is described in the PRSP and further articulated in Vision 2020. These two documents lay out an ambitious development program to transform Rwanda into a middle-income country by 2020. The bold targets of Vision 2020 include increasing per capita GDP from US\$230 in 2000 to US\$900 in 2020, reducing the proportion of the poor from 60 percent of the population to 25 percent, increasing life expectancy from 49 to 65 years, and increasing the literacy rate from 48 to 90 percent.

Agriculture is identified in the PRSP and Vision 2020 as a leading engine of future economic growth. According to Vision 2020, agricultural transformation is expected to boost growth in both the formal and informal sectors, with the effect of reducing the proportion of the population dependant on agriculture from the present 87 percent to about 50 percent in 2020. Because agricultural productivity is currently very low, there is considerable potential to achieve rapid income gains by increasing productivity at the farm level. Vision 2020 calls for greatly increased public investment in agriculture during a "primary growth phase" lasting from 2002 to 2006, to be followed by greatly increased private investment during a "consolidation phase" lasting from 2006 to 2010.

A key pillar of the Government's agricultural development strategy is the *Plan Stratégique pour la Transformation Agricole* (PSTA), which was finalized in 2004 and launched in June 2006. The PSTA aims to increase the incomes of the rural population by improving agricultural productivity and facilitating transformation from a subsistence economy to one that is geared to production for domestic and export markets.

Cropping systems and production trends

Agriculture in Rwanda is dominated by small-scale, subsistence-oriented family farming units. Approximately 1.4 million rural households depend on agriculture as their main livelihood source. These households produce a range of food crops (cereals, roots and tubers, bananas, and vegetables), with approximately 66 percent of production destined for home consumption. The remaining 34 percent of production finds its way to local markets. Crops are produced mainly under rainfed conditions using mostly family labor and few or no purchased inputs (improved seed, fertilizer, and crop protection chemicals). Approximately 60 percent of households also keep animals for milk, eggs, and meat. These animals, are mainly local breeds, are raised using traditional low-input extensive grazing methods, although in the case of cattle the dwindling availability of pasture land is causing a shift to confined feeding with cut fodder supplemented by grain and/or roots and tubers. A minority of rural households also produces export crops, the most important of which are coffee (cultivated by approximately one-third of all rural households) and tea (cultivated by less than 1 percent of all rural households).

Food crops dominate the area planted to annual crops, reflecting the subsistence orientation of Rwandan agriculture. In 2005, roots and tubers accounted for the largest share of total cropped area (25 percent), followed by bananas (22 percent), cereals (21 percent), pulses including beans and peas (21 percent), fruits and vegetables (5 percent), and oilseeds (3 percent). Traditional export crops accounted for only 3 percent of total cropped area, including coffee (2 percent), tea (1 percent), and pyrethrum (<1 percent).

Livestock production contributes significantly to the agricultural economy, but this contribution is to some extent hidden, because most livestock products are consumed at home and do not enter the market. Livestock herds were decimated during the genocide, but they have since recovered, and numbers of cattle, sheep, and goats are now approximately equal to pre-genocide levels. However, productivity remains low with a limited adoption of technological change.

Food security is a concern for policy makers. Fueled by high population growth and modest income gains, demand for food has outstripped food production increases, so national food self-sufficiency has declined. Food imports, destined mainly for urban markets, increased 11.6 percent between 2003 and 2005. Although its food self-sufficiency rate is high (more than 90 percent), Rwanda remains a structurally food-deficit country, importing approximately 130,000 tons of food per year, mainly edible oil, wheat, sugar, rice, beans, maize, cooking bananas, and dairy products.

Agricultural growth drivers

Rwanda's strategy to stimulate increased agricultural growth focuses on raising agricultural productivity and increasing production through a series of interventions directed at the supply side: intensifying sustainable production systems, strengthening research and extension, improving input distribution, building capacity among farmers' organizations, promoting commodity chain development, improving export competitiveness, and strengthening the institutions that support agriculture. These measures are undeniably important. Yet agricultural growth cannot be achieved with a supply-push strategy. Over the longer term, it will not be possible to sustain increased

production of food and cash crops unless the increased production finds a ready market. So where will future demand come from for commodities produced in Rwanda?

Demand

Three main sources of demand exist for Rwandan agricultural products: (1) domestic markets, (2) regional markets, and (3) international markets.

Domestic markets have received relatively little attention in most discussions of future sources of agricultural growth in Rwanda. Yet, with the nation's population growing at nearly 3 percent per year, domestic demand for food will grow at a similar rate in the short to medium term. In addition, given present low levels of food consumption, especially among lower income groups, future income gains will translate into increased per capita food consumption, which could easily add an additional 1-2 percent to demand. Combining these two effects, domestic demand for food can support 5 percent growth in the domestic food crop and livestock sectors during the short to medium term.

This is not to say that external demand is unimportant. Domestic demand for food will eventually level off when the population stabilizes and income growth slows at higher per capita income levels. From that point on, agricultural growth will be sustainable only if opportunities can be exploited to export into regional and global markets. Developing agricultural exports will be needed as well to diversify the rural economy, making it less vulnerable to short-term fluctuations in the fortunes of individual crops.

For Rwanda's traditional export commodities, especially coffee and tea, demand in international markets remains strong, although the nature of that demand will continue to change as consumers shift into higher quality specialty grades. In the short to medium term, traditional export commodities—especially coffee and tea—will continue to make an important contribution to agricultural growth. Over the longer term, development of new non-traditional export sectors will be needed to sustain export growth.

Supply

What will drive future growth in Rwandan agriculture? On the supply side, three sources of future growth are possible: (1) increased scale of production, (2) increased productivity, and (3) value addition.

Increased scale of production: The most obvious way to increase the scale of production will be to expand the land frontier. With the highest population density in Africa and the smallest average farm sizes, Rwanda clearly faces a major challenge with regard to land. There is a widespread perception that the land frontier is by now largely exhausted, but this perception may be unwarranted. Total cultivated area could continue to increase at a rate of 1 to 1.5 percent per year for the foreseeable future through intensification. Experience from other densely populated countries, for example in East and South Asia, also suggests that cropping intensity can increase well beyond the level at which Rwanda currently finds itself, although significant investments will be needed in land, soil, and water management technologies. Although there is little scope for bringing new land under production, intensification of the currently cultivated area should be possible if underutilized marshlands can be developed and if upland areas can be cultivated more intensively (i.e., multiple-cropped).

Increased productivity: Crop yields in Rwanda are generally speaking low compared to yields in neighboring countries, especially when Rwanda's generally more favorable agro-climatic endowment is considered. This suggests that possibilities exist to increase productivity in Rwandan agriculture. A recent study assessed the prospects for achieving productivity gains in Rwanda, taking into account what is technically feasible and economically rational for farmers (see Aertssen et al. 2006). For food crops, comparison of farm-level yields (actual yields) with experimental yields (potential yields) shows large yield gaps ranging from a low of about 25 percent in banana to 75 percent or more for wheat, maize, and beans. For horticultural crops, the yield gaps are similarly large. While it is unreasonable to suppose that farm-level yields will attain the same level as experimental yields, the gaps observed in Rwanda are large compared to those observed in many other developing countries. The yield gap analysis thus suggests that the productivity growth targets being pursued by the Government of Rwanda are reasonable. In most cases, the goal is to achieve yield growth in the range of 3 to 5 percent per year over the short to medium term. Given the very low productivity levels in farmers' fields, and considering the scope for achieving significant yield gains through relatively modest changes in crop and resource management practices, productivity gains of this magnitude are considered achievable.

Increased value of production: Currently, most food staples destined for the domestic market are consumed with little or no processing. The nature of demand will change, however, as consumers begin to demand more highly processed foods and/or foods with special qualities, such as organically produced foods or nutritionally fortified foods. In contrast, the traditional export crops of coffee, tea, pyrethrum, and hides and skins are sold in global markets where demand for quality is evolving very rapidly and where niche markets for specialized high value products offer increasingly attractive returns for those who can compete successfully. For producers and exporters of Rwanda's traditional export commodities, the challenge will be to adopt quality enhancement measures and develop linkages to high-value niche markets. The premium prices that can be obtained in these markets will help to promote sustained production and contribute appreciably to future agricultural growth.

Competitiveness of Rwandan commodities

The fact that Rwanda is landlocked, with relatively poor links to external markets, has both positive and negative implications for Rwanda's agricultural sector. On the positive side, the country's geographical isolation, coupled with its predominantly mountainous terrain, confers a natural level of protection for Rwandan producers in the domestic market, because high transport costs make the prices of imported commodities very high within the country. On the negative side, the same factors that confer natural protection to Rwandan producers in domestic markets pose a major challenge to producers looking to regional or global markets. The high cost of transporting Rwandan commodities to regional or global markets must be absorbed in order for those commodities to be competitive outside the country. These effects are particularly important in the case of unprocessed staples that have a high volume-to-value ratio, including most roots and tubers, bananas, and cereals. For these low-value commodities, transport costs represent a large share of the final price, and this discourages transportation over large distances.

Because high external transport costs add appreciably to the landed cost of food imports, Rwandan food crop producers are generally able to compete effectively with imports in domestic markets, even when domestic production costs are relatively high by international standards. Yet rice, wheat, maize, beans, sugar, and vegetable oils are imported regularly from regional and international markets to compensate for structural deficits in production. Bananas, potatoes, cassava, beef, and fish, are imported in smaller quantities from neighboring countries, mainly Uganda, Democratic Republic of Congo, and Tanzania, with the volumes varying considerably from year to year depending on local production conditions.

High transport costs also affect the competitiveness of traditional export crops, notably coffee and tea, but two factors have enabled Rwandan coffee and tea producers to remain competitive in international markets. First, coffee and tea have high volume-to-value ratios, so transport costs make up a relatively smaller share of the final selling price than is the case with food staples. Second, by pursuing a high-quality strategy for coffee and tea, Rwandan exporters have been able to differentiate Rwandan products in global markets. This has allowed them to build demand for Rwandan branded products, which in turn has allowed them to obtain premium prices, especially for specialty coffees.

With the goal of stimulating increased growth, increasing foreign exchange earnings, and diversifying commercial agriculture away from its current heavy reliance on coffee and tea, policy makers are promoting non-traditional export crops—for example, horticultural crops including fruits, vegetables, and cut flowers; essential oils such as petunia and geranium; macadamia nuts; vanilla; and silk. Non-traditional export crops show some promise, but they are unlikely to be a major source of long-term pro-poor growth for the country, for two reasons. First, the scale of production is very limited. All of these enterprises are capital intensive, and while many do also generate employment, wage growth will be constrained by the need to compete with similar enterprises in countries that have better access to end markets. Second, most non-traditional exports are targeted at niche markets, which by definition are small and ephemeral.

PROSPECTS FOR GROWTH AND POVERTY REDUCTION

Options for increasing agricultural growth in Rwanda were assessed using the Rwanda economy-wide multi-market (REMM) simulation model.¹ The REMM also made possible evaluation of the linkages and the trade-offs between growth and poverty reduction at both macro and micro levels.

Base Year: Initial conditions

To provide additional context for the simulation results that follow, it is useful to review some of the economic characteristics represented by the base year data.

¹ The REMM model was developed by a team from the International Food Policy Research Institute (IFPRI), with the help of financial support provided by the UK Department for International Development and World-Bank administered Belgian trust funds

Land holdings and poverty distribution

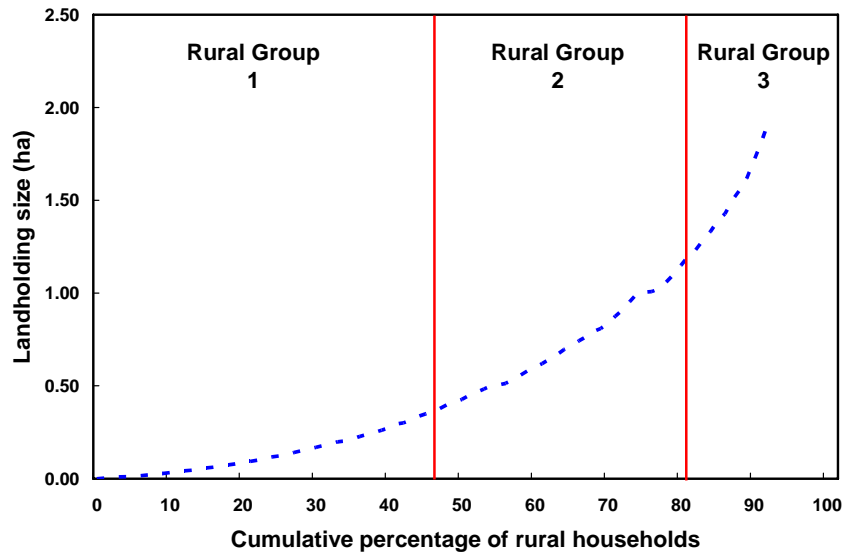
Rwanda's population of almost 9 million people is distributed across a land area of only 26,340 km². This gives Rwanda the highest average population density in sub-Saharan Africa—approximately 355 inhabitants per km² (in some places more than 1,000 inhabitants per km²). Land is arguably the single most critical natural resource for Rwandan agriculture. Since agricultural livelihoods depend critically on access to land, land is a key factor of production that heavily influences the welfare of rural households.

Insights into the distribution of land in Rwanda and the implications for household wealth and income can be gained by classifying the rural population into three roughly equal-sized groups, defined by landholding size:

- **Rural Group 1 (land holdings of less than 0.3 ha):** Approximately 40 percent of rural households hold less than 0.3 ha. Cumulatively, these households hold less than 6 percent of all agricultural land in the country. The average landholding per household is 0.11 ha, equivalent to 0.02 ha per capita when household size is taken into account. This group includes 11.5 percent of all households holding no land, i.e., landless households.
- **Rural Group 2 (land holdings between 0.3 ha and 1.0 ha):** Approximately 32 percent of rural households hold between 0.3 ha and 1.0 ha. Cumulatively, these households hold 25 percent of all agricultural land in the country. The average landholding per household is 0.58 ha, equivalent to 0.12 ha per capita when household size is taken into account.
- **Rural Group 3 (land holdings of more than 1.0 ha):** Approximately 26 percent of rural households hold more than 1.0 ha. Cumulatively, these households hold more than 70 percent of all agricultural land in the country. The average landholding per household is 1.94 ha, equivalent to 0.35 ha per capita when household size is taken into account.

The distribution of landholdings by Rural Group is shown in *Figure 1*.

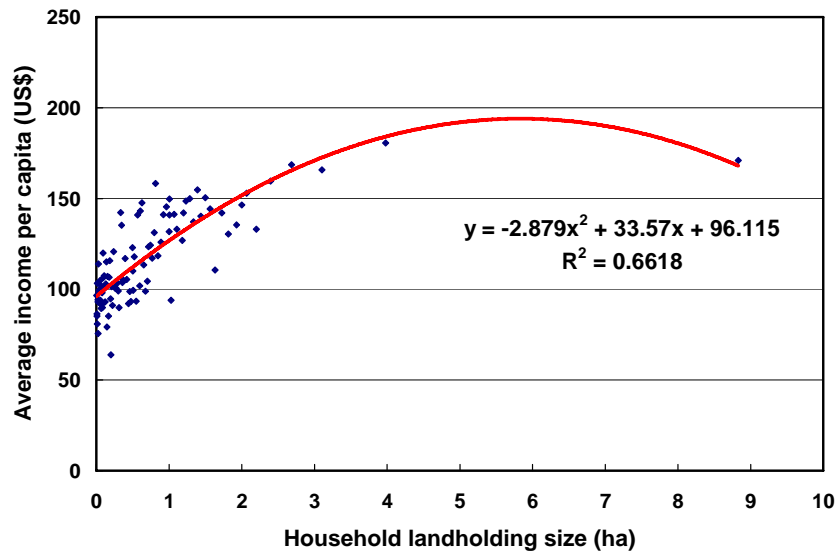
Figure 1. Distribution of landholdings by household size, Rwanda, 2001



Source: IFPRI calculations from EICV data, 2006.

The initial conditions prevailing in the base year of the REMM simulations strongly reinforce the idea that limited access to land is a key indicator explaining income inequality. Across the three rural groups, landholding size is highly correlated with household income ($R^2 = 0.66$) (Figure 2). Among all rural households holding less than 1 ha of land (a category that includes three-quarters of all rural households), more than 85 percent have an annual income below the national poverty line of US\$ 129.

Figure 2. Relationship between landholding size and income, Rwanda, 2001



Source: IFPRI calculations from EICV data, 2006.

Income distribution and consumption patterns

There are significant differences in average income among the three rural groups, but because the income level of the majority of households is everywhere low, there is no significant difference among the three rural groups in consumption patterns (*Table 1*). Consumption patterns do vary considerably among income quintiles, however, especially between the four lowest quintiles and the highest quintile. (*Table 2*). For this reason, the following discussion focuses on income quintiles.

Table 1. Annual commodity expenditures per household, Rwanda, 2003 (\$)

	Maize	Rice	Wheat	Cassava	Potatoes	Banana	Livestock	Total
Rural								
Lowest	15	2	2	26	26	10	5	287
Middle	40	6	3	65	67	49	18	756
Highest	61	19	7	99	73	186	100	1,493
Total	40	9	4	69	58	81	37	861
Urban								
Lowest	9	31	6	32	51	19	36	428
Middle	18	78	24	50	77	56	161	926
Highest	12	102	67	44	75	73	324	1,402
Total	14	80	36	44	70	52	184	974

Source: IFPRI Calculations from EICV data, 2006.

Table 2. Annual commodity expenditures by income quintile, 2003 (000 \$)

	Maize	Rice	Wheat	Cassava	Potatoes	Banana	Livestock	Total
Rural								
Lowest	3.7	0.5	0.4	6.8	6.8	2.6	1.4	74.0
Middle	10.9	1.6	0.8	17.6	18.3	13.4	4.9	205.5
Highest	21.3	6.6	2.4	34.3	25.5	64.5	34.7	519.0
Total	57.8	12.4	5.4	98.5	83.0	116.7	53.6	1,234.2
Urban								
Lowest	0.2	0.9	0.2	0.9	1.4	0.5	1.0	11.8
Middle	0.5	2.3	0.7	1.5	2.3	1.7	4.8	27.7
Highest	0.5	4.1	2.7	1.8	3.0	2.9	12.9	56.0
Total	2.2	12.6	5.7	6.9	11.1	8.2	29.0	153.4

Source: IFPRI Calculations from EICV data, 2006.

Analysis of the average budget share data from EICV reveals some clear patterns in food consumption patterns:

- Root crops account for one-third of total consumption expenditure for the rural households as a whole, and the shares are much higher among the low-income quintiles than that for the highest income quintile.
- Grain consumption accounts for about 8–10 percent of total consumption expenditure for rural households (except for the households in the highest income quintile). Low-income households consume more coarse grains, such as sorghum and maize, while high-income households consume more small grains, such as rice and wheat.
- Among other staples, bananas are strongly preferred among high-income households, as expenditure on bananas rises sharply in these households when income rises.
- As income increases, all households spend significantly more on livestock products and beverages. Nevertheless in the low-income quintiles, expenditure on livestock products still represents a very small budget share.

The EICV average budget share data reveal also that urban households have quite different spending patterns from the rural households:

- Expenditures on agricultural commodities account for slightly less than 50 percent of total household expenditure among urban households, as compared to more than 87 percent among rural households.
- Among urban households, the share of total expenditure going to grain purchases is comparable to the share among rural households. However the type of grain preferred differs: urban households spend mainly on rice and wheat, while rural households spend mainly on sorghum, maize, and millet.
- Urban households spend a very small budget share on root crops.
- As income increases, consumption of livestock products increases significantly among urban households.
- As income increases, consumption of bananas significantly decreases among the urban households.

Comparison of average budget shares across different income quintiles cannot fully reveal the changes in consumption patterns that occur with income growth. To get a better picture of income-related changes in consumption patterns, it is useful to consider also marginal budget shares, which reflect the marginal propensity to consume from additional income. A number of interesting insights emerge:

- There is no significant difference between the marginal and average budget shares of agricultural consumption for rural households, except among households in the highest income quintile. This pattern is typically found in situations of extreme poverty when households must devote a high share of their income to food purchases.
- For every additional FRW of income earned, the average rural household in Rwanda spends 0.84 FRW on food.

- Even the wealthiest rural households have a propensity to spend a large share of incremental income on food. Among rural households in the highest quintile, the marginal share of agricultural consumption falls only slightly to 74 percent, compared to an average budget share of 85 percent.

When rural households acquire additional income, their spending continues to be dominated by agricultural consumption, but the pattern of marginal spending varies among commodities and across income groups:

- For root crops the marginal budget share is generally lower than the average budget share, indicating that as incomes rise, most rural households consume relatively less of root crops and relatively more of other commodities. The effect is particularly pronounced for sweet potato, with the notable exception of households in the lowest income quintile, among which the marginal budget share for sweet potato exceeds the average budget share. These relationships confirm the status of sweet potato as a food for the very poor.
- For banana, the effect is the opposite: in the four lowest income quintiles, the marginal budget share is higher than the average budget share, indicating that as incomes rise, most rural households choose to consume relatively more of banana and relatively less of other commodities. Only in the highest income quintile does this relationship change; households in the highest income quintile consume relatively less of banana at the margin, indicating that beyond a certain income level, banana becomes an “inferior” food.
- Rural households in the highest income quintile display quite different marginal propensities to consume compared to their lower-income neighbors. For example, they spend a much smaller share of incremental income on root crops and cereals (except for rice), and they spend a much larger share of incremental income on livestock products, including meat and especially milk.

When urban households acquire more income, the extent to which the additional income is spent on food varies depending on the households’ income level.

- Among poor urban households (i.e., those included in the first two lowest income quintiles), average budget shares and marginal budget shares are similar, indicating that food purchases continue to dominate consumption expenditure. However, as their income rises, these households spend relatively less on root crops. Spending on cereals remains unchanged overall, but there is a clear shift away from coarse grains (sorghum and maize) toward small grains (rice and wheat).
- Among wealthy urban households (i.e., those included in the three highest income quintiles), increases in income result in relatively less spending on root crops, coarse grains, and banana, and relatively more spending on small grains (rice and wheat) and livestock products.

In considering these expenditure data, it is important to keep in mind that average and marginal budget shares do not necessarily give a good indication of the total amount of a given commodity consumed in the country (which is what determines the strength of

overall demand and hence production opportunities for farmers). This is because income is distributed very unequally, so total consumption tends to be heavily influenced by the expenditure choices made by wealthy households. The average and marginal budget shares for a given commodity may be very high among poor households, which make up the vast majority of all households, but if those shares are low among wealthy households, total consumption of that commodity will be low. Conversely, the average and marginal budget shares for a given commodity may be very low among poor households, but if those shares are high among wealthy households, total consumption of that commodity will be high.

In summary, the overall strength of demand for a given commodity is determined by a combination of the propensity of households to consume that commodity (at the margin as well as on average) and the amount of income commanded by households. Taking into account the EICV budget share data and the EICV absolute spending data, the following insights emerge:

- Demand for many commodities is dominated by demand emanating from wealthy households, given the much higher income and expenditure levels of these households compared to poor households.
- Given current low consumption levels among poor households and significant differences in the amount of staples consumed by wealthy households and poor households, demand for most staple foods will increase significantly with income growth, especially income growth among the poor households.
- If future economic growth benefits wealthy households more than poor households, then demand growth in sorghum, cassava and maize will be limited, given that the marginal propensity to consume these commodities is low among wealthy households. At the same time, demand for commodities preferred by wealthy households will increase significantly, including wheat, rice, and livestock products.

Simulation results

The REMM was developed to allow simulation of the likely impacts of alternative policy scenarios on growth, incomes and poverty, food security, and the trade balance. Since these impacts must be evaluated relative to a baseline, first it was necessary to simulate a Base Run Scenario representing the “business as usual” option, under which agricultural and non-agricultural growth are assumed to continue along current trends.

Base Run Scenario

Under the Base Run Scenario, the REMM model was used to simulate results over a 10-year period from 2005-15. The parameters used for the Base Run scenario are described in IFPRI (2006). Values for agricultural and non-agricultural growth parameters were set to reflect the rates that were actually registered during the previous decade. Some growth rates were subjectively adjusted downward, however, in the expectation that the unusually high growth rates recorded as the nation recovered from the effects of the genocide will not be maintained over the longer term. In effect, the Base Run Scenario represents the “business as usual” option.

Key results generated under the Base Run Scenario appear in *Table 3* and *Figure 3* and are summarized below.

Table 3. Income growth and poverty reduction, REMM simulation results

Annual growth rate, 2000-05 (%)	Growth rate in Base Run	Growth rate in Scenario 23	Additional growth vs. Base Run
GDP	3.88	6.24	2.36
Ag GDP	3.60	6.17	2.57
Non Ag GDP	4.08	6.28	2.21
GDP pc	1.15	3.44	2.29
Ag GDP pc	0.87	3.37	2.50
Non Ag GDP pc	1.34	3.49	2.15
Income for rural HH with cash crop	3.89	6.33	2.44
Income for rural HH without cash crop (10% of total rural HH)	3.73	6.01	2.28
Income for rural male-headed HH	3.87	6.37	2.50
Income for rural female-headed HH	3.90	6.18	2.28
Income for Rural Group 1	3.70	6.21	2.51
Income for Rural Group 2	3.89	6.33	2.45
Income for Rural Group 3	3.91	6.34	2.43
Staple production	3.76	6.21	2.45
Grain production	4.12	9.62	5.50
Root production	2.21	3.27	1.06
Pulse and oilseed production	1.44	3.69	2.25
Livestock production	4.28	7.82	3.54
Export crop production	1.21	9.93	8.72
Poverty measures	Poverty rate in 2005	Poverty rate by 2015	Poverty reduction (%)
National	59.2	42.4	-16.8
Rural	64.5	46.6	-17.9
Rural HH with cash crops	62.2	43.6	-18.7
Rural HH without cash crops	88.5	78.3	-10.2
Rural male-headed HH	61.9	43.6	-18.4
Rural female-headed HH	71.4	54.7	-16.7
Rural Group 1	73.1	56.9	-16.2
Rural Group 2	66.0	46.2	-19.8
Rural Group 3	52.5	34.4	-18.0

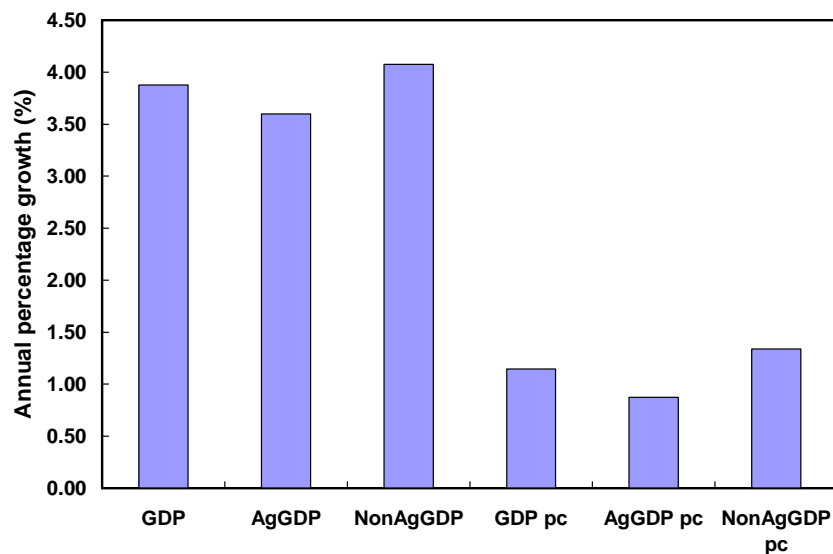
Source: IFPRI REMM simulations, 2006.

Growth

Modest agricultural growth averaging 3.60 percent per year will combine with slightly stronger non-agricultural growth averaging 4.08 percent per year to produce overall GDP growth of 3.88 percent per year from 2005 to 2015. Continued robust population growth averaging about 2.7 percent per year will reduce GDP growth per capita to only 1.15 percent, reflecting the combined effects of 0.87 percent annual growth in agricultural GDP per capita and 1.34 percent annual growth in non-agricultural GDP per capita.

Within the agricultural sector, growth in the grains sub-sector (4.12 percent per year) and in the livestock sub-sector (4.28 percent per year) will be considerably higher than growth in the export crops sub-sector (1.21 percent per year).

Figure 3. Annual GDP growth, REMM base run scenario, 2005-2015

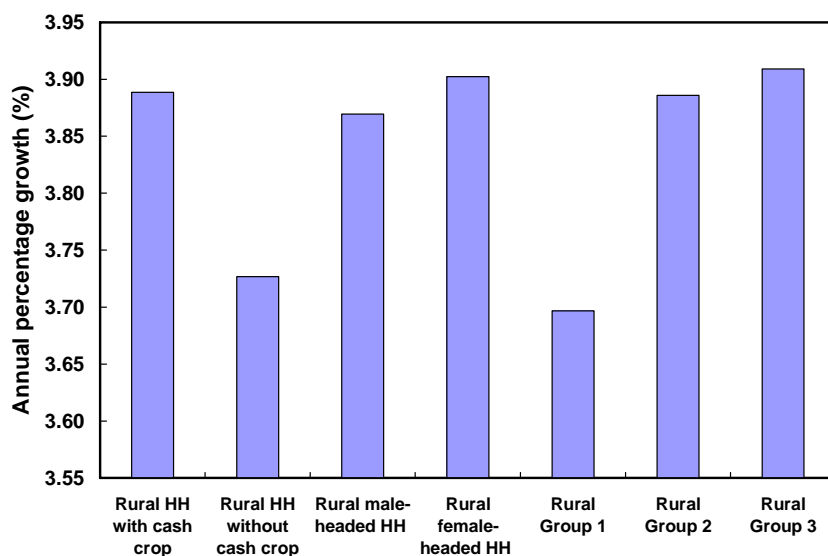


Source: IFPRI REMM simulations, 2006.

Incomes and poverty

The income gains associated with GDP growth will be distributed unevenly (**Figure 4**). Income growth will be highest among the relatively wealthy households in Rural Group 3 (3.91 percent year) and lowest among the relatively poor households in Rural Group 1 (3.70 percent per year). Female-headed households will do slightly better than male-headed households, experiencing income growth of 3.90 percent per year compared to only 3.87 percent among male-headed households. As a group, the 90 percent of rural households that engage in cultivation of cash crops (defined as coffee, tea, pyrethrum, hides and skins, potatoes, fruits and vegetables, sugar, and beverages) will experience higher income growth (3.89 percent per year) than will the 10 percent of households who do not cultivate cash crops (3.73 percent per year).

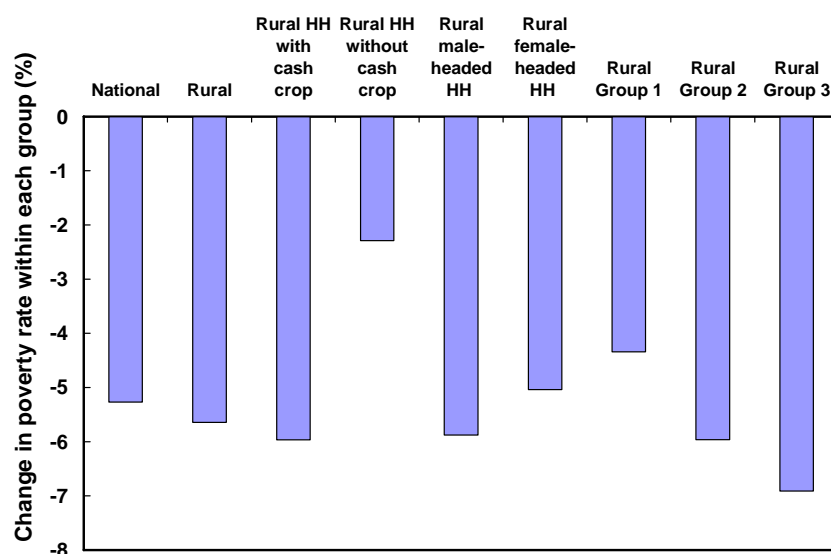
Figure 4. GDP growth by household type, REMM base run scenario, 2005-15



Source: IFPRI REMM simulations, 2006.

The overall national poverty rate will fall from 59.2 percent in 2005 to 53.9 percent in 2015. The number of people living below the poverty line will actually increase, however, rising from 4.95 million to 5.88 million because of continuing robust population growth. The poverty-reducing effects of growth will differ across the population. For example, the rural poverty rate will decline from 64.5 percent in 2005 to 58.9 percent in 2015, while the urban poverty rate will decline from 13.8 percent to 11.7 percent during the same period. Within the rural population, the incidence of poverty in 2015 will remain much higher in Rural Group 1 (68.0 percent) than in Rural Group 3 (45.8 percent). The incidence of poverty among rural households that do not engage in cash cropping will actually rise, to 86.2 percent, and it will be much higher than the incidence of poverty among rural households that engage in cash cropping (52.3 percent). Rural female-headed households will not benefit from growth nearly as much as rural male-headed households; the poverty rate among rural female-headed households will remain stubbornly high at 66.4 percent, compared to only 56.0 percent among male-headed households (*Figure 5*).

Figure 5. Declines in poverty rate by household type, REMM base run scenario, 2005-15



Source: IFPRI REMM simulations, 2006.

Food availability

Rwanda currently depends on imports to meet domestic consumption requirements for a number of key food commodities, including vegetable oil, wheat, sugar, maize, rice, and dairy products. Under the Base Run Scenario, projected increases in production of these commodities fails to keep pace with rising demand, resulting in increased levels of food imports by 2015 and a decline in national food self-sufficiency (*Table 4*).

Table 4. Projected imports of agricultural commodities, 2015

	Base year (2003)		Growth simulation (Scenario 23)		
	Production (1000 mt)	Imports (1000 mt)	Projected production in 2015 (1000 mt)	Projected imports in 2015 (1000 mt)	Annual import growth rate (2005-15) (%)
Maize	81	11	189	42	15.0
Rice	28	13	108	0	---
Wheat	15	20	36	30	3.9
Beans	240	8	367	96	16.7
Vegoil	1	6	2	9	3.0
Sugar	7	11	15	20	5.7
Milk	129	3	323	0	

Source: IFPRI REMM simulations, 2006.

Balance of trade

Rwanda depends heavily on agriculture to generate export earnings. In the base year of 2005, agricultural exports—mainly tea and coffee—contributed to a net agricultural trade surplus of about US\$ 15.4 million. Under the Base Run Scenario, agricultural exports grow at an average annual rate of 2.26 percent, while agricultural imports grow at an average annual rate of 2.34 percent. Because imports are smaller in absolute terms than exports, even though import growth is higher in percentage terms, under the Base Run Scenario the agricultural trade surplus actually increases to US\$ 66.3 million per year by 2015 (*Table 5*).

Table 5. Projected agricultural export growth and agricultural trade balance

Base Run Scenario annual growth rates (%), 2005-2015	Production	Exports
Coffee	1.09	0.95
Tea	1.09	0.97
Pyrethrum	7.28	7.28
Hides & Skins	4.29	4.29
	Annual growth rate (%)	
Agricultural exports		2.3
Agricultural imports		2.3
	Agricultural trade surpluses	
Agricultural trade surpluses in the base year (1000 \$US)		15,474
Agricultural trade surpluses by 2015 (1000 \$US)		19,041
Growth Scenario annual growth rates (%), 2005-2015	Production	Exports
Coffee	8.8	8.9
Tea	9.9	10.1
Pyrethrum	22.4	22.4
Hides & Skins	4.9	4.9
	Annual growth rate (%)	
Agricultural exports		9.9
Agricultural imports		5.3
	Agricultural trade surpluses	
Agricultural trade surpluses in the base year (1000 \$US)		15,474
Agricultural trade surpluses by 2015 (1000 \$US)		66,348

Source: IFPRI REMM simulations, 2006.

Summary of Base Run Scenario

Business as usual is not an option if Rwanda is to meet its national development targets, including the MDG and NEPAD goals. The results of the Base Run Scenario highlight that a continuation of current policies will bring about a modest reduction in the national poverty rate, but the absolute number of people living below the poverty line will actually increase because of population growth. Food self-sufficiency at the national level will be eroded in the face of rising food imports, and the trade balance will improve only slightly as increased export earnings stay just ahead of the rising cost of food imports.

Growth simulations

To assess how agriculture can contribute to growth and poverty reduction in Rwanda, a series of simulations was carried out using the REMM. These simulations, numbering 25 in all, included scenarios based on: (i) projected growth in production of individual commodities, (ii) projected growth in production of groups of commodities, (iii) projected growth in the non-agricultural sectors, and (iv) projected growth in all commodities / groups of commodities as well as in the two non-agricultural sectors.

The first set of simulations models the effects of exogenous increases in the production growth rates of each commodity considered one at a time, holding the production growth rates of all other commodities at their baseline levels (i.e., the levels used in the Base Run Scenario). Because the baseline levels of production of the various commodities differ, similar increases in production growth rates for different commodities can generate very different levels of economy-wide growth and impacts on poverty. To assess the extent to which a given commodity can drive economic growth, both the linkage effects on the economy and poverty, as well as the growth potential (determined by supply and demand factors) need to be considered.

The exogenous increases in production growth rates used to drive the simulations were generated in two ways. For about one-third of the commodities included in the REMM (12 out of 30), official national growth targets have been promulgated by the Government of Rwanda. Typically these official national growth targets appear in the form of the total production of a particular crop that is expected to be achieved in a specified future year, the area that is expected to be planted to the crop, and/or the average national yield that is expected to be realized. The official national growth targets were used to calculate projected future average annual rates of production growth. For the remaining commodities, projected future average annual rates of production growth were set equal to or slightly higher than the baseline growth rates (themselves derived from historical trends) to reflect expected future productivity gains attributable to technical change. (Details of the growth rate projections appear in IFPRI 2006.) Under the various growth scenarios, the increased production growth rates are maintained through 2015.

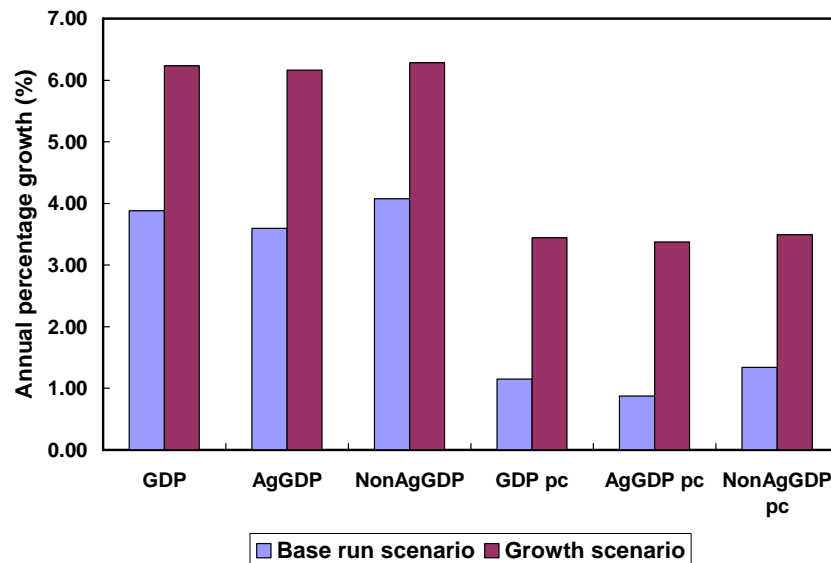
Key insights emerging from the growth scenario simulations are summarized in *Figure 6* and described below.

Growth

If the projected growth rates are realized for all commodities, agricultural GDP will grow at an average annual rate of 6.17 percent between 2005 and 2015, roughly double the

3.60 percent average annual rate projected under the Base Run Scenario. Increased agricultural growth will have a pronounced impact on the economy as a whole. Average annual growth in total GDP registered over the 10-year period would rise from 3.88 percent under the Base Run Scenario to 6.24 percent. These projected gains in total GDP growth include the effects of assumed 4.08 percent average annual growth in the manufacturing and services sectors, some of which is induced growth linked to growth in agriculture.

Figure 6. Annual GDP growth, REMM base run vs. growth scenario, 2005-2015



Source: IFPRI REMM simulations, 2006.

The projected agricultural growth rate of 6.17 percent per year is the same as the growth rate that has been achieved in Rwanda during the past decade, during a period when the rural economy has been recovering from the effects of the genocide. This rate is high compared to the rates that have been recorded in other developing countries over the longer term. While some would question whether agricultural growth in excess of 6 percent per year can be maintained, it is considered achievable in Rwanda, for at least five reasons. First, the rural economy has not yet recovered completely from the effects of the genocide. Second, productivity levels for many commodities are currently very low, so there are large yield gaps that can be exploited immediately. Third, the higher yield levels assumed in 2015 are still very modest by international standards. Fourth, ongoing marshlands development activities are providing a strong impetus to agricultural intensification efforts. Fifth, the strategy of targeting the specialty coffee and tea markets will add significant value to the already important coffee and tea crops even if the quantity of coffee and tea exports increase only modestly.

Because production and consumption patterns vary among household groups, there is considerable variability among household groups that is not evident from the overall

(population-wide) averages.² The sources of growth for different household groups are shown in *Table 6*. The following results are particularly noteworthy:

- Growth in *cereals* is very important across all households, contributing between 16.9 and 27.7 percent of income growth. Cereals are extremely important for rural households that do not engage in cash crop production, contributing 26.3 percent to their income growth under Scenario 23.
- Growth in *livestock* is important generally, contributing 13.6 and 20.1 percent of income growth for the three household groups. Livestock-led growth is particularly important for Rural Group 3, contributing 20.1 percent of the income growth realized by this group. Livestock-led growth is relatively more important for male-headed households in general, contributing 18 percent of the projected income growth for these households.
- Growth in *export crops* is much more important for male-headed households than for female-headed households. The importance of export crop-led growth is also positively correlated with land holding size: growth in export crops contributes 21 percent of the projected income growth for Rural Group 3, compared to only 16 percent of the projected income growth for Rural Group 1.

² In the REMM, poverty is measured based on the income and expenditures of individual households, but average income growth rates are measured at more aggregate levels (e.g., national level, household group level). Although they are calculated as an average of individual household incomes and expenditure measures, the average income growth rates obviously do not represent the income increase for each individual household. Because the production and consumption activities of individual households differ, some individual households achieve more rapid income gains than others. For example, export crops account for 21 percent of income growth on average for Rural Group 3, but for the poor households in this group who engage in limited production of export crops, export crops represent a minor source of income. Because production of export crops is much more concentrated among a smaller number of households (especially poor households) than production of staples, if growth at the national level is led by the export sector, fewer households benefit from such growth, and poor households whose income derives mainly from non-cash crop production will benefit less. In considering alternative growth strategies, policy makers therefore need to take into account household-level heterogeneity in production and consumption patterns, since these can lead to big differences between the income effect and the poverty reduction effect resulting from growth in a specific agricultural sub-sector.

Table 6. Sources of income growth and poverty reduction in the model

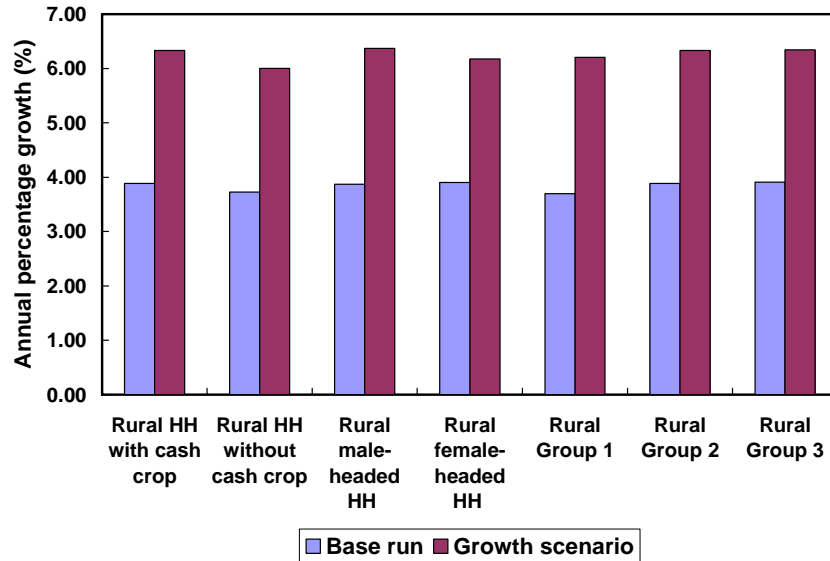
	Non-agriculture	Agriculture	Staple crops and livestock				Total	Export crops
			Cereals	Roots & bananas	Pulses & oilseeds	Livestock		
<i>Contribution to income growth (total is 100)</i>								
GDP	49.9	50.1	14.3	3.4	3.1	14.2	35.0	15.1
Ag GDP	2.7	97.3	30.1	7.2	6.9	25.1	69.2	28.1
<i>Income for different rural household groups:</i>								
With cash crop	33.7	66.3	19.3	4.5	4.1	17.2	45.1	21.2
Without cash crop (10% of rural)	48.5	51.5	26.3	4.3	7.4	7.6	45.6	5.9
Male-headed	32.1	67.9	19.1	4.4	4.1	18.0	45.5	22.3
Female-headed	38.7	61.3	19.7	4.5	4.5	17.1	45.8	15.5
Rural Group 1	27.9	72.1	27.7	6.0	5.2	13.6	52.4	19.7
Rural Group 2	32.6	67.4	20.6	4.6	4.1	14.6	43.9	23.5
Rural Group 3	35.3	64.7	16.9	4.0	4.0	20.1	45.0	19.8
<i>Contribution to poverty reduction (total is 100)</i>								
National	39.4	60.6	11.5	4.2	9.6	15.0	40.2	20.4
Rural	37.0	63.0	11.8	4.4	9.8	15.6	41.6	21.4
<i>Poverty level of different rural household groups:</i>								
With cash crop	36.7	63.3	11.2	4.3	9.3	16.0	40.9	22.4
Without cash crop (10% of rural)	41.1	58.9	19.5	6.0	16.1	9.9	51.5	7.3
Male-headed	36.5	63.5	12.1	2.9	9.4	16.5	40.9	22.6
Female-headed	38.3	61.7	11.0	8.2	10.7	13.3	43.2	18.5
Rural Group 1	33.2	66.8	18.7	6.0	9.8	12.1	46.6	20.2
Rural Group 2	42.4	57.6	7.5	2.3	10.3	15.7	35.8	21.8
Rural Group 3	34.3	65.7	8.1	5.1	8.9	20.9	42.9	22.8

Source: IFPRI REMM simulations, 2006.

Incomes and poverty

The simulations make clear that the benefits of accelerated agricultural growth will be distributed fairly evenly across rural households (*Figure 7*). Under Scenario 23, average annual income growth realized by Rural Groups 1, 2, and 3 are 6.21 percent, 6.33 percent, and 6.34 percent, respectively.

Figure 7. GDP growth by household type, REMM base run vs. growth scenario, 2005-15



Source: IFPRI REMM simulations, 2006.

Within each of the three rural groups, income growth will vary depending on the demographic characteristics of the household and the particular mix of cropping activities in which its members engage (*Figure 7*).

Gender: Income growth among male-headed rural households will average 6.37 percent per year, compared to only 6.18 percent per year among female-headed rural households. This difference in projected income growth rates, while relatively small (0.19 percent per year), will further exacerbate the existing poverty gender gap.

Cash crops vs. food crops: Income growth among the approximately 90 percent of rural households that engage in cash crop production will average 6.33 percent per year, compared to only 6.01 percent among the approximately 10 percent of rural households that engage exclusively in food crop production for home consumption. This indicates that the poverty rates among these two rural household groups will widen. By 2015, the poverty rate among households that engage in cash crop production will have fallen to 74.6 percent, while the poverty rate among households that do not engage in cash crop production will remain at 88.5 percent.

With the income growth projected under Scenario 23, the national poverty rate will fall from 59.2 percent in 2005 to 42.4 percent in 2015, a reduction of 16.8 percentage points.

Although poverty rates will fall within all three rural groups, the size of the declines will vary between groups, and by 2015 there will be significant differences in poverty rates among the three groups (*Table 6*). Within Rural Group 1, the poverty rate will remain stubbornly high at 56.9 percent, whereas in Rural Group 3 the poverty rate will fall to 34.4 percent. As observed under the Base Run Scenario, the benefits of accelerated income growth will be distributed unequally among different types of households. Rural female-headed households will benefit less than rural male-headed households; the poverty rate among rural female-headed households will fall from 71.4 percent in 2005 to 54.7 percent in 2015, compared to a decline among rural male-headed households from 61.9 percent in 2005 to 43.6 percent in 2015. Similarly, the incidence of poverty among rural households that do not engage in cash cropping will remain at 74.6 percent, significantly higher than the incidence among rural households that do engage in cash cropping (39.0 percent).

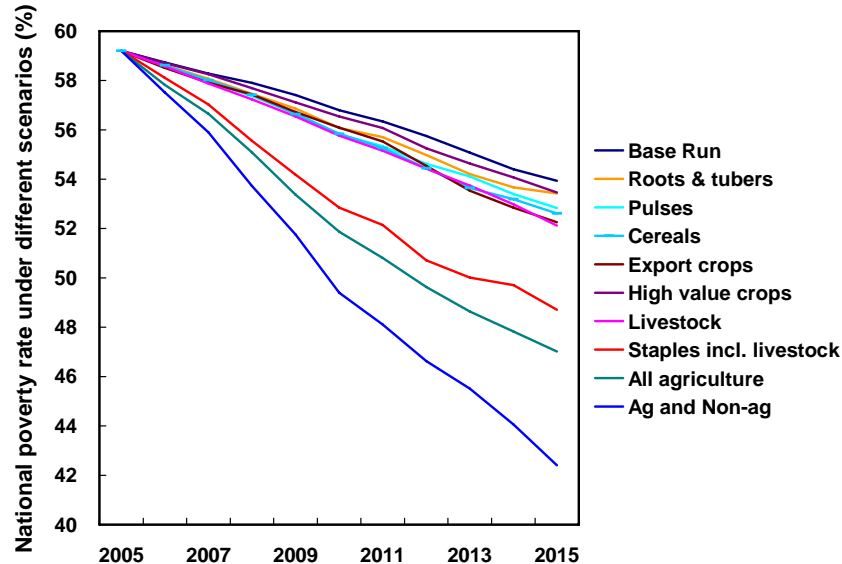
The contribution to poverty reduction of different commodities and commodity groups varies across rural household groups. Because production and consumption patterns vary among households and household groups, there is considerable variability among household groups that is not evident from the overall (population-wide) averages. The sources of poverty reduction for different household groups are shown in *Table 6*. The impacts of individual commodities or commodity groups in terms of reducing poverty may or may not be similar to their impacts in terms of contributing to increased growth.

- Growth in **food staples** is the dominant source of poverty reduction. This is true for all types of rural households: food crops and livestock account for 35.8 to 46.6 percent of poverty reduction across all of the different rural household groups.
- Growth in **pulses and oilseeds, roots and tubers, and bananas** is very important for reducing poverty across all households, especially among households that do not engage in cash crop production, accounting for 16.1 and 6 percent of poverty reduction respectively in these households. This compares to their contributions to income growth in these households of 7.4 and 4.3 percent, respectively.
- Growth in **cereals** is more important in terms of poverty reduction for this household group. Growth in cereals production accounts for 26.3 percent of income growth among households that do not engage in cash crop production, and 19.5 percent of poverty reduction.
- Growth in **livestock** has approximately the same impact on poverty reduction (12.1 – 20.9 percent across the three rural groups) as it does in raising incomes (13.6 – 20.1 percent).
- Growth in **export crops** has approximately the same impact on poverty reduction (20.2 – 22.8 percent across the three rural groups) as it does in raising incomes (19.7 – 23.5 percent).

The impact on poverty of different growth scenarios are shown in *Figure 8*. The greatest amount of poverty reduction comes from a balanced combination of agricultural and non-agricultural growth. Under the Agricultural and Non-Agricultural Growth Scenario, the

national poverty rate falls from 59.2 percent in 2005 to 42.4 percent in 2015. Among the various agricultural sector-led growth scenarios, staples-led growth contributes the most to poverty reduction (the national poverty rate falls from 59.2 percent in 2006 to 48.7 percent in 2015). In comparison, exports-led growth has a much more limited impact on poverty, reducing the national poverty rate from 59.2 in 2006 to 58.2 percent in 2015.

Figure 8. Summary of poverty impacts from different simulations, 2006-15



Source: IFPRI REMM simulations, 2006.

Food availability

Assuming the official growth targets for **cereals** are met, domestic supplies of cereals will increase significantly. However the projected production gains will not always be large enough to reduce or eliminate imports. In wheat, production gains will reduce reliance on imports, but imports will still be needed to meet rapidly growing demand. In rice, increased production will allow domestic consumption needs to be met, and imports will cease. In maize, production gains will not keep pace with projected strong increases in demand for livestock feed, leading to increased imports. The combined effect of these changes will be an increase in the overall level of cereals imports (*Table 5*).

For **root crops**, the general picture is one in which domestic supplies increase roughly in proportion with growth in domestic demand, with endogenous price effects helping to clear markets. In the case of potatoes and sweet potatoes, the large production increases implied by official growth targets would soon lead to an excess of supply over demand, but the projected surpluses are not likely to materialize, because prices for these two crops will fall, causing farmers to shift into other, more profitable crops. In the case of cassava and banana, production is projected to grow at rates slightly higher than those implied by official growth targets, driven by increases in domestic market prices.

In the case of **beans**, which similar to rice and wheat have a high income elasticity of demand, production growth is unlikely to keep pace with consumption growth. In the

absence of an official production target for beans, it was assumed that bean production will increase by 3.5 percent per year. With this projected growth rate, bean production will increase significantly, but even so, bean imports will rise sharply. Under Scenario 23, bean imports account for only 3.3 percent of total supply in 2003 (8 thousand tons out of 248 thousand tons consumed), but this figure rises to 20.9 percent by 2015 (96 thousand tons out of 463 thousand tons consumed).

For most **livestock products**—milk, beef, eggs, and poultry—official targets call for very high rates of production growth. While consumption of livestock products is projected to increase rapidly, not only because current consumption levels are low, but also because livestock products have high income elasticity of demand, the ambitious production growth rates implied by official targets may not be achieved. If they are achieved, however, imports of livestock products will cease. The only livestock product that is traded in significant quantities is milk. Under Scenario 23, milk production will grow at around 12.5 percent annually between 2005 and 2015, resulting in national self-sufficiency in milk production despite significant increases in consumption.

Balance of trade

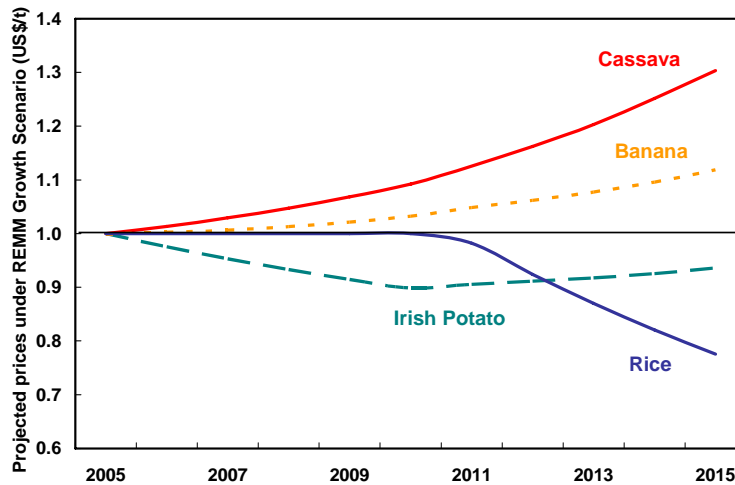
Assuming official growth targets for export commodities are met, and assuming no changes in real international prices for Rwanda's export commodities, the nation's total agricultural trade surplus will increase to about US\$ 66 million by 2015, four times higher than the level in 2003 (*Table 5*).

The overall trade balance could improve even further if efforts to improve the quality of coffee exports prove successful. Fully washed coffee currently accounts for only three percent of all coffee exports. If the proportion of coffee that is fully washed can be raised to 60 percent by 2015, in line with government targets, this will have the effect of raising average coffee export prices by three percent annually between 2005 and 2015, since the price of washed coffee is about 60 percent higher than the price of green coffee. Achieving the target for fully washed coffee will result in an additional increase of US\$ 55 million per year in coffee export revenues by 2015, further boosting the total agricultural trade surplus to just over US\$ 100 million.

Price trends

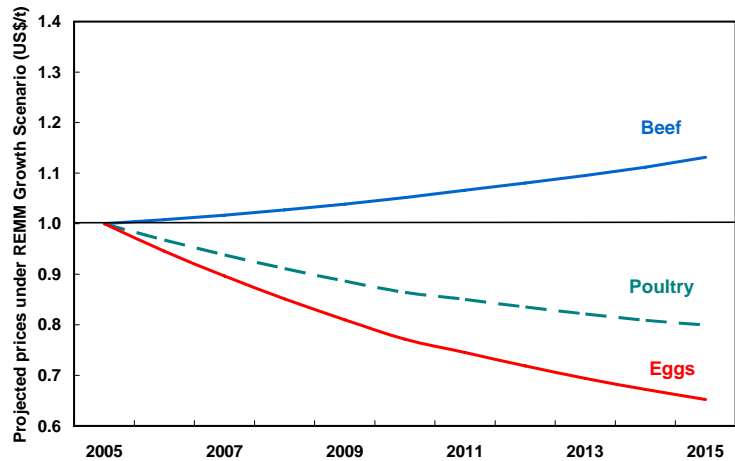
Differences in production and consumption growth in individual economies will lead to imbalances in supply and demand for those commodities, with consequent effects on prices that will benefit some households and disadvantage others. In Rwanda, the official production targets for some crops and livestock products are very high, and if the production growth rates implied by the official targets are achieved, supply of these commodities would soon outstrip demand, leading to strong downward pressure on domestic prices. Falling prices will benefit consumers of these commodities and hurt producers. For example in the case of rice, potatoes, and some livestock products (poultry and eggs) projected increases in production are considerably higher than the projected increases in demand. Domestic prices for these commodities therefore are likely to fall, benefiting consumers but resulting in revenue losses for producers (*Figure 9, Figure 10*).

Figure 9. Projected price trends, selected crops, REMM Growth Scenario, 2005-15



Source: IFPRI REMM simulations, 2006.

Figure 10. Projected price trends, livestock products, REMM Growth Scenario, 2005-15



Source: IFPRI REMM simulations, 2006.

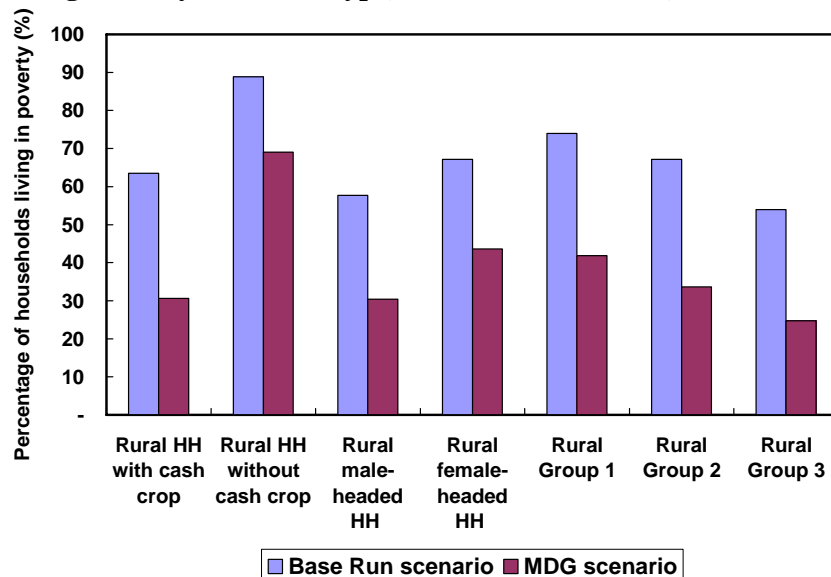
Reaching the Poverty MDG

The REMM was used to evaluate the growth rate that would be needed to meet the first MDG of halving the national poverty rate by 2015. As discussed above, if the government’s agricultural growth targets are achieved, Rwanda can achieve the 6 percent per year agricultural growth target established under CAADP. Together with expected growth in the non-agricultural sectors, this will significantly increase incomes and help to reduce poverty. But even with this level of growth, the poverty MDG is not likely to be met by 2015. The REMM shows that meeting the first MDG will require overall GDP growth of 8 percent per year from 2005 to 2015. Although many different combinations of agricultural and non-agricultural growth could produce overall GDP growth of 8 percent per year, one possible combination (presented for illustrative purposes) would be

9.0 percent annual growth in agricultural GDP and 7.2 percent annual growth in nonagricultural GDP.

Under this hypothetical scenario, the national poverty rate falls to 30.9 percent in 2015, while the rural poverty rate falls to 34.0 percent. However the poverty reduction varies between household groups (*Table 6*). Poverty remains much higher in Rural Group 1 (42 percent) than in Rural Group 3 (25 percent). For households without cash crop production, the poverty rate will be cut by only 20 percent by 2015, from its extremely high level of 89 percent in 2003 to 69 percent by 2015. The poverty rate for rural female-headed household will be as high as 44 percent by 2015, which is only 24 percent lower than in 2003. This suggests that targeted growth and poverty reduction policies will be needed if the majority of rural households are to share the benefits from growth. For households with very limited landholdings and that are unable to participate high value agricultural production, increasing non-farm employment opportunities may provide the best path out of poverty.

Figure 11. GDP growth by household type, REMM Base Run vs., MDG Scenario, 2005-15



Source: IFPRI REMM simulations, 2006.

Summary of REMM modeling results

Like any simulation model, the REMM has limitations, and projections generated using the REMM should be considered merely indicative. Still, a number of results emerging from the REMM modeling exercise are compelling, and they have important policy implications. These are summarized below.

Growth

Agriculture has the potential to be a leading engine of growth for Rwanda's economy over the short to medium term. Based on the assumptions used in the REMM, the agricultural sector is projected to grow at an average annual rate of 6.17

percent through 2015. Robust agricultural growth will fuel average annual growth in total GDP of 6.24 percent. Slightly more than one-half of the growth in total GDP projected through 2015 will come from agriculture.

Within agriculture, the main drivers of growth will be food staples. Based on the assumptions used in the REMM, some agricultural sub-sectors will grow more rapidly than others. The contribution of each sub-sector to total GDP growth will depend not only on the rate of growth achieved in that sub-sector, but on the absolute size of the sub-sector. Taking into account the large absolute size of the food staples sub-sectors, most of the growth in agriculture will come from growth in production of food staples (cereals, root crops, oilseeds, and livestock). Of the projected growth in agricultural GDP, over two-thirds will come from projected growth in production of food staples.

Export crops will make a significant contribution to growth. Export crops will make a significant contribution to growth, but the importance of this contribution will be limited because the export crop sub-sector is small relative to the food crops and livestock sectors. Of the projected growth in agricultural GDP, slightly more than one-quarter will come from projected growth in the production of export crops.

Incomes and poverty

Agriculture-led growth will lead to significant income gains. Based on the assumptions used in the REMM, robust agricultural growth averaging 6.17 percent per year will fuel growth in total GDP of 6.24 percent per year, allowing total GDP per capita to grow at an average annual rate of 3.44 percent, almost triple the rate projected under the Base Run Scenario.

Staple-led growth is more pro-poor. Growth in the production of food staples (including livestock) has a greater impact in terms of reducing poverty than growth in the production of export crops. Poverty-growth elasticities³ for individual commodities and for commodity groups are shown in *Table 7*. The largest impacts in terms of poverty reduction will come from growth in production of crops that are grown by the poor and also consumed by them: beans, pulses and oilseeds, sweet potatoes, and soybeans. Growth in the production of export crops is more variable, showing considerable differences between export crops. Pyrethrum-led growth shows high poverty-growth

³ The poverty-growth elasticity measures the responsiveness of the poverty rate to changes in the per capita GDP growth rate. The formula for this elasticity is shown below

$$\frac{\Delta P0/P0}{\Delta GDPpc/GDPpc} = \frac{\Delta P0}{\Delta GDPpc} \cdot \frac{GDPpc}{P0}$$

where $\Delta P0$ and $\Delta GDPpc$ are average annual changes (from the base-year) in the poverty headcount rate and level of per capita GDP; and $P0$ and $GDPpc$ are the base-year poverty headcount rate and per capita GDP. The poverty-growth elasticity measures the percentage change in the poverty headcount rate caused by a one-percent increase in per capita GDP. This is *not* equivalent to a percentage point change in the poverty headcount rate.

elasticity, and coffee-led growth shows moderately high poverty-growth elasticity, whereas tea-led growth shows low poverty-growth elasticity.⁴

Food availability

At the national level, food self-sufficiency will decrease. Based on the assumptions used in the REMM, strong income growth combined with population growth will fuel consumption increases that will outstrip production gains in most food crops. The current deficits in maize, wheat, beans, sugar, and vegetable oils will increase, while those for rice and milk will disappear. For all other commodities, including roots and tubers and livestock products other than milk, production will increase roughly in line with growth in demand, and current levels of self-sufficiency will be maintained.

Balance of trade

Agriculture will help to reduce the trade deficit, but it will not be able to eliminate it completely. Based on the assumptions used in the REMM, Rwanda's total agricultural trade surplus will increase to approximately US\$ 66 million by 2015, possibly to \$100 million if the strategy of targeting the specialty coffee market proves successful. The overall balance of trade will improve, but not sufficiently to eliminate the trade deficit.

Price trends

Differential production and consumption growth within some agricultural sub-sectors will lead to imbalances in supply and demand. This will result in price changes that will benefit some households and disadvantage others. For example in the case of rice, potatoes, and some livestock products (poultry and eggs), the increases in production that will be achieved if the government's growth targets are met will be considerably higher than the projected increases in demand. Domestic prices for these commodities therefore are likely to fall, which will benefit consumers but is likely to result in revenue losses for producers

⁴ As mentioned earlier, the contribution of export crops to income growth and poverty reduction is underestimated, because the REMM fails to account fully for wage income earned by rural households whose members work on tea estates.

Table 7. Poverty-growth elasticities in the model scenarios

<i>Scenarios</i>	Poverty-growth elasticity	
	National	Rural
Staple-led growth (scenario 21)	-1.30	-1.31
Cereal-led growth (scenario 4)	-1.22	-1.23
Maize-led growth (scenario 1)	-1.70	-1.70
Rice-led growth (scenario 2)	-0.49	-0.50
Wheat-led growth (scenario 3)	-0.83	-0.83
Root-led growth (scenario 8)	-1.56	-1.58
Cassava-led growth (scenario 5)	-1.56	-1.50
Potato-led growth (scenario 6)	-1.50	-1.53
Sweet potato-led growth (scenario 7)	-2.26	-2.32
Banana-led growth (scenario 9)	-1.03	-1.05
Pulses and oilseed-led growth (scenario 12)	-2.36	-2.36
Bean-led growth (scenario 10)	-2.37	-2.36
Soybean-led growth (scenario 11)	-2.16	-2.20
Livestock-led growth (scenario 20)	-1.05	-1.07
Poultry and egg-led growth (scenario 17)	-1.33	-1.35
Other meat and milk-led growth (scenario 18)	-0.98	-1.00
Export crop-led growth (scenario 16)	-0.85	-0.87
Coffee-led growth (scenario 13)	-1.45	-1.49
Tea-led growth (scenario 14)	-0.33	-0.34
Pyrethrum-led growth (scenario 15)	-2.97	-3.05
Agriculture-led growth (scenario 22)	-1.16	-1.18

Source: IFPRI REMM simulations, 2006.

Reaching the MDGs

Agricultural growth will contribute to the attainment of the first MDG of halving poverty by 2025, but agricultural growth alone will not be sufficient. With significant focused investments, agricultural growth of at least 6 percent per year is achievable, which is the target growth rate set under the Comprehensive African Agricultural Development Program (CAADP) of NEPAD. While the goal of halving poverty by 2015 could be achieved through many possible combinations of agricultural and non-agricultural growth, overall GDP growth would have to exceed 8 percent per year from 2005 to 2015, which is unlikely to happen unless agricultural growth can reach 9 percent or more.

POLICY IMPLICATIONS

Principal constraints to agricultural growth

The principal constraint to agricultural growth in Rwanda is the **low profitability of agriculture**, not only at the farm level but further along the value chain at the levels of processing, storage, and marketing. The low profitability of agriculture discourages investment in the sector and leaves most producers trapped in a low-input, low-output existence characterized by high levels of persistent poverty and chronic food insecurity.

The low profitability of agriculture in Rwanda results from many underlying causes, of which six stand out:

1. **Low farm-level productivity** in both the crops and the livestock sub-sectors caused by producers' limited use of improved management practices and compounded by the low use of land and water management practices that permit sustainable intensification (e.g., irrigation, terracing).
2. **Limited availability and high cost of agricultural inputs** (especially seed, fertilizer, crop chemicals, and machinery) resulting from poorly developed input distribution systems and exacerbated by high transportation costs and a weak private sector.
3. **Low and variable prices received for outputs** attributable to poorly developed commodity marketing systems and exacerbated by high transportation costs, particularly for regional and international exports.
4. **Lack of access to rural financial services** needed to support productive investment in primary production activities as well as post-harvest value-adding activities.
5. **Unfavorable business climate** that discourages private investment by subjecting small- and medium-scale enterprises to costly and time consuming regulatory procedures.
6. **Weak human capital base**, both in terms of skills (attributable to the lack of education opportunities for the rural population, particularly opportunities for vocational training) and also in term of physical capacity (resulting from poor nutrition, inadequate rural health services, and prevalence of debilitating diseases, especially HIV/AIDS).

Recommendations: An agenda for immediate action

The Government of Rwanda has set itself a target of sustained growth in agriculture of 6 percent over the short to medium term. Based on the analysis carried out for this study, recognizing the constraints identified above, and considering the programs and sub-programs identified in the PSTA, what should be the Government's immediate priorities?

The basic conclusion of this report is that the main thrusts of the PSTA are fundamentally sound and that the areas targeted for reform under the PSTA are consistent with those identified here. At the same time, the agenda spelled out in the PSTA is extremely comprehensive. Given the financial and human capital constraints facing MINAGRI and

the other organizations charged with implementing the government's agricultural development agenda, it will not be possible to implement all of the PSTA programs and sub-programs immediately. Some prioritization is needed to ensure that the available financial and human resources can have the greatest possible growth and poverty reduction impact in the short to medium term.

Rapid and sustainable growth in Rwanda's agricultural sector can be achieved only if the productivity, profitability, and competitiveness of agriculture can be improved. Based on the information and analysis presented in this report, and taking into account the most binding constraints identified above, we argue that seven areas should be targeted for immediate attention.

1. Stimulating productivity growth in food staples (crops and livestock)

Unlocking pro-poor agricultural growth in Rwanda will depend on increasing productivity growth in food staples. The REMM modeling results indicate that most of the growth in agriculture will come from growth in production of food staples, both crops and livestock. This growth will be pro-poor in that it will disproportionately benefit low income groups, including households that do not grow cash crops and households headed by women. Sustainable intensification of staple food crop production will not be possible unless farmers increase their use of purchased inputs, especially improved seed, fertilizer, crop chemicals, and animal health products. These inputs will not be available unless input markets are working well. Strengthening input supply systems therefore forms an integral component of the overall agricultural growth agenda in Rwanda.

2. Scaling up sustainable development of land and water resources

Unlocking agricultural growth in Rwanda will depend on improving the natural resource base on which agriculture depends. Evidence presented in this report on the high rate of land degradation, soil fertility losses, limited area under irrigation, and low use of improved water management practices illustrates the urgent need to scale up investment in the sustainable development and management of land and water resources.

3. Overhauling national agricultural research and extension systems

Unlocking agricultural growth in Rwanda will depend on overhauling the national agricultural research and extension systems. Technology-driven increases in agricultural productivity are critically needed to get Rwandan agriculture going. While new technology can be imported from outside the country, the distinctive features of many of Rwanda's production systems mean that much new technology will have to be adapted to local conditions. For this to happen, research and extension systems will have to be reformed and revitalized, with a clear delineation of public and private roles in funding and service delivery.

4. Strengthening producer organizations

Unlocking agricultural growth in Rwanda will depend on strengthening the capacity of producer organizations to compete effectively in domestic, regional, and international markets. Strong producer organizations will be needed if agriculture is to move away from traditional subsistence farming towards more market-oriented commercial agriculture. Achieving a successful transformation will depend on farmers' ability to identify market opportunities, access cutting-edge technology, procure essential

production inputs, produce products that meet the requirements of an increasingly quality-conscious market, and negotiate effectively with input suppliers as well as buyers.

5. Promoting agricultural export growth and diversification

Sustaining increased levels of agricultural growth in Rwanda will not be possible unless the export commodity sub-sectors can be revitalized. Immediate attention should be directed to strengthening and deepening the ongoing reforms in the coffee and tea sectors, as these traditional export crops have the greatest potential to contribute to growth, and in the case of coffee, poverty reduction, in the short run. Efforts should continue as well to revitalize the pyrethrum industry and to exploit the untapped potential in the hides and skins sector. In addition, opportunities should be explored to develop non-traditional export crops, particularly horticultural crops, through launching of pilot export promotion projects that target the development of value chains for particular commodities.

6. Improving the performance of agricultural markets

Unlocking agricultural growth in Rwanda will depend on improving the performance of agricultural markets. Evidence presented in this report has documented low rates of market participation among rural households, the lack of reliable market outlets for many staples, the high real marketing costs associated in many cases with deficient transportation infrastructure and storage facilities, the high seasonal variability of commodity prices, and the lack of access to timely and accurate market information. Rapid and sustained agricultural growth leading to structural change and, eventually, diversification of the rural economy will not happen without well-functioning markets populated by a dynamic and innovative private sector.

7. Improving access to rural financial services

Unlocking agricultural growth in Rwanda will depend critically on improving access to rural financial services. Current low levels of investment by financial institutions in the agricultural sector can be explained in part by their perception that lending to rural clients is risky and unprofitable. Rural entrepreneurs, not only producers of primary commodities but also those engaged in post-harvest activities such as processing, storage, and transporting, need resources for productive investment, but they have difficulty accessing credit through formal channels.

Relevance for other developing countries

These findings from Rwanda are relevant for the many other developing countries, in sub-Saharan Africa and also in other regions, in which policy makers are struggling to unlock the power of agriculture to serve as a driver of growth and poverty reduction. In recent years, much attention has focused on boosting agricultural growth by promoting the development of high-value export crops. The REMM simulation results serve as a reminder that in agrarian economies in which a large proportion of rural households continue to engage in production of food staples destined for home consumption, investments aimed at raising the productivity of food staples are likely to have a much greater impact in the short to medium term in fostering broad-based, pro-poor growth.

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