ReSAKSS

Annual Trends and Outlook Report 2011

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Regional Strategic Analysis and Knowledge Support System

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Trends and Spatial Patterns in Agricultural Productivity in Africa, 1961–2010

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The Regional Strategic Analysis and Knowledge Support System (ReSAKSS) is an Africa-wide network of regional nodes supporting implementation of the Comprehensive Africa Agriculture Development Programme (CAADP). ReSAKSS offers high-quality analyses and knowledge products to improve policymaking, track progress, document success, and derive lessons for the implementation of the CAADP agenda and other agricultural and rural development policies and programs in Africa.

ReSAKSS is facilitated by the International Food Policy Research Institute (IFPRI) in partnership with the Africa-based CGIAR centers, the NEPAD Planning and Coordinating Agency (NPCA), the African Union Commission (AUC), and the Regional Economic Communities (RECs). The Africa-based CGIAR centers and the RECs include: International Institute of Tropical Agriculture (IITA) and the Economic Community of West African States (ECOWAS) for ReSAKSS–WA; the International Livestock Research Institute (ILRI) and the Common Market for Eastern and Southern Africa (COMESA) for ReSAKSS–ECA; and the International Water Management Institute (IWMI) and the Southern African Development Community (SADC) for ReSAKSS–SA.

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ReSAKSS

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Abbreviations

AEZ	Agricultural Ecological Zone
AgGDP	Agriculture GDP
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASWAp	Agriculture Sector Wide Approach
ATOR	Annual Trends and Outlook Report
AUC	African Union Commission
AU/NEPAD	African Union/ New Partnership for Africa's Development
CAADP	Comprehensive Africa Agriculture Development Programme
CEN-SAD	Community of Sahel-Saharan States
CGIAR	Consultative Group on International Agricultural Research
COMESA	Common Market for Eastern and Southern Africa
CORAF/WECARD	West and Central African Council for Agricultural Research and Development
DFID	Department for International Development
DRC	Democratic Republic of Congo
DSIP	Development Strategy Investment Plan
EAAPP	Eastern Africa Agricultural Productivity Program
EAC	East African Community
ECA	Eastern and Central Africa
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
EU	European Union
FAO	Food and Agriculture Organization
FAOStat	Food and Agriculture Organization database
GDP	Gross Domestic Product
GIS	Geographic Information System
GRUMP	The Global Rural and Urban Mapping Project
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority for Development
IITA	International Institute of Tropical Agriculture
ILO	International Labor Organization
ILRI	International Livestock Research Institute
IMF	International Monetary Fund
IWMI	International Water Management Institute
M&E	Monitoring and Evaluation
MDG	Millennium Development Goal
MTIP	Medium Term Investment Plan
NAIP	National Agricultural Investment Plan
NARI	National Agricultural Research Institute
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organization
ODA	Official Development Assistance

OECD	Organization for Economic Co-operation and Development
PFP	Partial Factor Productivity
PPP	Public Private Partnership
PSTA	Strategic Plan for Agriculture Transformation
R&D	Research and Development
REC	Regional Economic Community
ReSAKSS	Regional Strategic Analysis and Knowledge Support System
SA	Southern Africa
SADC	Southern African Development Community
SAKSS	Strategic Analysis and Knowledge Support System
SIDA	Swedish International Development Cooperation Agency
SPAM	Spatial Production Allocation Model
SSA	Sub-Saharan Africa
TFP	Total Factor Productivity
UMA	Union du Maghreb Arabe
UN	United Nations
USAID	United States Agency for International Development
WDI	World Development Index
WA	Western Africa
WAAPP	Western Africa Agricultural Productivity Program

Foreword

With this fourth issue of the Annual Trends and Outlook Report (ATOR), the Regional Strategic Analysis and Knowledge Support System (ReSAKSS) adopts a new approach of featuring a focus theme pertinent to the Comprehensive Africa Agriculture Development Programme (CAADP) implementation agenda. Agricultural productivity is featured in the 2011 ATOR as the report presents its measures, trends, and spatial patterns. The assessment is timely in light of Africa's recent growth recovery, which still needs to be better documented and its underlying factors better understood. Identifying and highlighting options for accelerating and sustaining agricultural productivity growth in Africa, as the report does, is crucial at this juncture.

Previous ATORs have been centered on assessing trends and progress on key CAADP spending and growth targets, the first millennium development goal and the implementation agenda itself. This information remains relevant to monitoring and evaluating the CAADP agenda. In its new format, the report presents the information in annexes to the main text.

Raising agricultural productivity is central to accelerating broad-based economic growth, reducing poverty, and improving food security in Africa. Nevertheless, doing so in a sustainable manner has eluded many African countries. The report finds that agricultural productivity growth has been rapid in among African countries since the mid-1980s. This is a welcome change. The report also shows that the recent strong growth has merely allowed countries to catch up to levels of the 1960s, illustrating the depth of the decline in the preceding decades. Moreover, the growth has been driven largely by efficiency gains and less by technical change. Sustaining the current recovery and broadening growth will require countries to continue to pursue conducive policies and to increase investments in agricultural research and development (R&D) to further promote technical change in the sector. Despite encouraging progress, a majority of African countries have not yet achieved the 2003 Maputo Declaration target of allocating 10 percent of the national budget to agriculture. More needs to be done by countries to provide increased funding for better-performing science and technology systems that would allow African agriculture to meet the challenges of tomorrow and raise its competitiveness in global, regional, and national markets.

In addition to raising the level and effectiveness of agricultural investments, as countries seek to raise and maintain high agricultural productivity, the 2011 ATOR recommends policies that address diversity

across farmers and locations, as well as the potential impact of climate change. And given that many African countries are small, have limited capacities and resources, and share similar agroecologies and farming systems, the report also recommends the adoption of regional agricultural R&D strategies to facilitate economies of scale and technology spillovers across countries.

Finally, as agricultural productivity is invariably linked to agricultural investments, it is fitting that the featured theme in the 2012 ATOR is public agricultural expenditure and investment.

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Executive Summary

The Comprehensive Africa Agriculture Development Programme (CAADP) provides an agriculture-led integrated framework of development priorities aimed at reducing poverty and increasing food security by achieving an average of 6 percent agricultural growth rate every year. Initial economic modeling results to support CAADP planning indicate that, while it is possible for many African countries to reach this target, it will require substantial additional growth across different agricultural sub-sectors and commodities, as well as substantial investments to stimulate the necessary acceleration in growth. In many cases, the agricultural investments required are in excess of the 10 percent of total expenditures commitment agreed on under the Maputo declaration. This is necessary because of the moderate and slowly growing agricultural productivity across the continent. As countries enter the operational stage of CAADP investment program design and execution, mostly starting in 2011, a fundamental policy research question is how to raise and maintain high agricultural productivity across different parts of the continent, particularly technical change, given the limits to factor substitution. This 2011 annual trends and outlook report (ATOR) addresses the gap by analyzing the inter-temporal trends and spatial patterns in partial and total factor productivity, to help identify options for raising and sustaining high agricultural productivity across different parts of the continent.

Major findings and recommendations

Agricultural productivity in Africa has been increasing since the mid-1980s, but this represents catching up with the levels achieved in the early 1960s.

While there is substantial spatial variation in agricultural productivity across the continent, agricultural productivity growth in many parts of Africa has been rapid since the mid-1980s. However, this result has been merely to restore the levels achieved in the early 1960s, suggesting that there has been very little technical change. Sustaining the recent rapid growth in productivity will require policy improvements and significant investments in agricultural Research and Development (R&D), as well as complementary investments in areas such as irrigation, market infrastructure, and institutions that accelerate the expansion of Africa's technical frontier.

Agricultural investments and R&D infrastructure and capacities in Africa have eroded, as a result of poor to moderate performance in the largest agricultural economies in the continent.

Agricultural research infrastructure and capacities in Africa exhibit trends similar to agricultural productivity: they have eroded through years of neglect, primarily from lack of public funding for agricultural

R&D, and have only recently picked up (Beintema and Stads 2006, 2011). The New Partnership for Africa's Development (NEPAD) established a national agricultural R&D investment target of at least 1 percent of agricultural GDP, but most countries have spent far less than this target. In 2008 for example, the average level of agricultural R&D investment for a majority of countries was 0.6 percent. This is reflected in the low performance of the continent in meeting the Maputo Declaration target for agricultural financing by governments, of 10 percent of total national expenditures. Only a handful of countries have surpassed this target. The largest ten agricultural economies in Africa (Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia, Tanzania, and Cote d'Ivoire)—accounting for about 73 percent of the total of Africa's agriculture value added—have performed poorly, resulting in the low performance for Africa as a whole.

Large incremental agriculture expenditures and investments are required to raise and maintain a high level of agricultural productivity and growth in Africa.

To increase agricultural productivity by 50 percent by 2030 (for example), public agricultural investment should increase by 167–250 percent (representing about 6–8 percent of agricultural GDP) by 2030. This is in addition to recurrent spending, which presently constitutes the bulk of public spending on the sector. In light of the current low levels of public agriculture expenditures, and the high shares allocated to salaries and other low productive or short-term productive items, this level of agricultural investment translates into total amounts in excess of the 10 percent of total expenditures commitment agreed to under the Maputo declaration.

Different types of agricultural investments and policies are not growth neutral; the critical investments will be those that deliver location-specific technologies and those that account for diversity of farmers.

Because different policies and types of investments are not growth neutral, it is important to find the right focus for different contexts, including proper sequencing. And because of the heterogeneity of the production environment, including different constraints faced by different farmers in different places, such investments and policy interventions need to deliver location-specific technologies that are tailored to the relevant agroecological characteristics and production systems, while also accounting for the considerable diversity of opportunities and constraints faced by farmers. Case studies of actual agricultural productivity investment projects suggest that successful interventions have been very few, short-lived, and thinly scattered across the continent, with very little impact in the aggregate. Most of the successful interventions in Africa only last for the project duration (3 to 5 years) and cease functioning almost immediately when the external or initial funding ends. There is a need for more commitments and actions by governments and other national stakeholders to ensure that good interventions are sustained.

Because many countries are small and have limited capacities, regional agricultural strategies, with complementary policies and extension systems to maximize the spillovers of technologies, will be helpful.

Many countries in Africa have small economies and limited capacities and resources for developing effective agricultural R&D systems. Therefore, focusing on regional agricultural R&D strategies can help fill these gaps

and facilitate scale economies. A regional strategy, such as the African centers of excellence initiatives,[1] must overcome many institutional and administrative barriers to management and coordination across national boundaries. Because any cross-country collaboration will be affected by each country's R&D system and specific program needs, as well as its desire to maintain a bargaining position for domestic resources, it will be critical to find ways to minimize these transaction costs. To be successful, such interventions require complementary polices and agricultural extension systems that maximize the spillovers of the technologies generated, to reach other areas of the continent.

The potential impact of climate change should be taken into account in the design and implementation of policies and strategies for raising and maintaining high agricultural productivity.

There is strong evidence that climate change or global warming due to accumulating greenhouse gases could impose serious costs to agricultural growth in Africa, and that the changes are likely to have very different effects on people in different locations; in general, the projected warming is likely to increase livestock income while reducing crop income. Extrapolating from the findings of Seo et al. (2008) shows that climate change may have a zero net effect on total agricultural income of households engaging in both crop and livestock production. The most vulnerable to climate change are likely to be those engaging solely or mostly in crop production, as well as those in the Cereal-Root Crop Mixed, Dryland Mixed, AgroPastoral, and Pastoral farming systems (which characterize most of the savannah agroecological zones (AEZs)); farmers standing to gain—even from severe climate change—are those engaging solely or mostly in livestock, as well as those in the forest-based and tree crop farming systems (which characterize most of the sub-humid or humid forest AEZs). Therefore, the strategies for raising and maintaining high agricultural productivity should also be based on impact assessments of climate change to identify the most attractive adaptation options, with location-specific implementation approaches.

For most countries in Africa, especially those with large rural populations, there is no more pressing development objective than raising the level and rate of growth of agricultural productivity. Moreover, as we have seen, almost all of the observed growth in agricultural productivity over the past several decades is explained by improvement in efficiency of factor use, rather than by technical change. The core of a sustainable development strategy for Africa must be to make full use of its regional and sub-regional alliances in order to promote and disseminate well-designed and appropriately targeted technological innovations in agriculture.

[1] For example, the Eastern Africa Agricultural Productivity Program (EAAPP, implemented by ASARECA) and the West Africa Agricultural Productivity Program (WAAPP, implemented by CORAF/WECARD) are subregional centers of excellence for particular crops and commodities—maize and wheat in Ethiopia, dairy in Kenya, cassava in Uganda, roots and tubers in Ghana, and rice in Mali and Tanzania, to mention a few. See http://waapp.org.gh/ and http://www.eaapp.org/ for details.

Introduction

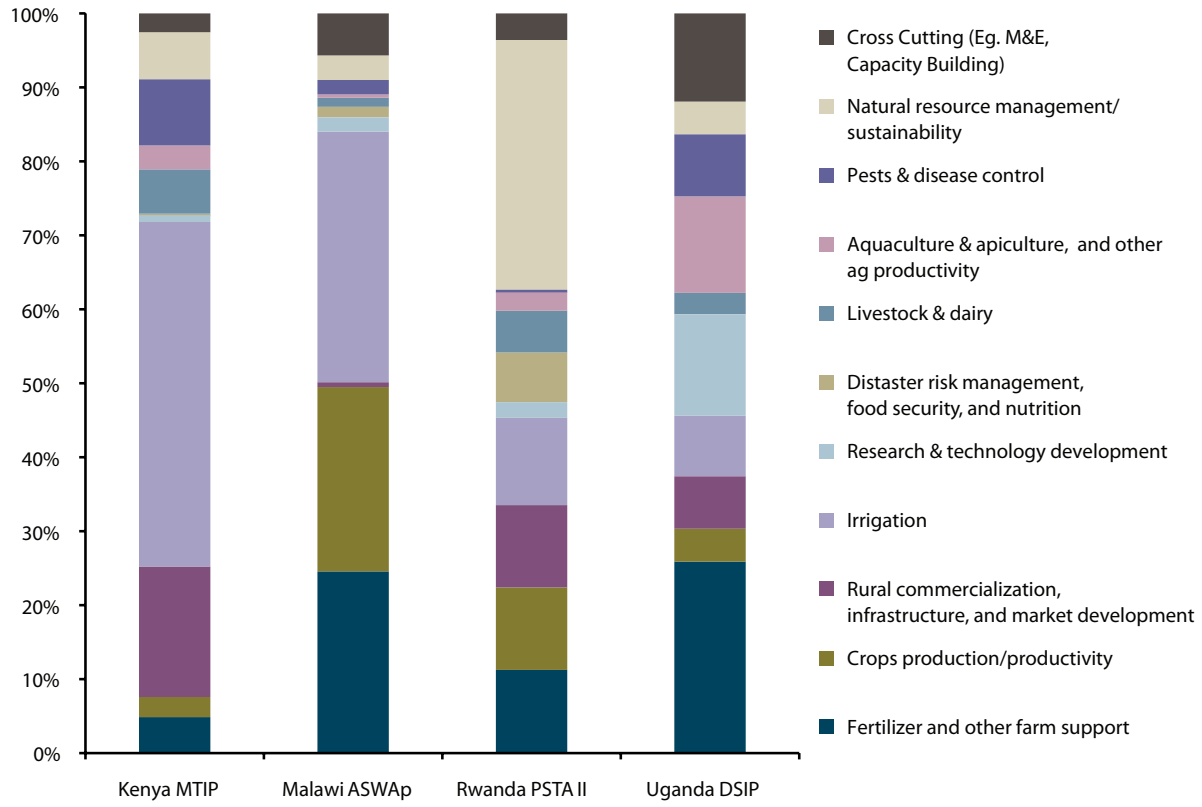
The Comprehensive Africa Agriculture Development Programme (CAADP) provides an agriculture-led integrated framework of development priorities aimed at reducing poverty and increasing food security by achieving an average of 6 percent annual agricultural growth rate. Initial economic modeling results to support CAADP planning indicate that, while it is possible for many African countries to reach this target, it will require substantial additional growth across different agricultural sub-sectors and commodities, as well as substantial investments to stimulate the necessary acceleration in growth. In many cases, the agricultural investments required are in excess of the 10 percent of total expenditures commitment agreed under the Maputo declaration (see for example Diao et al. 2012). This is necessary because of the moderate and slowly growing agricultural productivity across the continent. The evidence further suggests that the current growth in productivity has been driven mostly by reallocation of productive factors (that is, efficiency gains) rather than technological advancement (technical change) (see for example Nin Pratt and Yu 2008). As countries enter the operational stage of CAADP investment program design and execution, mostly starting in 2011,[2] a fundamental policy research question has been to examine how to raise and maintain high agricultural productivity across different parts of the continent—particularly focusing on technical change, given the limits to factor substitution. Different countries have in the past adopted different agricultural strategies to achieve their development objectives. While varying climate and natural resource endowments (and varying agricultural potential) have a large influence on these strategies, there are also clear differences in national investment and development approaches, as Figure 1.1 shows for selected countries. For example, Kenya's National Agricultural Investment Plan (NAIP) favors irrigation and commercialization, while Malawi's favors irrigation, maize, and farm input (particularly fertilizer) support. The NAIPs of Rwanda and Uganda, on the other hand, tend to be more cautious by adopting an even spread, though slightly favoring natural resource management in Rwanda and farm support in Uganda (through the national extension program).

Looking at these different investment and development approaches, several follow-on questions emerge. The most critical one is to identify which strategies work best, in a cost-effective manner, under various conditions. The overall goal of this report is to present spatial patterns and trends in agricultural productivity and to summarize research findings on options for raising and maintaining high agricultural productivity, to promote more

[2] As of the end of July, 2012, 30 countries—Benin, Burkina Faso, Burundi, Cape Verde, Central African Republic, Cote d'Ivoire, The Democratic Republic of Congo, Djibouti, Ethiopia, The Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Liberia, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Swaziland, Tanzania, Togo, Uganda, Zambia—had signed their compacts with the main stakeholder groups. Twenty-three of them have developed detailed Country Investment Plans (or National Agricultural and Food Security Investment Plans) and conducted costing and financing needs of proposed investments, and several of the plans are being implemented.

effective design and implementation of agricultural policies and strategies in Africa. First, we address some fundamental and conceptual issues in the definition and measurement of agricultural productivity. We then analyze inter-temporal trends and spatial patterns in partial and total factor productivity; the spatial analysis helps to identify some of the factors that influence agricultural productivity. We conclude with a discussion of options for raising and sustaining high agricultural productivity across different parts of the continent.

FIGURE 1.1—BUDGET ALLOCATION UNDER CAADP INVESTMENT PLANS FOR SELECTED COUNTRIES



Source: Benin et al. 2010a.
Notes: MTIP is Medium Term Investment Plan; ASWAp is Agriculture Sector Wide Approach; PSTA is Strategic Plan for Agricultural Transformation; DSIP is Development Strategy Investment Plan

As in the 2010 report, we include annexes on the data and trends on the general CAADP monitoring and evaluation (M&E) indicators, organized around the CAADP principles and targets: allocation of 10 percent of budget expenditures to the agricultural sector; 6 percent agricultural growth rate; and achieving the first millennium development goal (MDG1) of slashing the 1992 levels of poverty and hunger by one-half by 2015. These annexes include tables for: the continent of Africa; five geographic regions of the African Union (central, eastern, northern, southern, and western); four economic groups, based on production potential, non-agricultural alternative sources of growth, and income level; and the eight Regional Economic Communities (RECs) (see Benin et al. 2010a). These tables and the original annual country-level data can be viewed at the ReSAKSS website (www.resakss.org).

Measures of Agricultural Productivity and Data Sources

Because improvements in agricultural productivity are important for broader development objectives such as poverty reduction and food security, it is essential to use the appropriate indicator and measure of agricultural productivity—partial factor or total factor productivity. Conceptually, productivity is simply a measure of output to input. However, because it embodies many different components, changes in productivity can catalyze a wide range of direct and indirect effects on the pathways to achieving different development objectives. For example, output per worker or labor productivity, as a partial measure of productivity, may be a better measure to identify linkages to non-agricultural growth, since it encapsulates the additional ways through which farm households earn income (Mellor 1999). Regarding the total measure of productivity, Fan et al. (2000) for example find that investments in roads, agricultural research and development, and education had the largest impact on raising total factor productivity, in turn substantially reducing poverty via reduced prices and increased wages, albeit at the cost of increased landlessness.

Partial Factor Productivity (PFP)

Partial factor productivity (PFP) is a ratio of output to a specific subset of the total input factors. Usually PFP is limited to one input factor, described as single factor productivity. Two commonly used measures of PFP are land productivity (defined as the ratio of output to total harvested area) and labor productivity (the ratio of output to total number of hours worked). Obviously, these two PFP measures differ from one another in the variables they measure and the variables they exclude. Basically, PFP measures make it possible to focus on a given variable (for instance, land or labor) to assess how that variable is influencing or contributing to the level of output. In support of the argument for using labor productivity, Byerlee et al. (2009) show that countries with the highest agricultural growth per worker experienced the greatest rate of rural poverty reduction. Other measures of partial productivity have also been found to be significant determinants of poverty: see for example Datt and Ravallion (1998) for the relationship between the squared poverty gap and output per unit of land in India, reflecting the scarcity of land. However, the policy implications of changes in partial productivity measures are not clear, due to uncertainty about their determinants, including changes in use of other factors or inputs or changes in output mix. Furthermore, changes in output and in productivity may not have similar impacts, and in some cases may move in different directions with differing consequences for poverty (Schneider and Gugerty 2011); productivity gains may not actually result in poverty reduction (Thirtle et al. 2001).

Total Factor Productivity (TFP)

Total factor productivity (TFP) addresses some of the shortcomings of using partial productivity measures. TFP, conceptually also a measure of output to input, is the ratio of an index of agricultural output to an index of agricultural inputs. Because TFP is a ratio of output to all factors and inputs used in producing the output, the variables measured in PFP are by definition components of TFP. Thus, PFP measures can be used to approximate TFP to the extent that the excluded variables are trivial in the production of the output—an empirical issue. Use of TFP is favored in the analysis of productivity because long-run agricultural growth depends on TFP and its two constituents: efficiency, arising from reallocation of inputs; and technical change or technological advancement, arising from changes that are not due to change in the amount of inputs. Basically, technical change is used to describe a change in the amount of output produced with unchanged levels of inputs. While such a change is typically technological and may derive from investment in agricultural R&D, human capital, infrastructure, and institutional development, it might also be organizational or due to a change in a constraint (such as a regulation), or due to an external factor such as climate change (see for example Hayami 2001). There are various challenges in measuring TFP however, particularly in allocating inputs across sub-sectors and, in developing countries, obtaining (market) prices to use in aggregating outputs and inputs.

TABLE 2.1: COUNTRIES BY GEOGRAPHIC REGION AND COUNTRY'S SHARE IN REGION'S TOTAL AGRICULTURE VALUE ADDED

Central Africa	Eastern Africa	Northern Africa	Southern Africa	Western Africa
Burundi (3.6)	Comoros (0.5)	Algeria (17.7)	Angola (12.9)	Benin (3.1)
Cameroon (38.5)	Djibouti (0.1)	Egypt (50.9)	Botswana (1.5)	Burkina Faso (3.1)
Central African Rep. (7.8)	Eritrea (0.5)	Libya (2.7)	Lesotho (0.7)	Cape Verde (0.2)
Chad (6.7)	Ethiopia (22.1)	Mauritania (0.7)	Malawi (7.0)	Cote d'Ivoire (3.7)
Congo, Dem. Rep. (33.3)	Kenya (17.7)	Morocco (21.5)	Mozambique (15.2)	Gambia, The (0.4)
Congo, Rep. (2.8)	Madagascar (4.8)	Tunisia (6.5)	Namibia (4.4)	Ghana (6.9)
Equatorial Guinea (2.3)	Mauritius (1.1)		South Africa (43.8)	Guinea (3.1)
Gabon (5.0)	Rwanda (4.0)		Swaziland (1.6)	Guinea Bissau (0.4)
Sao Tome & Principe (–)	Seychelles (0.1)		Zambia (6.9)	Liberia (0.9)
	Somalia (–)		Zimbabwe (6.1)	Mali (3.7)
	Sudan (23.6)			Niger (2.4)
	Tanzania (17.1)			Nigeria (62.3)
	Uganda (8.5)			Senegal (2.4)
				Sierra Leone (1.9)
				Togo (1.6)

Source: Authors' calculation based on AU 2011 and World Bank 2012.
Notes: Figure in parenthesis is country's percentage share in the region's total agriculture value added (2003–2010 annual average). Sudan includes South Sudan because the data are not disaggregated for the two countries. Those highlighted are the largest (Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia and Tanzania) and the fastest-growing (Angola, Guinea, Nigeria, Ethiopia, Rwanda, and Mozambique) agricultural economies in Africa.

Data Sources and Methodology

The data used to measure the different PFP and TFP indicators are drawn from two main sources: the United Nation's Food and Agriculture Organization database (FAOStat, FAO 2012); and the World Bank World Development Indicators (WDI, World Bank 2012). For the PFP measures we focus on land and labor productivity, measured at the national level by the ratio of total value of agricultural output to (respectively) total harvested

area and total number of hours worked. Performance over time (1980–2010) is analyzed by plotting the logarithm of labor productivity on the y-axis against the logarithm of land productivity on the x-axis. The results are presented at an aggregate level for the entire continent (Africa) and for the five geographic regions of the African Union (central, eastern, northern, southern, and western). (See Table 2.1 for the distribution of countries by region.) The results are also presented using other aggregations or groupings of countries, based on the concept that different countries, depending on their resource endowments and stage of development, are on different trajectories to achieving their development objectives (Diao et al. 2007). In one case, we use a four-category economic development typology based on three factors: agricultural potential; alternative (or nonagricultural) sources of growth; and income level (see Benin et al. 2010a; see Table 2.2). Another aggregation is based on Regional Economic Communities (RECs—see Table 2.3). The aggregated value of an indicator is estimated using the weighted sum approach, where the weight for each country is the share of that country's value in the total value of the indicator for all countries

TABLE 2.2—COUNTRIES BY ECONOMIC DEVELOPMENT CLASSIFICATION AND COUNTRY'S SHARE IN GROUP'S TOTAL AGRICULTURE VALUE ADDED

		Low income	Middle income (MI)
More favorable agricultural conditions	Mineral rich (LI-1)	Central African Republic (9.6)	***Algeria (8.3)***
		Congo, Dem. Rep. (40.9)	***Angola (1.6)***
		Guinea (19.6)	Botswana (0.2)
		Liberia (5.6)	Cameroon (3.2)
		Sierra Leone (11.9)	Cape Verde (0.1)
		Zambia (12.4)	Congo, Rep. (0.2)
	Non-mineral rich (LI-2)	Benin (4.6)	Cote d'Ivoire (3.3)
		Burkina Faso (4.6)	Djibouti (0.0)
		Ethiopia (23.6)	***Egypt (23.7)***
		Gambia, The (0.6)	Equatorial Guinea (0.2)
		Guinea Bissau (0.6)	Gabon (0.4)
		Kenya (19.0)	Ghana (3.0)
		Madagascar (5.1)	Lesotho (0.1)
		Malawi (3.0)	Libya (1.2)
		Mozambique (6.4)	Mauritius (0.3)
		Tanzania (18.3)	***Morocco (10.0)***
		Togo (2.4)	Namibia (0.5)
		Uganda (9.1)	***Nigeria (26.8)***
		Zimbabwe (2.6)	Sao Tome & Principe (–)
Less favorable agricultural conditions (LI-3)		Burundi (5.6)	Senegal (1.0)
		Chad (10.5)	Seychelles (0.0)
		Comoros (2.6)	***South Africa (5.3)***
		Eritrea (2.8)	***Sudan (7.2)***
		Mali (29.7)	Swaziland (0.2)
		Mauritania (6.1)	Tunisia (3.0)
		Niger (19.6)	
		Rwanda (23.1)	
		Somalia (–)	

Source: Authors' calculation based on Benin et al. 2010a and World Bank 2012.
Notes: Figure in parenthesis is country's percentage share in the group's total agriculture value added (2003–2010 annual average). Sudan includes South Sudan because the data are not disaggregated for the two countries. Ghana changed status from LI-1 in 2010 to MI in 2011. Those in bold italic text are the largest (Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia and Tanzania) and fastest-growing (Angola, Guinea, Nigeria, Ethiopia, Rwanda, and Mozambique) agricultural economies in Africa.

TABLE 2.3—COUNTRIES BY REGIONAL ECONOMIC COMMUNITY (REC) AND COUNTRY'S SHARE IN REC'S TOTAL AGRICULTURE VALUE ADDED

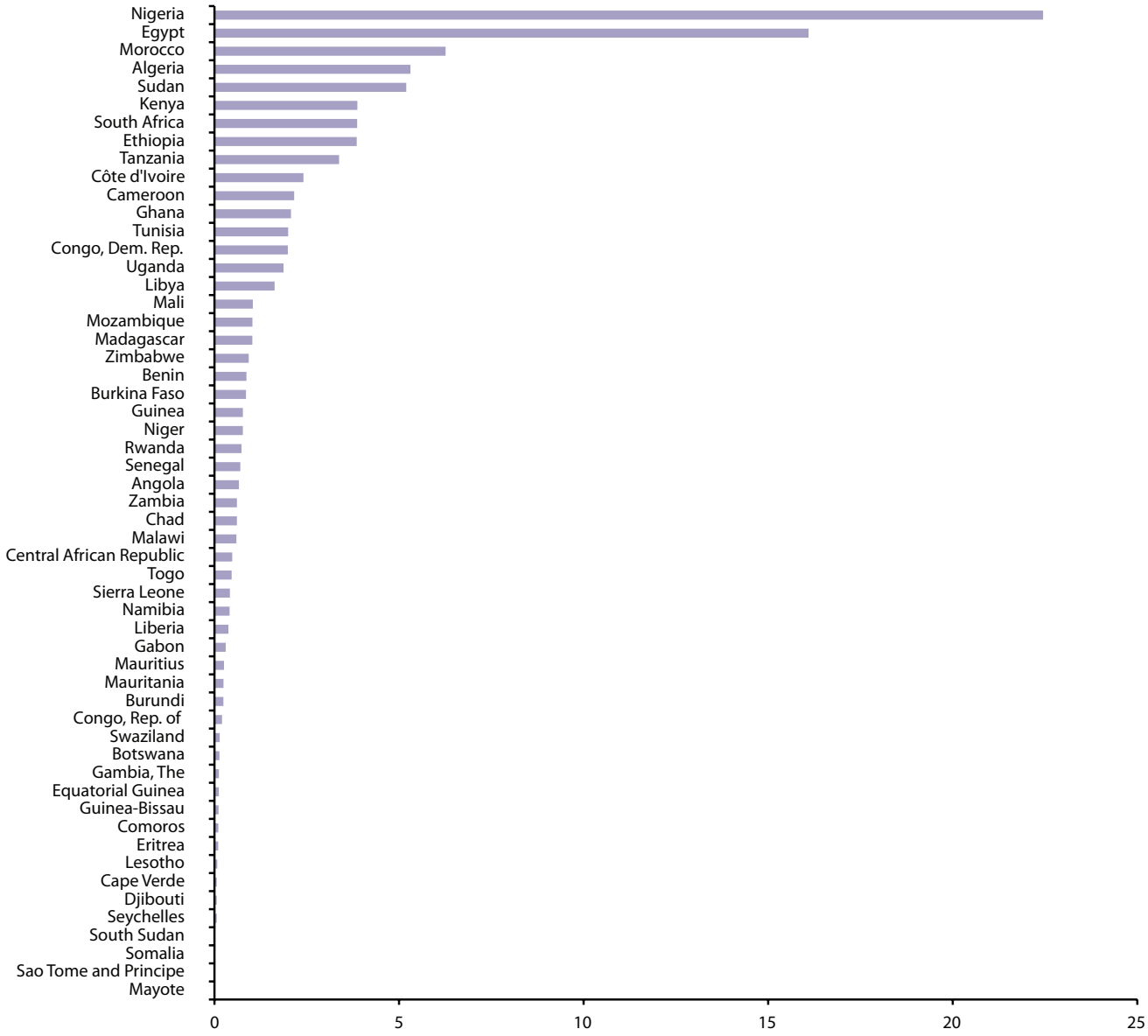
CEN-SAD	COMESA	EAC	ECCAS	ECOWAS	IGAD	SADC	UMA
Benin (1.4)	Burundi (0.5)	Burundi (2.4)	Angola (14.0)	Benin (3.1)	Djibouti (0.1)	Angola (7.1)	Algeria (36.2)
Burkina Faso (1.4)	Comoros (0.3)	Kenya (42.9)	Burundi (2.7)	Burkina Faso (3.1)	Eritrea (0.7)	Botswana (0.8)	Libya (5.4)
Central African Rep. (0.7)	Congo, Dem. Rep. (4.9)	Rwanda (9.8)	Cameroon (28.8)	Cape Verde (0.2)	Ethiopia (30.4)	Congo, Dem. Rep. (12.6)	Mauritania (1.4)
Chad (0.6)	Djibouti (0.1)	Tanzania (24.2)	Central African Rep. (5.8)	Cote d'Ivoire (7.7)	Kenya (24.4)	Lesotho (0.4)	Morocco (43.7)
Comoros (0.1)	Egypt (42.4)	Uganda (20.7)	Chad (5.1)	Gambia, The (0.4)	Somalia (–)	Madagascar (6.7)	Tunisia (13.3)
Cote d'Ivoire (3.5)	Eritrea (0.3)		Congo, Dem. Rep. (24.9)	Ghana (6.9)	Sudan (32.6)	Malawi (3.9)	
Djibouti (0.6)	Ethiopia (12.1)		Congo, Rep. (2.1)	Guinea (3.1)	Uganda (11.7)	Mauritius (1.5)	
Egypt (24.9)	Kenya (9.6)		Equatorial Guinea (1.7)	Guinea Bissau (0.4)		Mozambique (8.4)	
Gambia, The (0.2)	Libya (2.2)		Gabon (3.8)	Liberia (0.9)		Namibia (2.4)	
Ghana (3.1)	Madagascar (2.6)		Rwanda (11.1)	Mali (3.7)		Seychelles (0.1)	
Guinea (1.4)	Malawi (1.5)		Sao Tome & Principe (–)	Niger (2.4)		South Africa (24.2)	
Guinea-Bissau (0.2)	Mauritius (0.6)			Nigeria (62.3)		Swaziland (0.9)	
Kenya (5.7)	Rwanda (2.2)			Senegal (2.4)		Tanzania (23.9)	
Liberia (0.4)	Seychelles (0.0)			Sierra Leone (1.9)		Zambia (3.8)	
Libya (1.3)	Sudan (12.9)			Togo (1.6)		Zimbabwe (3.3)	
Mali (1.7)	Swaziland (0.3)						
Mauritania (0.3)	Uganda (4.6)						
Morocco (10.5)	Zambia (1.5)						
Niger (1.1)	Zimbabwe (1.3)						
Nigeria (28.2)							
Sao Tome & Principe (–)							
Senegal (1.1)							
Sierra Leone (0.8)							
Somalia (–)							
Sudan (7.6)							
Togo (0.7)							
Tunisia (3.2)							

Sources: Authors' calculation based on AU 2011, CEN-SAD 2011, COMESA 2010, EAC 2011, ECOWAS 2010, IGAD 2011, SADC 2010, UMA 2011, and World Bank 2012.
Notes: CEN-SAD is the Community of Sahel-Saharan States; COMESA is the Common Market for Eastern and Southern Africa; EAC is the East African Community; ECCAS is the Economic Community of Central African States; ECOWAS is the Economic Community of West African States; IGAD is the Intergovernmental Authority for Development; SADC is the Southern Africa Development Community; and UMA is the Union du Maghreb Arabe. Figure in parenthesis is country's percentage share in the REC's total agriculture value added (2003–2010 annual average). Sudan includes South Sudan because the data are not disaggregated for the two countries. Those highlighted are the largest (Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia and Tanzania) and fastest-growing (Angola, Guinea, Nigeria, Ethiopia, Rwanda, and Mozambique) agricultural economies in Africa.

in the region or group. To get a sense of how individual countries are performing with respect to these indicators, we also present trends for selected countries, those with the largest or fastest-growing agricultural economies. The largest agricultural economies are defined by their share in Africa's total agriculture value added: Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia and Tanzania (see Figure 2.1). The fastest-growing agricultural economies are those surpassing the CAADP agricultural growth rate target of 6 percent annually, on average, since 2003: Angola, Guinea, Nigeria, Ethiopia, Rwanda, and Mozambique (see Figure 2.2).

For the TFP measure, a commonly used approach is the growth accounting approach, using the Törnqvist-Theil index. The main challenge in developing country analysis is obtaining (market) prices to use in aggregating outputs and

FIGURE 2.1—AGRICULTURE VALUE ADDED BY COUNTRY (% of Africa total), 2003–2010 ANNUAL AVERAGE

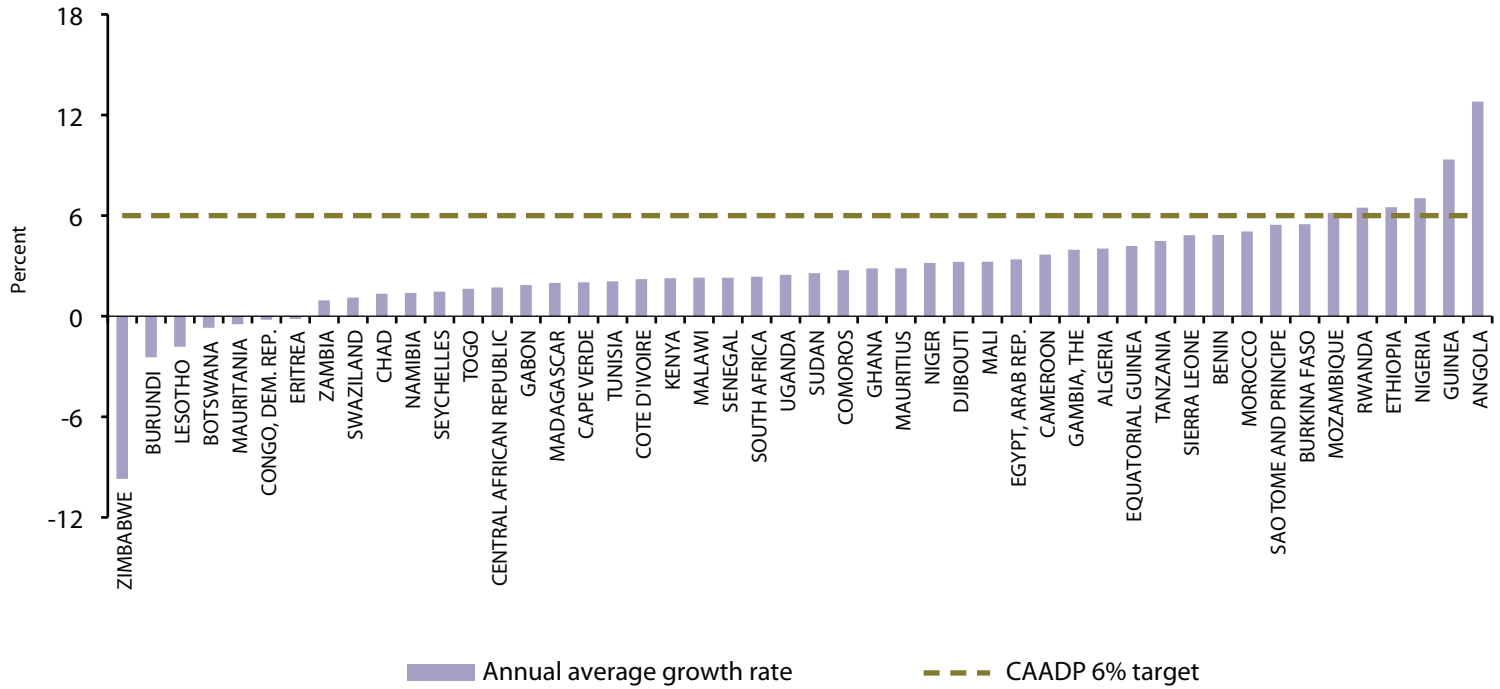


Source: Authors' compilation based on World Bank 2012.
Notes: Sudan includes South Sudan because the data are not disaggregated for the two countries.

inputs. Instead, we use the Malmquist index (Caves et al. 1982; Färe et al. 1994). This approach is based on distance functions, which does not entail assumptions about economic behavior (profit maximization or cost minimization) and, therefore, does not require prices for its estimation. The approach used here is fully documented in Nin Pratt and Yu (2008). Performance in TFP over time is analyzed across different sub-periods: 1961–1970, 1970–1980, 1980–1990, 1990–2000, and 2000–2010, using overlapping years to smooth the ends of the range. As for the PFP analysis, the unit of analysis is the country; the results are presented at an aggregate level for the entire continent (Africa), the five geographic regions of the African Union, four economic classification groups, regional economic communities, and individual countries representing the largest and fastest-growing agricultural economies.

For the spatial analysis of agricultural productivity, we change the

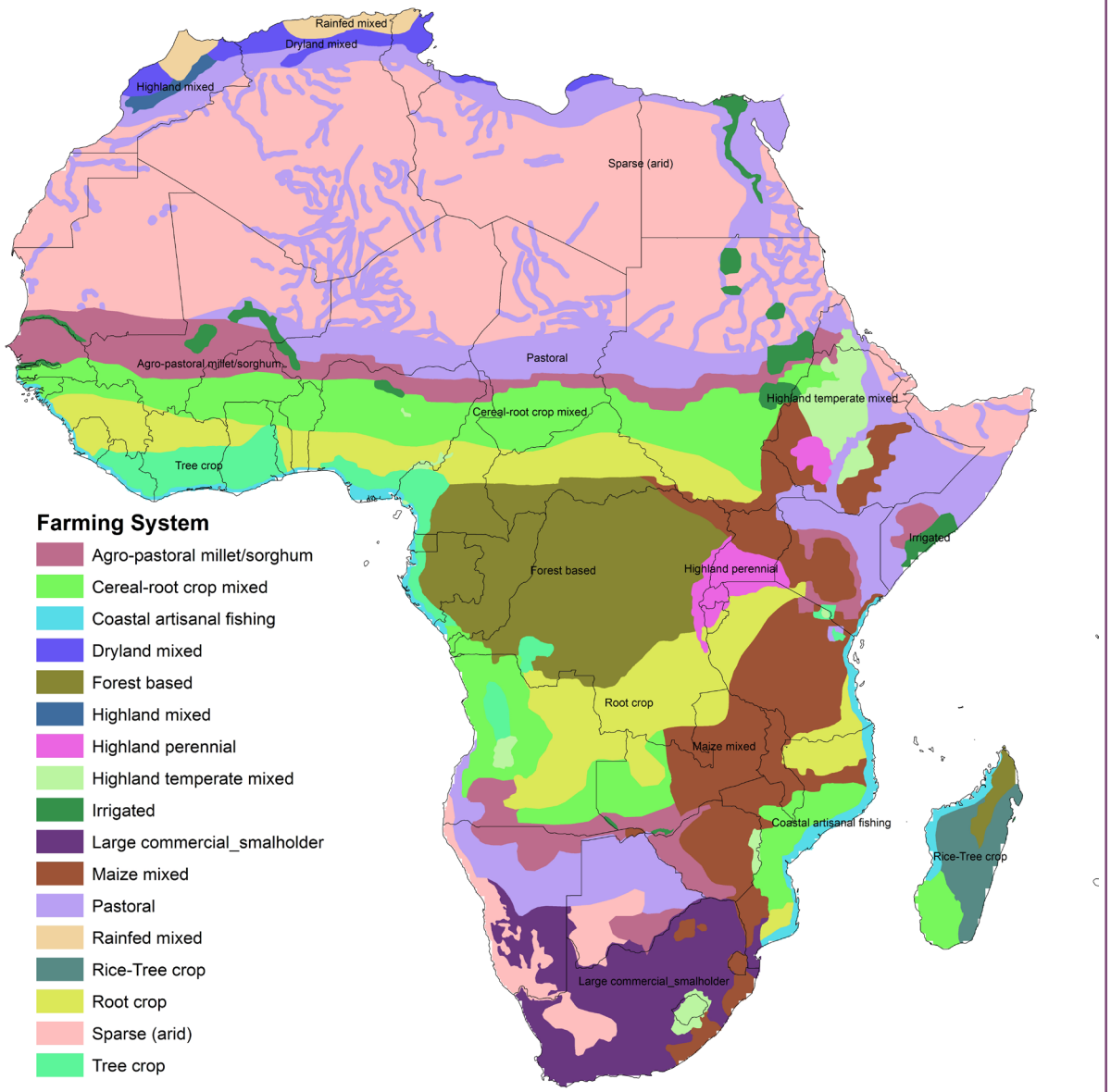
FIGURE 2.2—ANNUAL AVERAGE AGRICULTURE GDP GROWTH RATE (2003–2009)



Source: Authors' calculation and representation based on World Bank 2012.
Notes: Sudan includes South Sudan because the data are not disaggregated for the two countries.

primary unit of analysis from countries to farming systems, defined as a set of non-contiguous geographic areas that—largely through similarities of biophysical endowments, demographics, and built infrastructure (such as roads and irrigation)—support similar patterns of livelihood choices, especially in relation to agriculture. We use the classification of farming systems developed by Dixon et al. (2001). As Figure 2.3 indicates, individual countries can contain several major farming systems. It is expected that levels of productivity will differ between systems, as for example between Agro-Pastoral and Highland-Perennial. For this report, we use the average (2005–2007) value of land and labor productivity in crop production to assess the spatial patterns of agricultural productivity. These are obtained from IFPRI's Spatial Production Allocation Model (SPAM), based on analyses of data at ~10km grid cell (5 arc minute) resolution across Africa.[3]

FIGURE 2.3—FARMING SYSTEMS IN AFRICA



Source: Dixon, Gulliver, and Gibbon 2001.

[3] The SPAM includes 19 crops: wheat, rice, maize, barley, millet, sorghum, potatoes, sweet potatoes, cassava, bananas and plantains, soy beans, beans, oilseeds and pulses, sugarcane, sugar beets, coffee, cotton, other fiber crops, groundnuts, and other oilseeds. The SPAM approach and underlying datasets are fully documented in You, Wood, and Wood-Sichra (2009).

Trends and Spatial Patterns in Land and Labor Productivity

Annual Trends in Land and Labor Productivity

Annual trends in land and labor productivity are detailed in Figures 3.1–3.3 and Table 3.1 for the aggregations and for selected countries. The graphics are quite revealing and offer a quick overview of the comparative trends. There are three aspects to the graphics: the position of a plot in the quadrant space, the slope of the plot (judged from a fitted line relative to an imaginary 45-degree line from the origin), and the length of the plot. The *position* shows the magnitude that is increasing in both land and labor productivity, going from the origin in a north-easterly direction. For a particular plot, the *slope* reflects the relative growth rates of labor and land productivity: a slope steeper than the 45-degree line reflects a higher labor productivity growth rate relative to land productivity growth rate (with labor productivity shown on the y-axis); conversely, for a plot flatter than the 45-degree line, land productivity growth rate is higher relative to labor productivity growth rate. (This can be extended to compare different plots. For any two plots, the steeper one has a higher labor-land productivity growth rate ratio, irrespective of the position of the plots in the quadrant.) The *length* reflects the magnitude of the combined growth rates, with a longer plot depicting a larger combined growth rate and a shorter plot depicting a smaller combined growth rate, again irrespective of the position of the plot in the quadrant.

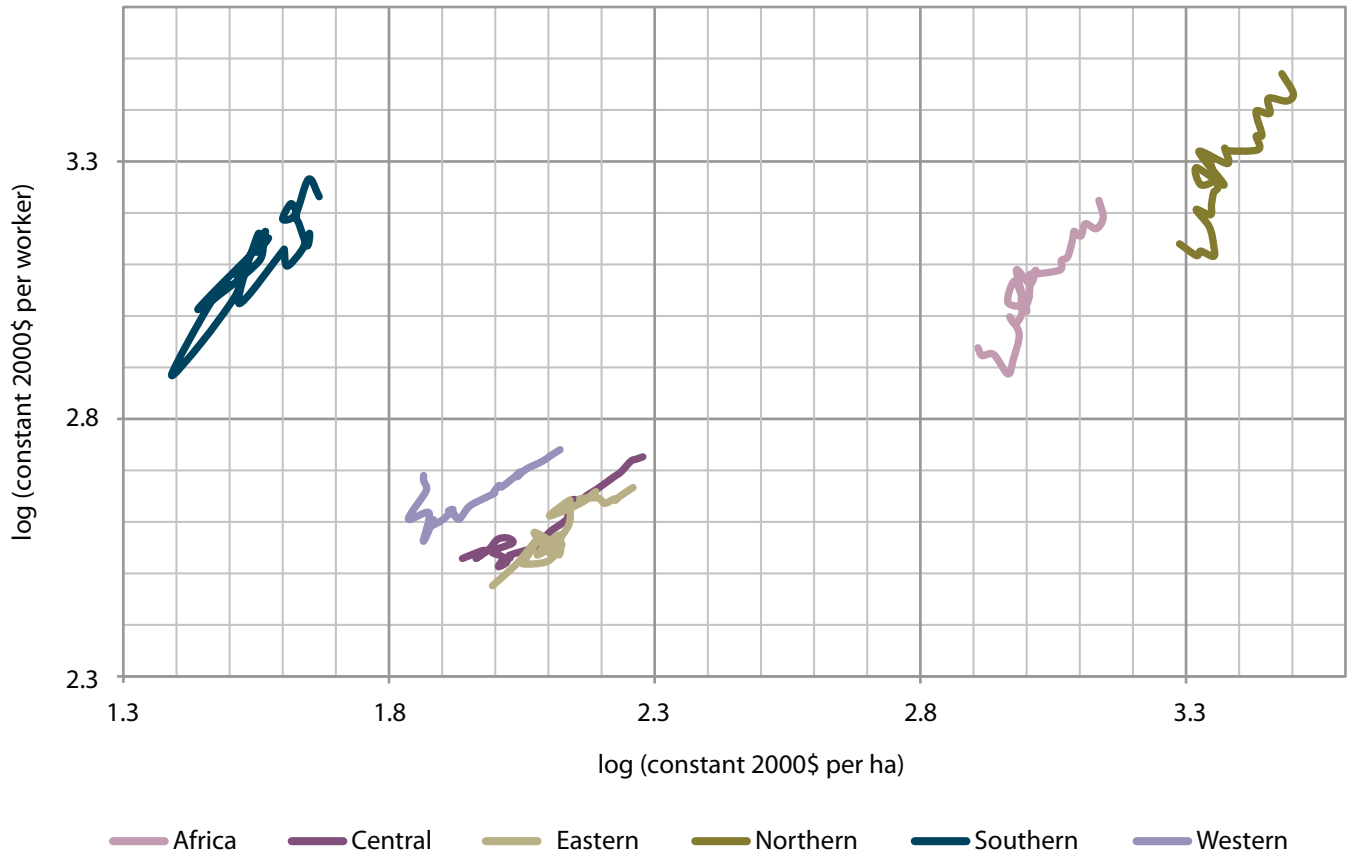
Africa and geographic sub-regions

Figures 3.1–3.3 and Table 3.1 show that the trends in land and labor productivity are highly variable in different dimensions across different parts of the continent. For Africa as a whole, labor productivity increased on average by 2.3 percent per year in 1980–2010, compared to 1.6 percent increase per year for land productivity, starting from 1980 levels of $996 per worker and $929 per hectare (ha). This trend suggests higher rates of investment in human capital than in agricultural land. A similar trend is observed in the northern African region, which experienced an annual average rate of growth of 2.7 percent in labor productivity and 1.4 percent in land productivity.

Northern and southern Africa have the highest annual average labor productivities, at $1969 per worker in northern Africa and $1324 per worker in southern Africa, compared to only $396 in central Africa, $390 in eastern Africa, and $457 in western Africa. Comparing the northern and southern Africa regions shows some significant differences, however. First, land productivity is much higher in northern Africa: $2428 per ha on average in 1980–2010, compared to only $37 per ha in southern Africa over the same

period. The relatively low land productivity in the southern region reflects the much higher land-labor ratios associated with large plantations, with more mechanized agricultural operations. Second, while labor productivity has risen much faster than land productivity in the northern region (with annual averages of 2.7 and 1.4 percent respectively in 1980–2010), land and labor productivity in the southern region have risen at a roughly equal rate (1.7 and 1.8 percent respectively). The trends observed in northern and southern Africa are driven by Egypt and South Africa, respectively; Egypt accounts for 51 percent of the total agriculture value added in the northern Africa region, while South Africa accounts for about 44 percent in the southern Africa region (see Table 2.1).

FIGURE 3.1—SCATTER PLOTS OF LAND AND LABOR PRODUCTIVITY BY GEOGRAPHIC REGION (1980-2010)



Source: Authors' calculation and representation, based on World Bank 2012

Figure 3.1 shows that the trends in the other three sub-regions (central, eastern, and western) are fairly similar to one another, with land and labor productivity much lower than the levels for Africa as a whole. Also, land productivity increased at a faster rate than labor productivity, again in contrast to Africa as a whole. In 1980–2010, the annual average growth in land productivity in the three sub-regions was in the range of 1.5–2.6 percent, as compared to the range of 0.9–1.6 for labor productivity.

Looking at the trends by sub-periods (1980–1990, 1990–2000, and 2000–2010—see Table 3.1),

we see that the increase in both land and labor productivity in Africa as a whole was lower on average in the 1990s than in the other two sub-periods. The patterns were different for different sub-regions. In the central region, for example, there was a consistent increase in both land and labor productivity across all three sub-periods. In the eastern, northern, and southern regions, the 1990s show either higher or lower average growth in either land or labor productivity. And in the western region, the 1990s show a higher annual average growth rate in both land and labor productivity.

TABLE 3.1—LAND AND LABOR PRODUCTIVITY, ANNUAL AVERAGE LEVEL AND GROWTH RATES (1980–2010)

	Annual average (constant 2000$ per unit)								Annual average growth rate (%)							
	1980–1990		1990-2000		2000–2010		1980–2010		1980–1990		1990–2000		2000–2010		1980–2010	
	land	labor	land	labor	land	labor	land	labor	land	labor	land	labor	land	labor	land	labor
Africa	925.5	927.8	1,008.7	1,149.0	1,263.1	1,433.4	1,058.1	1,162.2	2.0	3.1	1.0	1.2	2.2	3.0	1.6	2.3
Geographic location																
Central	98.8	350.1	117.9	364.2	161.8	477.8	125.4	396.0	1.7	0.0	3.5	2.6	4.0	2.8	2.6	1.6
Eastern	120.2	346.0	132.3	385.9	159.8	443.6	136.6	390.0	2.1	1.2	0.7	2.4	2.4	0.3	1.5	1.3
Northern	2,175.3	1,503.2	2,299.7	1,957.2	2,863.5	2,490.6	2,428.1	1,969.5	1.1	3.3	1.4	1.6	1.7	3.3	1.4	2.7
Southern	31.5	1,131.9	37.6	1,298.1	43.0	1,578.2	37.0	1,324.5	2.5	3.3	3.0	0.8	0.1	2.3	1.7	1.8
Western	75.8	421.9	93.6	440.0	118.7	513.9	95.3	456.8	1.3	-1.6	3.1	1.9	2.1	1.2	2.3	0.9
Economic group																
LI-1	61.6	219.8	77.2	216.7	80.9	227.9	73.1	221.7	2.2	0.0	1.6	0.4	2.1	1.0	1.5	0.2
LI-2	76.0	238.4	99.9	239.4	131.6	260.5	101.6	245.5	3.1	1.0	2.7	0.3	3.4	0.9	2.9	0.5
LI-3	85.4	282.8	84.9	306.6	146.5	310.2	104.8	300.2	0.4	0.5	2.0	0.2	6.1	1.4	2.6	0.5
MI	1,421.6	1,326.3	1,545.6	1,678.2	1,917.9	2,107.0	1,616.9	1,691.8	1.7	3.1	1.0	1.3	2.1	3.2	1.5	2.4
Regional Economic Community																
CEN-SAD	1,548.1	1,066.7	1,649.7	1,369.5	2,058.0	1,739.1	1,739.9	1,381.8	1.7	3.1	0.8	1.4	2.4	3.5	1.5	2.6
COMESA	1,708.6	812.7	1,843.6	1,075.5	2,326.1	1,392.7	1,945.6	1,084.3	2.4	2.2	0.5	2.7	2.5	2.5	1.6	2.8
EAC	124.0	624.5	152.6	845.7	205.1	945.9	159.2	797.1	1.8	2.1	2.3	0.8	3.1	2.1	2.6	2.1
ECCAS	104.7	320.1	124.7	334.2	179.2	416.3	135.3	355.8	0.9	-0.1	3.8	2.5	3.8	2.2	2.7	1.3
ECOWAS	75.8	421.9	93.6	440.0	118.7	513.9	95.3	456.8	1.3	-1.6	3.1	1.9	2.1	1.2	2.3	0.9
IGAD	71.3	330.7	89.2	370.2	115.0	447.0	91.2	380.9	2.6	0.7	1.9	3.5	3.6	0.5	2.5	1.5
SADC	93.6	797.6	104.8	873.7	110.6	1,044.8	102.5	897.7	2.3	2.8	0.5	0.6	0.4	1.8	0.9	1.5
UMA	123.4	1,514.9	155.2	1,838.1	202.6	2,281.4	159.5	1,869.9	5.9	4.4	0.4	-0.2	5.0	4.4	2.8	2.3

Economic groups

The trends in land and labor productivity analyzed by the other aggregations (that is, by economic classification or regional economic communities) are presented in Figures 3.2 and 3.3. Looking at the trends by economic classification (Figure 3.2), the *middle-income* (MI) category clearly outperformed the others in both measures of productivity. In the MI countries, average labor productivity has increased faster than land productivity, whereas the opposite is observed in the other categories of countries. Performance of the MI group as whole is heavily influenced by the performance of Egypt and Nigeria, which account for about 24 and 27 percent respectively of the group's total agriculture value added (see Table 2.2). However, while Egypt's performance drives up the group's average performance in levels of productivity, Nigeria's lower performance drags down the average (see Table 3.1). The other three categories of countries are

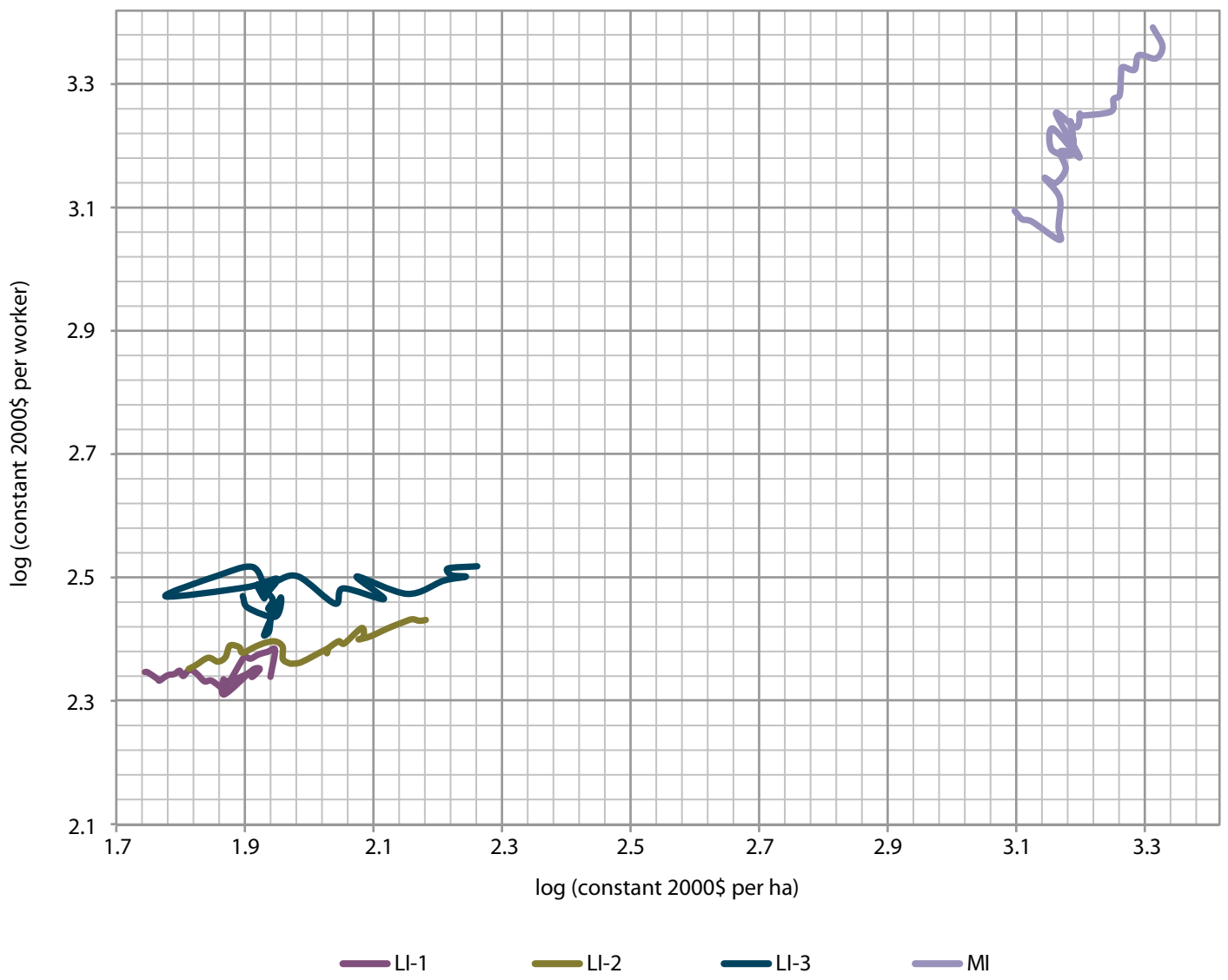
TABLE 3.1—LAND AND LABOR PRODUCTIVITY, ANNUAL AVERAGE LEVEL AND GROWTH RATES (1980–2010)—Continued

	Annual average (constant 2000$ per unit)								Annual average growth rate (%)							
	1980–1990		1990-2000		2000–2010		1980–2010		1980–1990		1990–2000		2000–2010		1980–2010	
	land	labor	land	labor	land	labor	land	labor	land	labor	land	labor	land	labor	land	labor
Selected countries																
Largest agricultural economies																
Algeria	70.0	1,572.1	104.6	1,773.0	150.7	2,067.5	107.6	1,802.5	4.8	2.6	3.2	0.0	4.1	2.9	4.1	1.5
Egypt	3,972.1	1,486.7	4,217.6	2,050.4	5,201.5	2,669.0	4,435.2	2,050.0	2.0	2.3	0.7	3.0	2.3	2.7	1.4	3.0
Ethiopia	83.1	157.8	113.0	167.4	148.7	176.7	114.1	167.3	3.4	1.1	2.6	-0.4	5.2	3.9	3.1	0.7
Kenya	100.9	399.9	120.6	346.4	156.4	352.7	124.9	366.7	2.7	-0.2	2.1	-1.3	2.0	0.1	2.3	-0.6
Morocco	156.4	1,439.1	183.1	1,678.5	239.6	2,269.7	192.5	1,790.9	6.2	6.2	-0.6	-0.9	6.1	6.5	2.5	2.6
Nigeria	384.9	n.a.	347.0	n.a.	297.6	n.a.	344.4	n.a.	-1.2	n.a.	-0.8	n.a.	-1.5	n.a.	-1.3	n.a.
South Africa	33.5	1,955.1	36.2	2,288.8	41.9	3,080.3	36.9	2,417.8	2.7	2.9	0.7	1.8	1.6	3.7	1.3	2.4
Sudan	22.8	507.9	29.5	643.5	41.7	845.2	31.1	661.1	0.5	0.9	6.6	5.3	2.0	1.4	3.1	2.6
Tanzania	56.9	202.9	79.6	222.0	113.1	261.5	82.3	227.8	3.7	1.6	3.2	0.6	4.0	2.1	3.6	1.3
At least 6% agGDP growth rate per year in 2003–10																
Angola	11.1	212.3	8.0	118.5	17.6	195.7	12.2	176.0	2.3	-0.6	-1.4	-4.0	13.8	10.9	2.2	-0.4
Ethiopia	83.1	157.8	113.0	167.4	148.7	176.7	114.1	167.3	3.4	1.1	2.6	-0.4	5.2	3.9	3.1	0.7
Guinea	22.7	142.2	35.1	162.8	68.6	266.0	41.7	189.4	5.6	3.0	4.8	1.5	6.0	5.0	5.7	3.1
Mozambique	14.4	103.6	16.0	123.2	26.7	165.2	19.0	129.7	-3.5	4.8	5.0	1.8	7.9	6.0	3.1	2.7
Nigeria	384.9	n.a.	347.0	n.a.	297.6	n.a.	344.4	n.a.	-1.2	n.a.	-0.8	n.a.	-1.5	n.a.	-1.3	n.a.
Rwanda	274.6	198.2	300.0	194.9	480.0	217.4	349.1	204.1	-0.3	-2.5	4.0	1.3	4.5	0.4	2.7	0.3

Source: Authors' calculation and representation, based on World Bank 2012.

low income, more favorable agriculture, and mineral rich (LI-1); *low income, more favorable agriculture, and non-mineral rich* (LI-2); and *low income and less favorable agriculture* (LI-3). For these groups, we see very little increase in labor productivity (with annual average growth rate of only 0.2–0.5 percent for 1980–2010), and a more rapid increase in land productivity (annual average growth rate of 1.5–2.9 percent for the same period). Average performance in the LI-1 group was the lowest, with an annual average land and labor productivity of only $73 per ha and $222 per worker in 1980-2010; the annual average rate of growth was just 1.5 and 0.2 percent for land and labor productivity respectively. Note that the LI-1 group

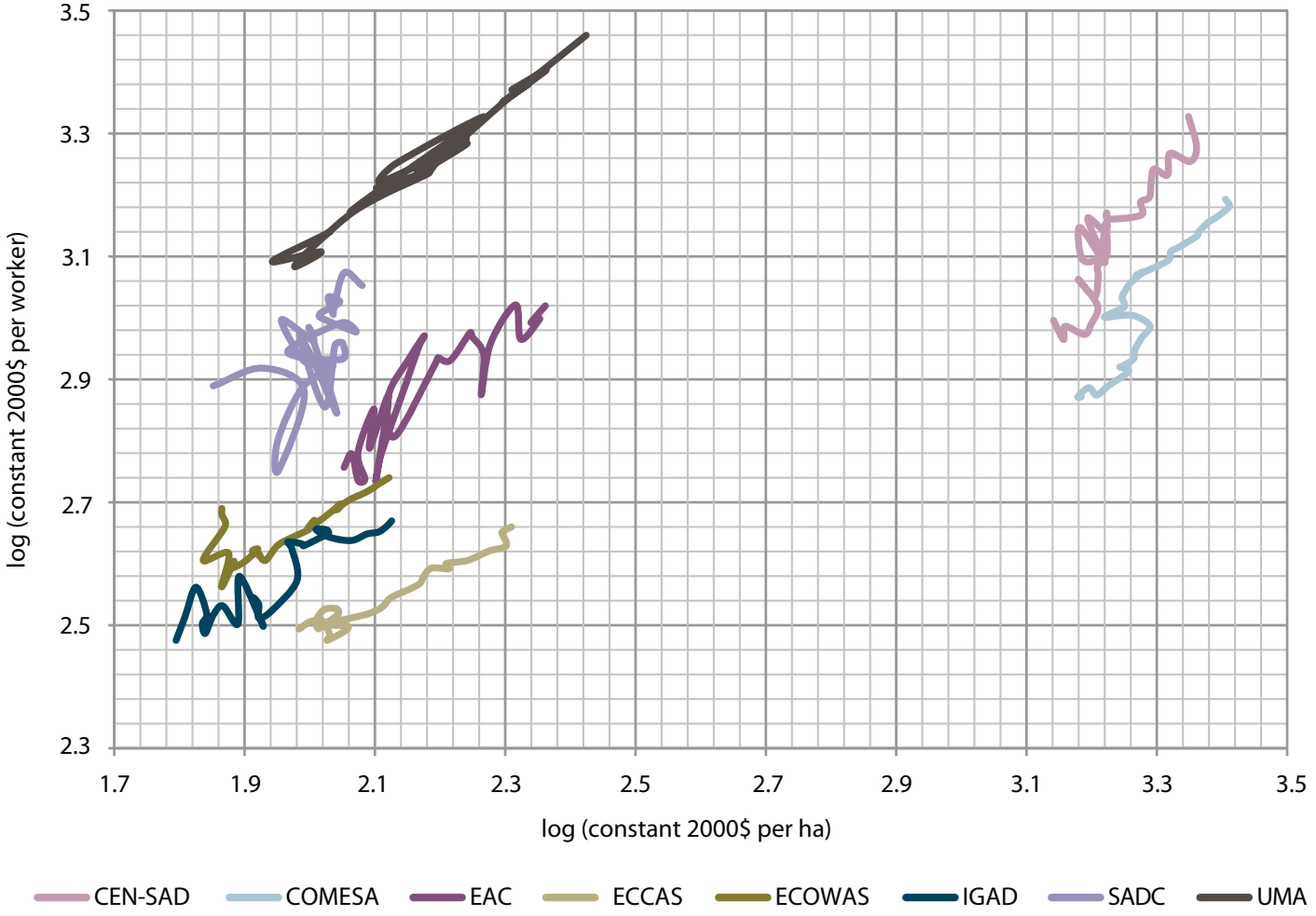
FIGURE 3.2—SCATTER PLOTS OF LAND AND LABOR PRODUCTIVITY BY ECONOMIC CLASSIFICATION (1980–2010)



Source: Authors' calculation and representation, based on World Bank 2012.

has favorable agriculture production potential and is also rich in minerals—dominated by DRC, which accounts for about 41 percent of the group's total agriculture value added; the poor performance thus seems consistent with the "resource curse" thesis. The trends by sub-periods (1980–1990, 1990–2000, and 2000–2010) reveal that, for all four economic categories, the increase in both land and labor productivity was generally lower on average in the 1990s than in the other two sub-periods. The exceptions are labor productivity in LI-1 and land productivity in LI-3, which both show a consistent increase across all three sub-periods.

FIGURE 3.3—SCATTER PLOTS OF LAND AND LABOR PRODUCTIVITY BY REGIONAL ECONOMIC COMMUNITY (1980–2010)



Source: Authors' calculation and representation, based on World Bank 2012.

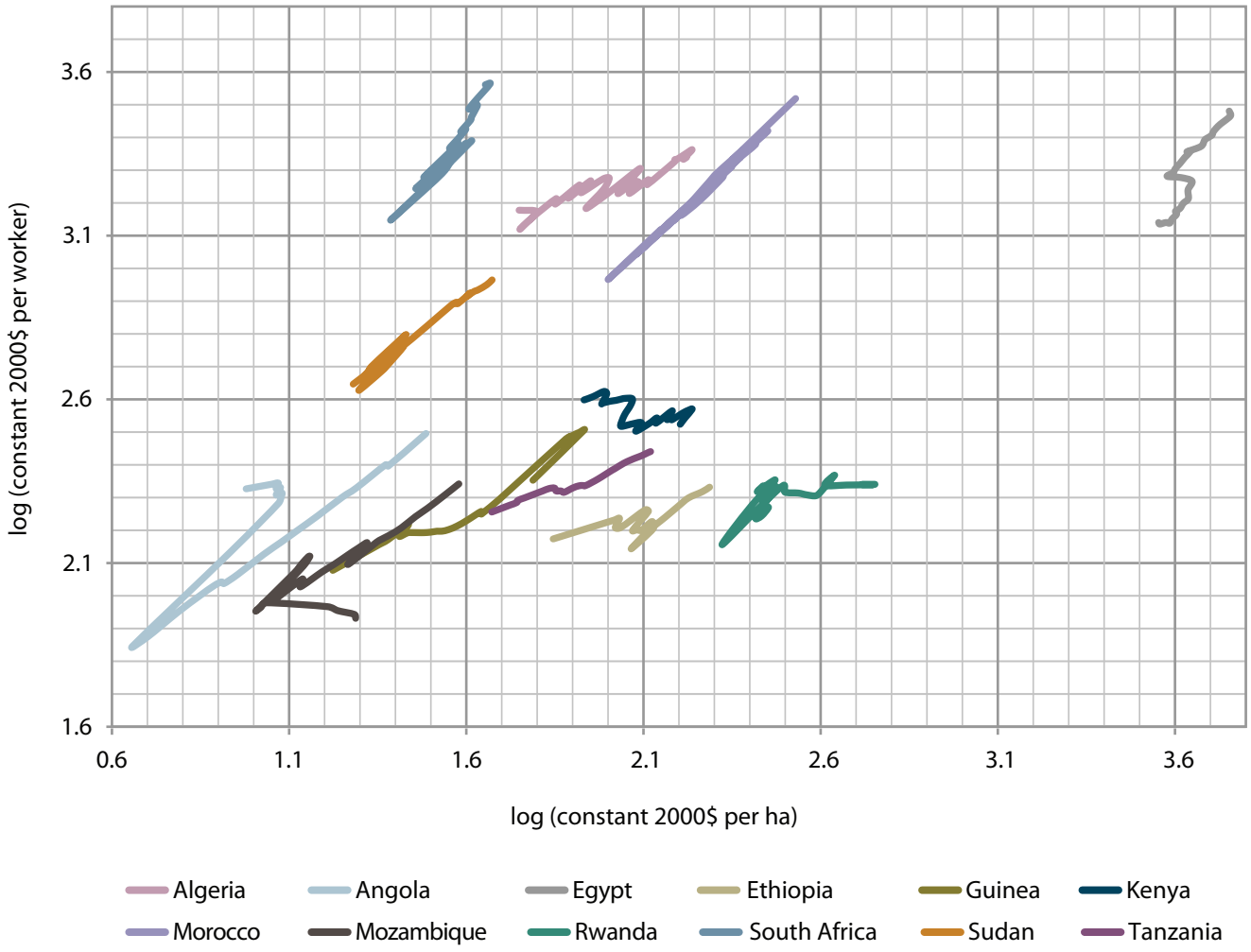
Figure 3.3 shows the trends by Regional Economic Community. Two of the RECs outperformed the others in land productivity: the CEN-SAD REC, with an average level of $1740 per ha for the entire period (dominated by Nigeria and Egypt in total agriculture value added—see Table 2.3); and COMESA REC (also dominated by Egypt), with an average $1946 per ha (see Table 3.1). The UMA REC, dominated by Algeria and

Morocco, outperformed the other RECs in labor productivity, with an average of $1870 per worker. The lower-performing RECs in both land and labor productivity are ECOWAS, IGAD, and ECCAS, with average land and labor productivity values in the range of $91–135 per ha and $381–457 per worker. Land productivity increased relatively faster in these three RECs, with an average annual rate in the range of 2.3–2.7 percent, compared to an average annual rate of growth in labor productivity in the range of only 0.9–1.5 percent (see Table 3.1). The EAC and SADC RECs experienced the most variability in land and labor productivity, as reflected in the tortuous shape of their plots (Figure 3.3).

Selected countries

Turning now to the selected countries representing the largest or fastest-growing agricultural economies in Africa, we see that Egypt is ahead of the pack in both

FIGURE 3.4—SCATTER PLOTS OF LAND AND LABOR PRODUCTIVITY BY LARGEST OR FASTEST-GROWING AGRICULTURAL ECONOMIES IN AFRICA (1980–2010)

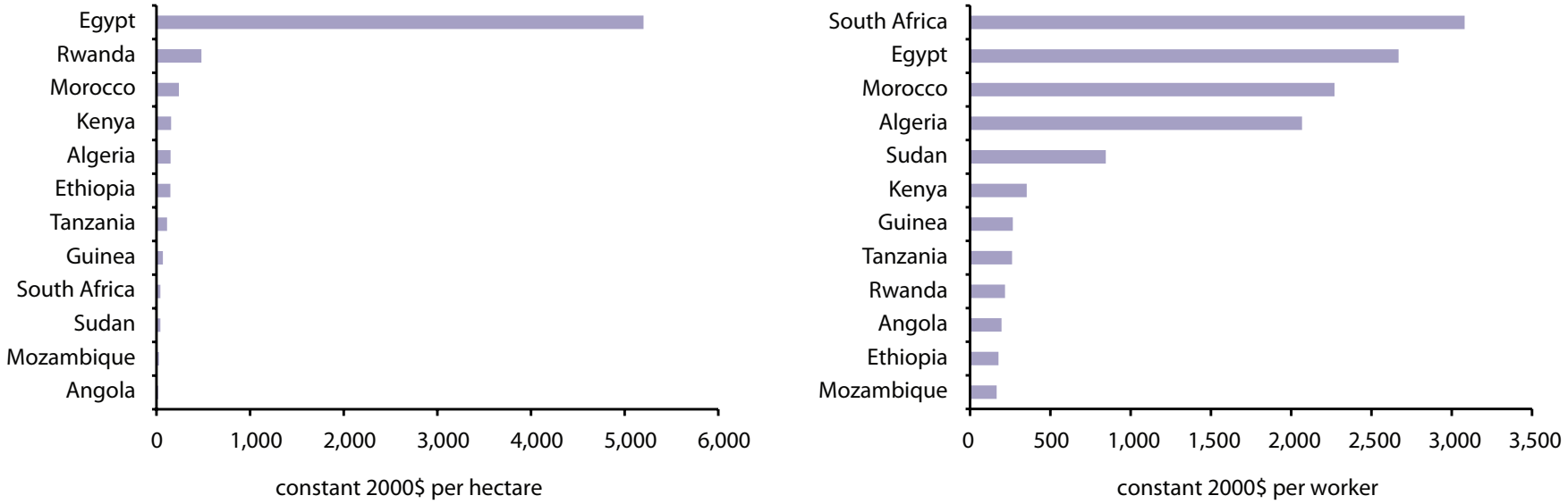


Source: Authors' calculation and representation, based on World Bank 2012.
Notes: Largest agricultural economies are the top nine countries in terms of percentage share in Africa's total agriculture value added (see Figure 2.1); the fastest-growing agricultural economies are those surpassing the CAADP agricultural growth rate target of 6 percent (see Figure 2.2). Nigeria is missing because there were no data on labor productivity.

land and labor productivity (Figure 3.4). While Algeria, Morocco, and South Africa have similar high labor productivity values, averaging more than $2000 per worker in 2000–2010, Egypt clearly outperformed all the other selected countries in land productivity, with an average of $5201 per ha in 2000–2010 compared to next highest level of $480 per ha in Rwanda (Table 3.1). Focusing on labor productivity alone, three clusters of countries can be identified as showing similar performance: (1) Algeria, Egypt, Morocco, and South Africa; (2) Angola, Guinea, and Mozambique; and (3) Ethiopia, Rwanda, and Tanzania. (The outliers are Kenya and Sudan, in separate classes of their own.) A similar exercise can be done for land productivity: (1) Angola and Mozambique; (2) Sudan and South Africa; and (3) Algeria, Ethiopia, Kenya and Tanzania. (The outliers in separate classes of their own are Egypt, Guinea, Morocco and Rwanda.) It is difficult to do this, however, for the combined indicators.

It is clear that high performance in one indicator does not mean equally high performance in the other indicator. South Africa, for example, is among the top performers in labor productivity (with an average of $3080 per worker in 2000–2010) but has a relatively low land productivity (with an average

FIGURE 3.5—LAND AND LABOR PRODUCTIVITY FOR THE LARGEST OR FASTEST-GROWING AGRICULTURAL ECONOMIES IN AFRICA (average 2000–2010)



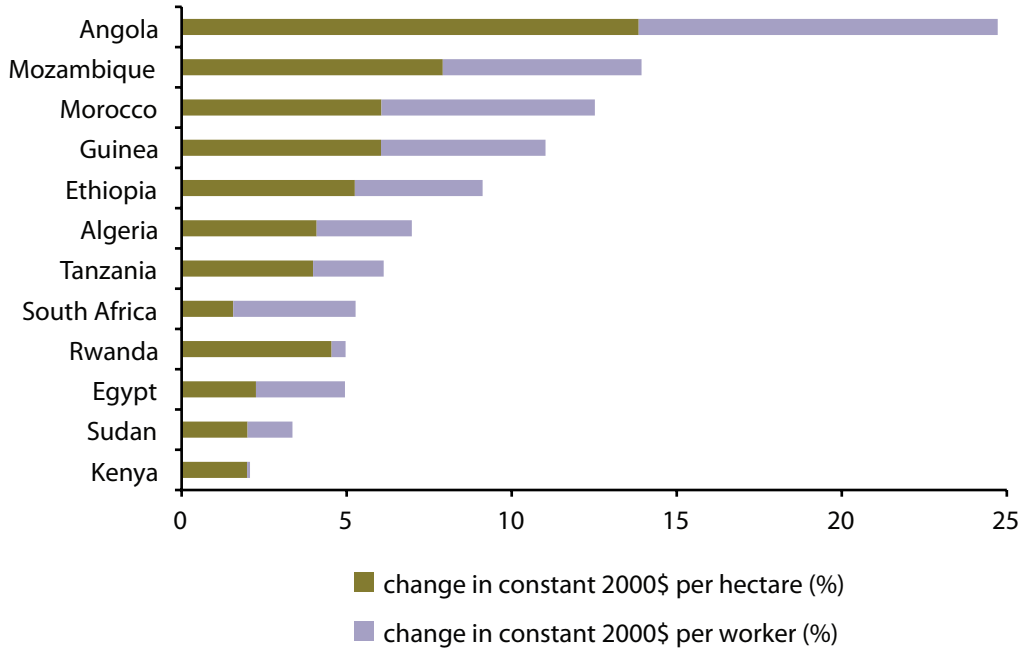
Source: Authors' calculation and representation, based on World Bank 2012.
Notes: Largest agricultural economies are the top nine countries in terms of percentage share in Africa's total agriculture value added (see Figure 2.1); the fastest-growing agricultural economies are those surpassing the CAADP agricultural growth rate target of 6 percent (see Figure 2.2). Nigeria is missing because there were no data on labor productivity.

of only $42 per ha in the same period). Figure 3.5 shows countries' relative rankings in the two indicators, using the average annual levels in 2000–2010 for illustration. Only Morocco has the same ranking in both measures, as third highest performer.

Looking at change in productivity over the entire period (1980–2010), Guinea is the top performer, with an annual average growth rate of 5.7 percent in land productivity and 3.1 percent in labor productivity, although it started from very low levels of $7 per ha and $120 per worker in 1980. This is reflected by the longest plot for Guinea (Figure 3.4). The next highest performers in terms of change in productivity over the entire period are Algeria and Morocco, which had high initial levels, and Mozambique and Sudan, which had lower initial levels. Angola is the only country that experienced a sharp reverse in growth: there was a substantial decline in both land and labor productivity in the 1980s and 1990s, due mostly to the war, followed by recovery in the 2000s. Productivity went down from its already low starting point of $9 per ha and $212 per worker in 1980 to $5 per ha and $70 per worker in 1993, and then bounced back, with an average annual growth rate of 13.8 and 10.9 percent in land and labor productivity in the 2000s, reaching $31 per ha and $313 per worker in 2010. Kenya shows the lowest performance in labor productivity growth, with a declining trend, followed by Ethiopia and Rwanda, as reflected in the relatively flat plots in Figure 3.4.

Analyzed by sub-periods (1980–1990, 1990–2000, and 2000–2010), the trends show that the growth in both land and labor productivity was generally lower on average in the 1990s than in the other two sub-periods, with many countries actually experiencing decline for that decade (see Table 3.1). The 2000s saw strong positive growth in both land and labor productivity in many countries, headed by Angola followed by Mozambique, Morocco, and Ethiopia; these four countries experienced roughly equal average annual growth rates in land and labor productivity (Figure 3.6).

FIGURE 3.6—GROWTH RATE IN LAND AND LABOR PRODUCTIVITY FOR THE LARGEST OR FASTEST-GROWING AGRICULTURAL ECONOMIES IN AFRICA (annual average 2000–2010)



Source: Authors' calculation and representation, based on World Bank 2012.
Notes: Largest agricultural economies are the top nine countries in terms of percentage share in Africa's total agriculture value added (see Figure 2.1); the fastest-growing agricultural economies are those surpassing the CAADP agricultural growth rate target of 6 percent (see Figure 2.2). Nigeria is missing because there were no data on labor productivity.

TABLE 3.2—VALUE ($) OF CROP PRODUCTION PER HA OF CROPLAND (average 2005–2007)

Farming system	Eastern and central Africa	Southern Africa	Western Africa	Total
Agro-Pastoral millet/sorghum	289	465	337	340
Cereal-Root Crop Mixed	372	437	613	572
Coastal-Artisanal Fishing	688	357	1,125	870
Forest Based	523	1,315	839	575
Highland Perennial	822	n.a.	n.a.	822
Highland Temperate Mixed	530	368	1,103	547
Irrigated	268	439	440	344
Large Commercial Smallholder	n.a.	850	n.a.	850
Maize Mixed	592	563	721	582
Pastoral	418	660	240	326
Rice-Tree Crop	853	n.a.	n.a.	853
Root Crop	658	544	1,070	945
Sparse (Arid)	246	545	735	278
Tree Crop	710	1,064	1,108	1,093
Not Labeled[1]	625	778	949	878
Average	**555**	**604**	**671**	**624**

Source: Authors' calculations based on: HarvestChoice/IFPRI SPAM Crop Distribution (You, Wood, and Wood-Sichra 2009); farming systems (Dixon, Gulliver, and Gibbon 2001); FAO crop prices (FAOSTAT 2012); and cropland distribution (Ramankutty et al. 2008). See Tables 3A.1 and 3A.2 for details.
Notes: n.a. means not applicable. Other systems not shown are: Dryland Mixed, Highland Mixed, and Rainfed Mixed, which occur in northern Africa.
[1] "Not labeled" comprises grid cells that do not have an assigned farming system, because of differences in the delineation of water and land interface (such as coastlines, lake areas) between data layers

Spatial Patterns in Land and Labor Productivity

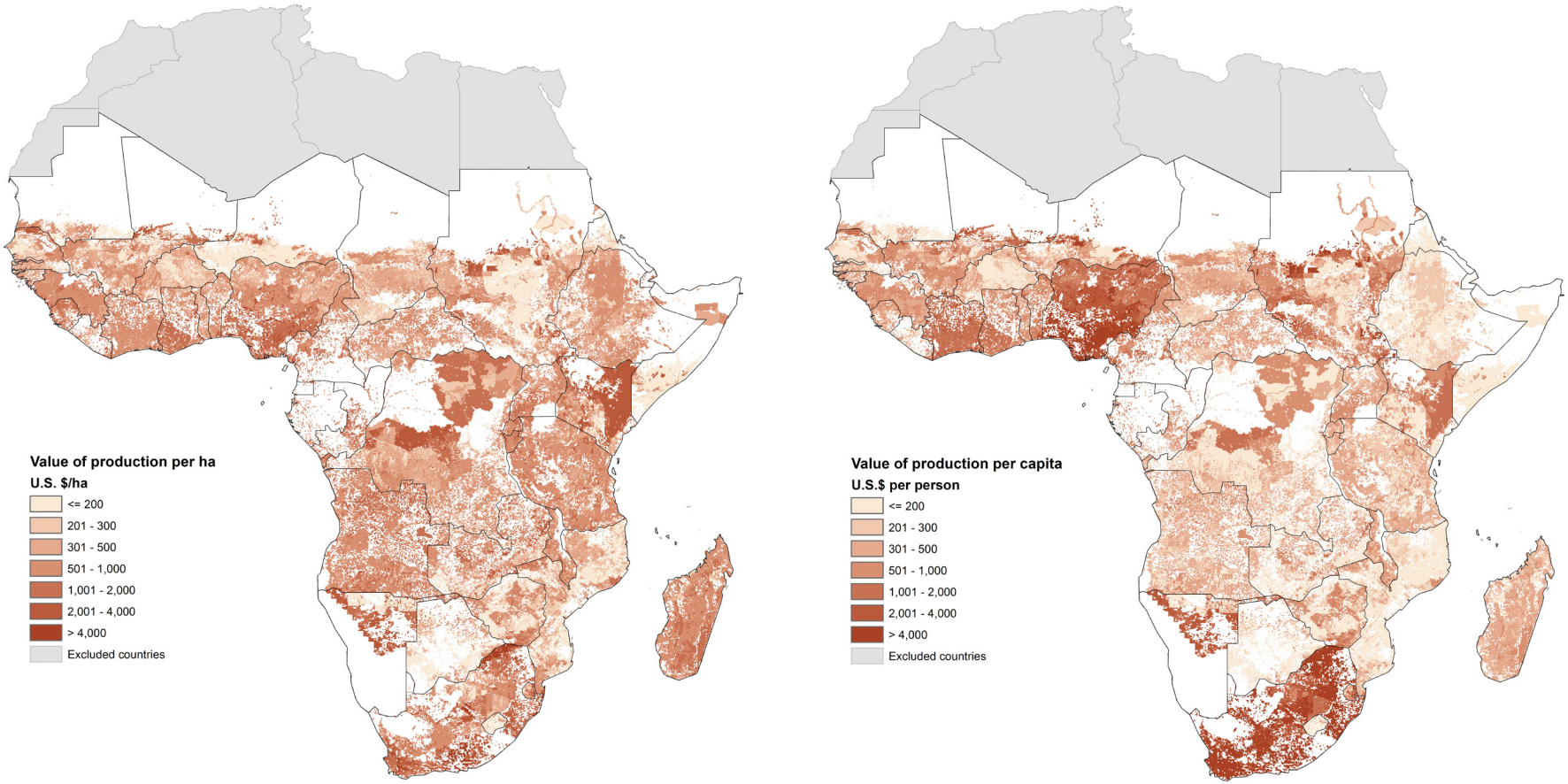
The analysis of trends does not indicate the factors underlying the observed differences across regions and countries. The following spatial analysis helps to fill this gap, using farming systems as the primary spatial unit of observation (see Figure 2.3). Due to data constraints, we use the 2005–2007 average value of land and labor productivity in crop production, corresponding to the four geographic regions of central, eastern, southern, and western Africa. Detailed results are presented in Figure 3.7 and Tables 3.2 and 3.3.

Land productivity in crop production, 2005–2007

The results in Table 3.2 show that there is some consistency in the overall regional land productivity levels, with a progression from eastern and central Africa (average $555 per ha), through southern Africa ($604 per ha), to western Africa ($671 per ha).

Western Africa shows a progressive increase in land productivity, from the semi-arid Agro-Pastoral (millet/sorghum) systems of the Sahel ($337 per ha), through the higher rainfall Cereal-Root Crop system ($613 per ha) and Root Crop system ($1070 per ha), to the sub-humid and humid Coastal-Artisanal Fishing system ($1125 per ha). In the humid Tree Crop system, land productivity is assessed at $1108 per ha. The higher productivity in the more humid systems reflects higher-value cash crops, especially cocoa and rice, and probably higher levels of market accessibility. While the pastoral systems produce only about $240 per ha in crop production, these areas are, by definition, primarily livestock oriented. The progression of land productivity values in western Africa represents an almost five-fold range, from $240 per ha in the semi-arid marginal croplands that fringe the Sahel to $1125 per ha in the most humid coastal areas, showing a striking pattern of alignment between the gradients of rainfall and productivity. Furthermore, based on a separate analysis of the spatial patterns of rainfall variability, it is likely that the higher returns to land in more humid zones are also more stable from year to year. In the semi-arid pastoral systems, in contrast, crop production is not only less suited but also more erratic from year to year. A surprising

FIGURE 3.7—LAND AND LABOR PRODUCTIVITY OF CROP PRODUCTION IN AFRICA (average 2005–2007)



Source: Authors' calculations and illustration based on: HarvestChoice/IFPRI SPAM Crop Distribution (You, Wood, and Wood-Sichra 2009); FAO crop prices and agricultural labor (FAOSTAT 2012); cropland distribution (Ramankutty et al. 2008); and rural population distribution (GRUMP 2005).

finding is the modest value of land productivity in the formal Irrigated systems ($440 per ha) that occupy just over 2 percent of the region's cropland, primarily in the semi-arid Niger basin, and particularly the Office du Niger. Data results for such small geographic areas may be less reliable however, owing to differences in resolution across multiple data layers.

In eastern and central Africa as well, land productivity patterns vary significantly by system. The highest land productivity of the major systems, ranging from $822 to 853 per ha, is assessed for the high population density, high market access Highland Perennial systems of Ethiopia, Uganda, Rwanda, and Burundi. This farm system is associated with banana, plantain,

enset, coffee, cassava, sweet potato, beans, cereals, and livestock. The Rice-Tree Crop systems (only found in Madagascar) show a similarly high level of land productivity. The largest system, Maize Mixed, shows land productivity of $592 per ha. The Root Crop system (cassava, legumes) shows somewhat higher land productivity, estimated at $658 per ha; this system enjoys around 15 percent higher annual rainfall, with only about one-third of the population density as compared to the Maize Mixed system. Although small in extent, the Tree Crop systems provide high returns to land, estimated at $710 per ha. Land productivity in the more remote, less densely (but still highly) populated, and less humid Highland Temperate Mixed system is significantly lower than other systems, at $530 per ha, producing wheat, barley, teff, peas, lentils, broad beans, potatoes, and livestock.

In southern Africa, the Large Commercial Smallholder system—by far the predominant system—provides the highest land productivity ($850 per ha), with two small-scale exceptions: the very humid Forest Based systems, at $1315 per ha, and Tree Crop systems, at $1064 per ha, the largest return to land of all the major systems in the region. The second largest system, Maize Mixed, shows land productivity similar to the level in eastern and central Africa ($563 per ha). The Pastoral systems show significantly higher land productivity ($660 per ha). Lowest levels of land productivity are shown in Cereal-Root Crop ($437 per ha), Root Crop ($544 per ha), and Agro-Pastoral ($465 per ha). These findings suggest that, through the use of fertilizer inputs over many years, the soils of the Large Commercial Smallholder system remain more fertile than those in other rainfed, cereal-based systems.

TABLE 3.3—VALUE ($) OF CROP PRODUCTION PER AGRICULTURAL WORKER (average 2005–2007)

Farming system	Eastern and central Africa	Southern Africa	Western Africa	Total
Agro-Pastoral millet/sorghum	235	264	580	461
Cereal-Root Crop Mixed	360	215	985	699
Coastal-Artisanal Fishing	300	175	1,534	696
Forest Based	235	512	576	273
Highland Perennial	381	n.a.	n.a.	381
Highland Temperate Mixed	206	296	1,974	234
Irrigated	246	187	644	374
Large Commercial Smallholder	n.a.	3,620	n.a.	3,620
Maize Mixed	269	388	489	300
Pastoral	305	277	610	382
Rice-Tree Crop	371	n.a.	n.a.	371
Root Crop	312	247	1,588	867
Sparse (Arid)	337	619	799	373
Tree Crop	315	415	1,626	1,473
Not Labeled[1]	240	504	967	680
Average	**287**	**461**	**1,084**	**544**

Source: Authors' calculations based on: HarvestChoice/IFPRI SPAM Crop Distribution (You, Wood, and Wood-Sichra 2009); farming systems (Dixon, Gulliver, and Gibbon 2001); FAO crop prices and agricultural labor (FAOSTAT 2012); and rural population distribution (GRUMP 2005). See Tables 3A.1 and 3A.3 for details.
Notes: n.a. means not applicable. Other systems not shown are: Dryland Mixed, Highland Mixed, and Rainfed Mixed which occur in northern Africa.
[1] "Not labeled" comprises grid cells that do not have an assigned farming system, because of differences in the delineation of water and land interface (such as coastlines, lake areas) between data layers.

Labor productivity in crop production, 2005–2007

Details of labor productivity are presented in Figure 3.7 and Table 3.3. There are striking differences in labor productivity across both sub-regions and farming systems. Most notably, labor productivity in the Large Commercial Smallholder systems of Southern Africa, at $3,620 per worker, is sevenfold larger than the overall average of $544 per worker. This system comprises a mix of scattered smallholders along with large-scale commercial operations

that are generally highly mechanized. All the other systems with high levels of labor productivity are found in western Africa, led by the Root Crop and Tree Crop systems, representing about 40 percent of western Africa's cropland. The Tree Crop systems in the sub-region yield an estimated $1626 per worker, producing many high-value cash crops (such as cocoa, coffee, oil palm, rubber, and yams), including perennials that require less intensive labor inputs than annual crops. Root Crop systems ($1588 per worker) are characterized by crops with high yields and, in the case of yams, high value.

By contrast, labor productivity in eastern and central Africa is remarkably uniform and low, ranging from $235 to $380 per worker. The Highland Perennial and Rice-Tree Crop systems show the highest productivity, at $381 and $371 per worker respectively. Comparing the major cereal-based farming systems, western Africa shows two- to three-fold higher labor productivity than eastern and central Africa. (Note that the relative productivities among systems in the eastern and central regions are fairly consistent with expectations.) There are two possible explanations for this systematic difference. First, western Africa shows a wider prevalence of informal irrigation within rainfed systems (for example, inland valley production practices); these systems, while not classified as part of the Irrigated farming systems, boost yields and in many cases produce rice, a higher-value cereal. (Note that, consistent with this hypothesis, land productivity is also high for these two cereal-based systems.) Second, there may be a structural bias to our estimates, reflecting the systematically lower share of the population identified as "economically active in agriculture" in western Africa, since the primary proxy used for number of agricultural workers is the International Labor Organization (ILO) national estimate of "economically active in agriculture" (spatially downscaled according to the distribution of rural population).

Summary of Findings

We find that the trends in land and labor productivity are highly variable in different dimensions across different parts of the continent. High performance in one indicator does not necessarily mean equally high performance in the other indicator. Looking at the annual trends over the entire 1980–2010 period, we find that labor productivity has risen much faster than land productivity in Africa as a whole. This holds particularly for the northern Africa region, the middle income country group, and the CEN-SAD REC, reflecting Egypt's performance and inclusion in these groupings. In many of the other groups, however, we find the opposite: land productivity has risen much faster than labor productivity. The exceptions are the southern Africa region and Morocco, where land and labor productivity have risen at about the same rate, on average. Looking at the trends by sub-periods (1980–1990, 1990–2000, and 2000–2010), we find a slower rate of increase in both land and labor productivity in the 1990s than in the other two sub-periods. The 2000s saw strong positive growth in both land and labor productivity, reflecting a recovery from the downturn in the 1990s, with the UMA REC and Angola clearly in the forefront of the agricultural recovery.

The geographic context conditions both the baselines and the likely trajectory of productivity growth, and thus plays a significant role in accounting for the differences in land and labor productivity across different parts of the continent—characterized by diverse farming systems based on shared characteristics of biophysical endowment, demographics, and infrastructure. Setting aside the findings for the least important farming systems, the results of the spatial analysis show 2005–07 average land productivity values for crop production ranging from a low of $240-$290 per ha for the Agro-Pastoral (millet/sorghum) systems in eastern Africa and the Pastoral systems in western Africa to a high of $1125 per ha

in the humid Coastal systems of western Africa, where cash crops are widespread. With respect to labor productivity, our estimates span a much broader range—from $206 per worker in the Highland Temperate Mixed systems in eastern and central Africa, to the singularly high $3620 per worker in the Large Commercial Smallholder systems in southern Africa.

These results point to the enduring relevance of the development theories of Ricardo (1891), von Thuenen (1826), and Boserup (1965). We clearly see evidence of larger returns to land and labor in areas of comparative rainfall advantage, as well as in the more market-accessible farm systems. We also see suggestions of higher returns to land (if not to labor) in some areas of high population density (such as the eastern Africa Highland Perennial systems), where pressure on natural resources is known to have prompted improved management practices; Machakos is the storied example in this region. With typical holdings of 1–3 hectares and with about 5–8 family members per farm household, it is easy to understand why rural poverty is so prevalent and persistent—and why raising land and labor productivity in a sustainable manner remains a fundamental development goal for Africa.

Annex: Additional Tables

TABLE 3A.1—DISTRIBUTION OF VALUE OF CROP PRODUCTION BY FARMING SYSTEM ($ millions), 2005–2007

Farming system	Eastern and central Africa	Southern Africa	Western Africa	Total
Agro-Pastoral millet/sorghum	8,133	7,474	65,471	81,078
Cereal-Root Crop Mixed	9,955	14,988	148,846	173,789
Coastal-Artisanal Fishing	2,934	4,133	29,570	36,637
Forest Based	23,298	125	7,141	30,564
Highland Perennial	57,589	n.a.	n.a.	57,589
Highland Temperate Mixed	29,064	2,182	3,956	35,202
Irrigated	5,928	74	7,593	13,595
Large Commercial Smallholder	n.a.	52,428	n.a.	52,428
Maize Mixed	74,437	39,029	6	113,472
Pastoral	28,108	3,764	22,669	54,541
Rice-Tree Crop	13,282	n.a.	n.a.	13,282
Root Crop	32,677	5,994	161,246	199,917
Sparse (Arid)	2,745	521	165	3,431
Tree Crop	2,971	172	119,987	123,130
Not Labeled1	820	1,161	6,452	8,433
Total	**291,941**	**132,043**	**573,101**	**997,085**

Sources: Authors' calculations based on: HarvestChoice/IFPRI SPAM Crop Distribution (You, Wood, and Wood-Sichra 2009); farming systems (Dixon, Gulliver, and Gibbon 2001); FAO crop prices (FAOSTAT 2012);
Notes: n.a. means not applicable. Other systems not shown are: Dryland Mixed, Highland Mixed, and Rainfed Mixed which occur in the northern Africa.
[1] "Not labeled" comprises grid cells that do not have an assigned farming system, because of differences in the delineation of water and land interface (such as coastlines, lake areas) between data layers.

TABLE 3A.2—DISTRIBUTION OF CROPLAND AREA BY FARMING SYSTEM (1000 hectares), 2005

Farming system	Eastern and central Africa	Southern Africa	Western Africa	Total
Agro-Pastoral millet/sorghum	5,594	1,926	21,008	28,527
Cereal-Root Crop Mixed	4,778	3,808	21,657	30,242
Coastal-Artisanal Fishing	350	364	2,243	2,957
Forest Based	2,910	159	1,503	4,572
Highland Perennial	5,317	n.a.	n.a.	5,317
Highland Temperate Mixed	6,101	868	434	7,402
Irrigated	1,879	39	2,333	4,251
Large Commercial Smallholder	n.a.	13,219	n.a.	13,219
Maize Mixed	13,823	9,636	1	23,460
Pastoral	9,010	976	11,719	21,705
Rice-Tree Crop	1,825	n.a.	n.a.	1,825
Root Crop	8,920	3,317	25,222	37,459
Sparse (Arid)	161	178	6	344
Tree Crop	263	165	11,930	12,358
Not Labeled1	163	268	604	1,034
Total	**61,092**	**34,924**	**98,659**	**194,675**

Sources: Authors' calculations based on: HarvestChoice/IFPRI SPAM Crop Distribution (You, Wood, and Wood-Sichra 2009); farming systems (Dixon, Gulliver, and Gibbon 2001); and cropland distribution (Ramankutty et al. 2008).
Notes: n.a. means not applicable. Other systems not shown are: Dryland Mixed, Highland Mixed, and Rainfed Mixed which occur in the northern Africa.
[1] "Not labeled" comprises grid cells that do not have an assigned farming system, because of differences in the delineation of water and land interface (such as coastlines, lake areas) between data layers.

TABLE 3A.3—DISTRIBUTION OF RURAL POPULATION HEADCOUNT BY FARMING SYSTEM (number), 2005

Farming system	Eastern and central Africa	Southern Africa	Western Africa	Total
Agro-Pastoral millet/sorghum	5,387,031	3,143,550	32,808,336	41,338,917
Cereal-Root Crop Mixed	9,301,065	13,472,937	48,709,206	71,483,208
Coastal-Artisanal Fishing	3,391,375	3,651,007	10,257,584	17,299,966
Forest Based	29,966,512	129,907	4,136,853	34,233,272
Highland Perennial	40,217,290	n.a.	n.a.	40,217,290
Highland Temperate Mixed	34,974,185	4,033,144	536,657	39,543,986
Irrigated	3,559,508	75,607	4,767,946	8,403,061
Large Commercial Smallholder	n.a.	13,124,074	n.a.	13,124,074
Maize Mixed	59,566,865	27,801,226	1,064	87,369,155
Pastoral	23,294,528	789,492	8,316,146	32,400,166
Rice-Tree Crop	8,967,891	n.a.	n.a.	8,967,891
Root Crop	14,715,031	3,036,864	29,322,488	47,074,383
Sparse (Arid)	4,881,068	100,120	416,379	5,397,567
Tree Crop	2,521,193	831,987	32,975,758	36,328,938
Not Labeled1	1,877,891	882,511	3,580,151	6,340,553
Average	**242,621,433**	**71,072,426**	**175,828,568**	**489,522,427**

Sources: Authors' calculations based on: HarvestChoice/IFPRI SPAM Crop Distribution (You, Wood, and Wood-Sichra 2009); farming systems (Dixon, Gulliver, and Gibbon 2001); FAO crop prices (FAOSTAT 2012);
Notes: n.a. means not applicable. Other systems not shown are: Dryland Mixed, Highland Mixed, and Rainfed Mixed which occur in the northern Africa.
[1] "Not labeled" comprises grid cells that do not have an assigned farming system, because of differences in the delineation of water and land interface (such as coastlines, lake areas) between data layers.

Trends in Total Factor Productivity (TFP)

By accounting for all factors and inputs used in production, total factor productivity (TFP) can better capture the overall performance of agricultural production. Moreover, it can be decomposed into efficiency, changes reflecting the reallocation of productive factors, and technical change, changes in the amount of output produced with unchanged levels of inputs. Because of data constraints, the analysis and results are based on 29 countries in four geographic regions—central, eastern, southern, and western Africa.[4] These countries include six of the nine largest agricultural economies and five of the six fastest-growing agricultural economies in Africa identified in this study.[5] The results are shown in Tables 4.1 and 4.2 and Figures 4.1–4.3 and 4.5 for the different aggregations and selected countries. Table 4.1 shows the average annual levels of TFP and its decomposed parts (indexed at 1961=1) for the period 1961–2005 and for five sub-periods (1961–1970, 1970–1980, 1980–1990, 1990–2000, and 2000–2005). Table 4.2 shows the average annual percentage growth rates, in the same format. Because the annual averages, although useful from the quantitative perspective, can hide significant variations across time, Figures 4.1–4.3 and 4.5 give a bird's-eye view of such variations.

Trends in TFP at the Aggregate Levels

Taking all the 29 countries together (which we use to represent Africa as a whole), the results show that the annual average growth rate in TFP over the entire period of 1961–2005 was -0.28 percent (Table 4.1), declining from a value of 1.00 in 1961–1970 to 0.94 in 2000–2005 (Table 4.2). This means that on average, agricultural TFP was 6 percentage points lower in 2000–2005 than the level in 1961–1970. From Figure 4.1, we can see that there was a slight overall improvement in the 1960s, followed by a rapid deterioration that stretches from the late 1960s to the mid-1980s. TFP declined by 4.36 percent on average per year in 1970–1980 (see Table 4.2). TFP started to recover after the mid-1980s and continuing through 2005, the last year for which data were available. During this recovery period,

[4] The countries include Angola, Benin, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mozambique, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Zambia, and Zimbabwe.

[5] The nine largest agricultural economies include Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia, and Tanzania. The six fastest-growing agricultural economies include Angola, Guinea, Nigeria, Ethiopia, Rwanda, and Mozambique.

TABLE 4.1—TOTAL FACTOR PRODUCTIVITY, EFFICIENCY, AND TECHNICAL CHANGE (annual average level, 1961–2005: 1961=1)

	1961–1970			1970–1980			1980–1990			1990–2000			2000–2005			1961–2005		
	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech
All countries	1.00	0.95	1.05	0.79	0.70	1.13	0.63	0.55	1.14	0.80	0.69	1.16	0.94	0.79	1.19	0.82	0.73	1.13
Geographic location																		
Central	0.96	0.95	1.01	0.85	0.84	1.01	0.78	0.78	1.01	0.92	0.89	1.04	1.08	0.98	1.10	0.90	0.88	1.03
Eastern	0.87	0.86	1.02	0.76	0.73	1.05	0.82	0.78	1.05	0.89	0.85	1.05	1.02	0.98	1.05	0.86	0.83	1.04
Southern	0.99	0.92	1.07	1.03	0.91	1.13	1.14	0.93	1.22	1.38	0.96	1.45	1.76	1.07	1.67	1.21	0.95	1.28
Western	1.02	0.97	1.05	0.74	0.65	1.15	0.51	0.45	1.15	0.71	0.62	1.15	0.82	0.71	1.15	0.75	0.67	1.13
Economic group																		
LI-1	0.98	0.98	1.01	0.91	0.90	1.01	0.82	0.81	1.01	1.02	1.01	1.01	1.11	1.09	1.02	0.96	0.95	1.01
LI-2	0.90	0.88	1.02	0.82	0.78	1.04	0.88	0.84	1.04	0.95	0.90	1.05	1.10	1.03	1.07	0.91	0.87	1.05
LI-3	0.83	0.82	1.01	0.66	0.64	1.02	0.64	0.62	1.02	0.63	0.62	1.02	0.72	0.71	1.02	0.69	0.68	1.02
MI	1.02	0.97	1.05	0.77	0.67	1.15	0.56	0.49	1.16	0.77	0.65	1.19	0.91	0.74	1.23	0.79	0.70	1.15
Regional Economic Community																		
CEN-SAD	1.01	0.97	1.05	0.76	0.67	1.14	0.55	0.48	1.14	0.74	0.65	1.14	0.85	0.74	1.14	0.77	0.69	1.12
COMESA	0.91	0.89	1.03	0.84	0.80	1.05	0.87	0.82	1.05	0.92	0.87	1.06	1.02	0.95	1.07	0.90	0.86	1.05
EAC	0.95	0.95	1.00	1.10	1.10	1.00	1.19	1.19	1.00	1.29	1.29	1.00	1.37	1.37	1.00	1.17	1.17	1.00
ECCAS	0.91	0.90	1.01	0.71	0.70	1.02	0.64	0.63	1.02	0.82	0.79	1.04	1.03	0.94	1.10	0.80	0.78	1.03
ECOWAS	1.02	0.97	1.05	0.74	0.65	1.15	0.51	0.45	1.15	0.71	0.62	1.15	0.82	0.71	1.15	0.75	0.67	1.13
IGAD	0.89	0.88	1.02	0.79	0.76	1.04	0.81	0.78	1.04	0.86	0.83	1.04	0.97	0.93	1.05	0.86	0.83	1.04
SADC	0.94	0.88	1.07	0.91	0.82	1.11	1.05	0.90	1.17	1.23	0.94	1.32	1.56	1.09	1.45	1.10	0.91	1.20
Selected countries																		
Largest agricultural economies																		
Ethiopia	0.89	0.88	1.01	0.73	0.69	1.05	0.70	0.67	1.05	0.67	0.63	1.05	0.77	0.72	1.06	0.75	0.72	1.04
Kenya	0.95	0.95	1.00	1.10	1.10	1.00	1.19	1.19	1.00	1.29	1.29	1.00	1.37	1.37	1.00	1.17	1.17	1.00
Nigeria	1.04	0.99	1.05	0.74	0.64	1.16	0.47	0.41	1.16	0.68	0.58	1.16	0.78	0.67	1.16	0.73	0.65	1.13
South Africa	1.06	0.95	1.11	1.33	1.09	1.22	1.65	1.19	1.39	2.02	1.09	1.85	2.74	1.15	2.41	1.66	1.08	1.52
Sudan	0.86	0.82	1.04	0.63	0.60	1.06	0.56	0.53	1.06	0.65	0.61	1.06	0.74	0.70	1.06	0.69	0.65	1.06
Tanzania	0.79	0.76	1.04	0.56	0.53	1.05	0.76	0.72	1.05	0.89	0.84	1.05	1.18	1.12	1.05	0.80	0.77	1.05
At least 6% agGDP growth rate per year in 2003-10[†]																		
Angola	0.73	0.71	1.03	0.33	0.32	1.04	0.26	0.25	1.04	0.43	0.41	1.04	0.75	0.72	1.04	0.47	0.46	1.04
Guinea	0.63	0.60	1.06	0.45	0.42	1.08	0.41	0.38	1.08	0.40	0.37	1.08	0.44	0.41	1.09	0.47	0.44	1.08
Mozambique	0.91	0.90	1.01	0.71	0.70	1.01	0.62	0.62	1.01	0.64	0.63	1.01	0.82	0.81	1.01	0.73	0.73	1.01

Source: Authors' calculation, based on TFP model results.
Notes: TFP is total factor productivity; Eff is efficiency; and Tech is technical change.
[†] Ethiopia and Nigeria are part of this group—see results under largest agricultural economies.

TABLE 4.2—PERCENTAGE CHANGE IN TOTAL FACTOR PRODUCTIVITY, EFFICIENCY, AND TECHNICAL CHANGE (annual average %, 1961–2005)

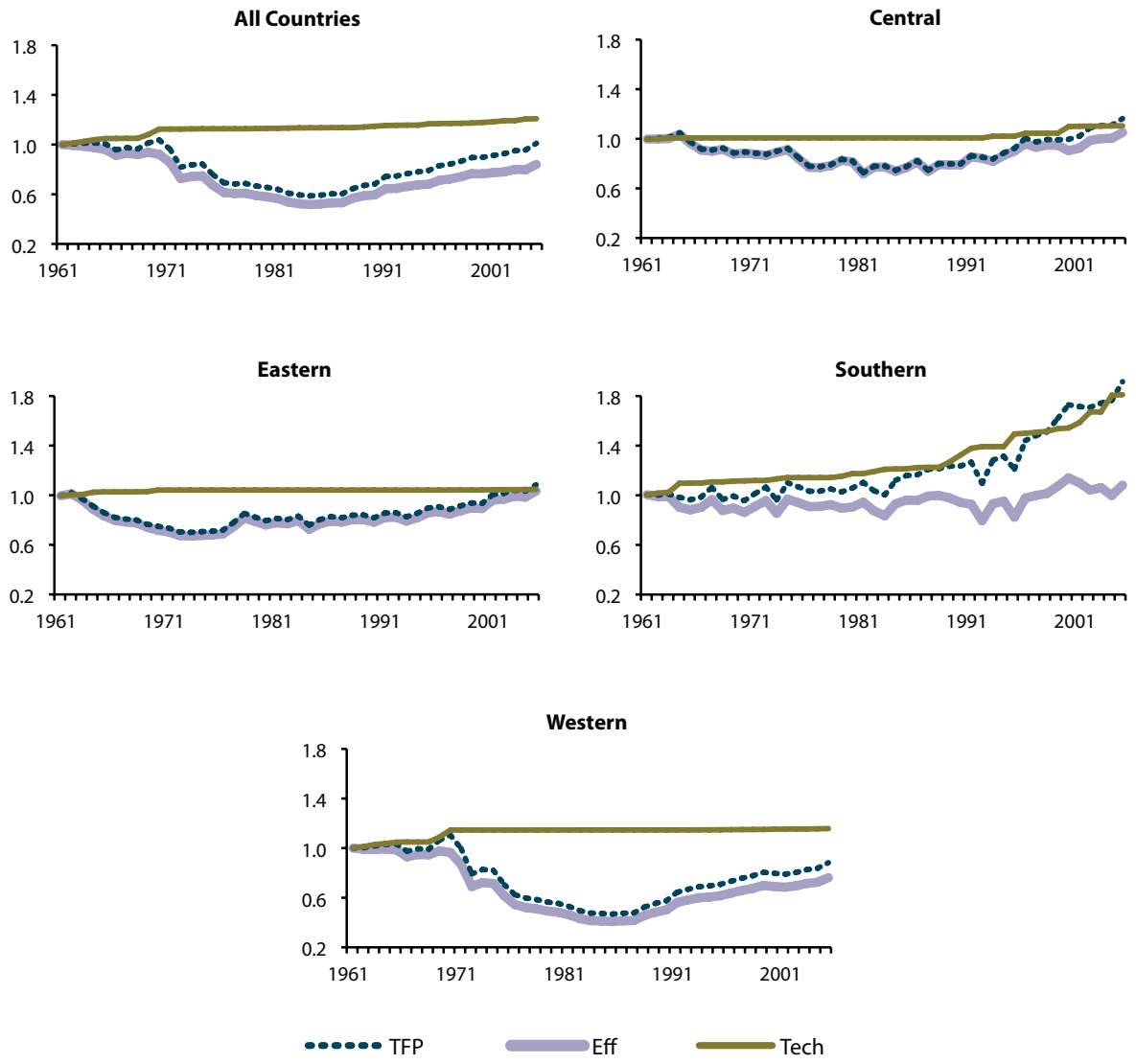
	1961–1970			1970–1980			1980–1990			1990–2000			2000–2005			1961–2005		
	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech
All countries	-0.01	-1.02	1.02	-4.36	-4.40	0.04	0.58	0.48	0.11	2.59	2.37	0.25	2.20	1.70	0.52	-0.28	-0.59	0.32
Geographic location																		
Central	-1.67	-1.75	0.08	-1.28	-1.28	0.00	0.29	0.29	0.00	2.34	1.65	0.69	3.02	2.91	0.10	0.20	0.02	0.18
Eastern	-3.49	-3.88	0.42	1.41	1.41	0.00	0.42	0.42	0.00	1.28	1.27	0.01	2.45	2.38	0.07	0.40	0.34	0.06
Southern	-0.28	-1.48	1.23	0.54	0.13	0.42	1.94	1.02	0.94	3.71	2.24	1.54	1.79	-1.53	3.46	1.39	0.27	1.15
Western	0.62	-0.51	1.13	-6.61	-6.62	0.00	0.51	0.51	0.00	2.94	2.89	0.05	2.06	1.98	0.08	-0.70	-0.93	0.23
Economic group																		
LI-1	-1.18	-1.25	0.09	-0.42	-0.42	0.00	2.00	2.00	0.00	0.77	0.74	0.04	3.68	3.40	0.27	0.29	0.27	0.02
LI-2	-2.59	-2.97	0.39	0.65	0.65	0.00	0.99	0.95	0.04	1.27	1.10	0.17	2.29	2.06	0.24	0.48	0.38	0.10
LI-3	-3.41	-3.65	0.25	0.17	0.14	0.03	-0.74	-0.74	0.00	0.74	0.74	0.00	4.87	4.76	0.10	-0.45	-0.48	0.03
MI	0.47	-0.67	1.15	-5.62	-5.68	0.05	0.48	0.35	0.14	3.16	2.91	0.30	1.97	1.34	0.68	-0.44	-0.81	0.39
Regional Economic Community																		
CEN-SAD	0.36	-0.71	1.07	-5.62	-5.62	0.00	0.45	0.45	0.00	2.71	2.67	0.04	1.95	1.88	0.07	-0.58	-0.79	0.21
COMESA	-2.44	-2.93	0.52	1.19	1.19	0.00	0.04	0.00	0.04	1.42	1.34	0.10	0.96	0.79	0.17	0.25	0.15	0.10
EAC	-0.69	-0.69	0.00	3.15	3.15	0.00	1.12	1.12	0.00	0.27	0.27	0.00	0.20	0.15	0.05	0.95	0.95	0.00
ECCAS	-3.23	-3.35	0.13	-2.31	-2.31	0.00	0.58	0.58	0.00	3.37	2.79	0.59	2.85	2.77	0.09	0.17	0.02	0.15
ECOWAS	0.62	-0.51	1.13	-6.61	-6.62	0.00	0.51	0.51	0.00	2.94	2.89	0.05	2.06	1.98	0.08	-0.70	-0.93	0.23
IGAD	-2.67	-3.07	0.43	1.06	1.06	0.00	-0.30	-0.30	0.00	1.43	1.42	0.01	1.61	1.52	0.09	0.18	0.12	0.07
SADC	-1.86	-2.84	1.02	1.03	0.73	0.30	2.10	1.47	0.66	2.68	1.76	1.02	2.84	0.73	2.24	1.25	0.49	0.80
Selected countries																		
Largest agricultural economies																		
Ethiopia	-2.65	-2.98	0.33	-0.97	-0.97	0.00	-1.51	-1.51	0.00	0.87	0.83	0.04	2.09	1.83	0.26	-0.54	-0.67	0.13
Kenya	-0.69	-0.69	0.00	3.15	3.15	0.00	1.12	1.12	0.00	0.27	0.27	0.00	0.20	0.15	0.05	0.95	0.95	0.00
Nigeria	0.97	-0.22	1.20	-7.47	-7.47	0.00	0.26	0.26	0.00	3.09	3.09	0.00	1.88	1.88	0.00	-0.92	-1.15	0.23
South Africa	1.82	-0.04	1.86	2.91	2.07	0.83	2.08	0.46	1.61	3.74	1.26	2.44	2.78	-3.60	6.63	2.39	0.39	2.00
Sudan	-4.43	-5.12	0.73	0.03	0.03	0.00	-1.27	-1.27	0.00	3.12	3.12	0.00	2.20	2.20	0.00	-0.41	-0.45	0.05
Tanzania	-7.60	-7.93	0.36	2.28	2.28	0.00	3.07	3.07	0.00	1.13	1.13	0.00	5.82	5.82	0.00	1.16	1.14	0.02
At least 6% agGDP growth rate per year in 2003-10[†]																		
Angola	-9.89	-10.18	0.33	-5.73	-5.73	0.00	0.19	0.19	0.00	8.72	8.72	0.00	2.46	2.46	0.00	-0.30	-0.32	0.02
Guinea	-7.30	-7.85	0.60	-1.16	-1.16	0.00	-1.73	-1.73	0.00	0.42	0.33	0.09	1.50	1.49	0.01	-1.05	-1.10	0.05
Mozambique	-1.68	-1.75	0.06	-3.98	-3.98	0.00	-0.36	-0.36	0.00	4.63	4.63	0.00	7.78	7.78	0.00	-0.55	-0.55	0.00

Source: Authors' calculation, based on TFP model results.
Notes: TFP is total factor productivity; Eff is efficiency; and Tech is technical change.
[†] Ethiopia and Nigeria are part of this group—see results under largest agricultural economies.

annual average TFP growth rates were 0.58 in 1980–1990, 2.59 in 1990–2000, and 2.20 in 2000–2005. The trends observed for the entire group of countries is driven by its largest economy, Nigeria, which experienced a decline in TFP (average annual rate of -0.92 percent) over the entire period of 1961–2005 (Table 4.2), declining from an average value of 1.04 in 1961–1970 to 0.78 in 2000–2005 (Table 4.1). In 1970–1980, Nigeria's TFP declined at a rate of -7.47 percent, nearly double the average decline for all 29 countries (see Table 4.2).

The improvement in performance in TFP for Africa as a whole during the period of recovery (particularly after 1990) is significant not only when compared with the preceding periods' poor performance but also when compared with TFP growth in other global regions. Nin Pratt and Yu (2008) show that, from 1961 to the early 1980s, TFP growth in sub-Saharan Africa (SSA) fell behind the level of other regions, even though performance in many other regions was also poor during that period, including Asia and Latin America. From the mid-1980s to the mid-1990s, however, Nin Pratt and Yu (2008) show that TFP growth in SSA was comparable to that of Near East countries and better than the trend in

FIGURE 4.1—TOTAL FACTOR PRODUCTIVITY, EFFICIENCY, AND TECHNICAL CHANGE BY GEOGRAPHIC LOCATION (1961–2005: 1961=1)

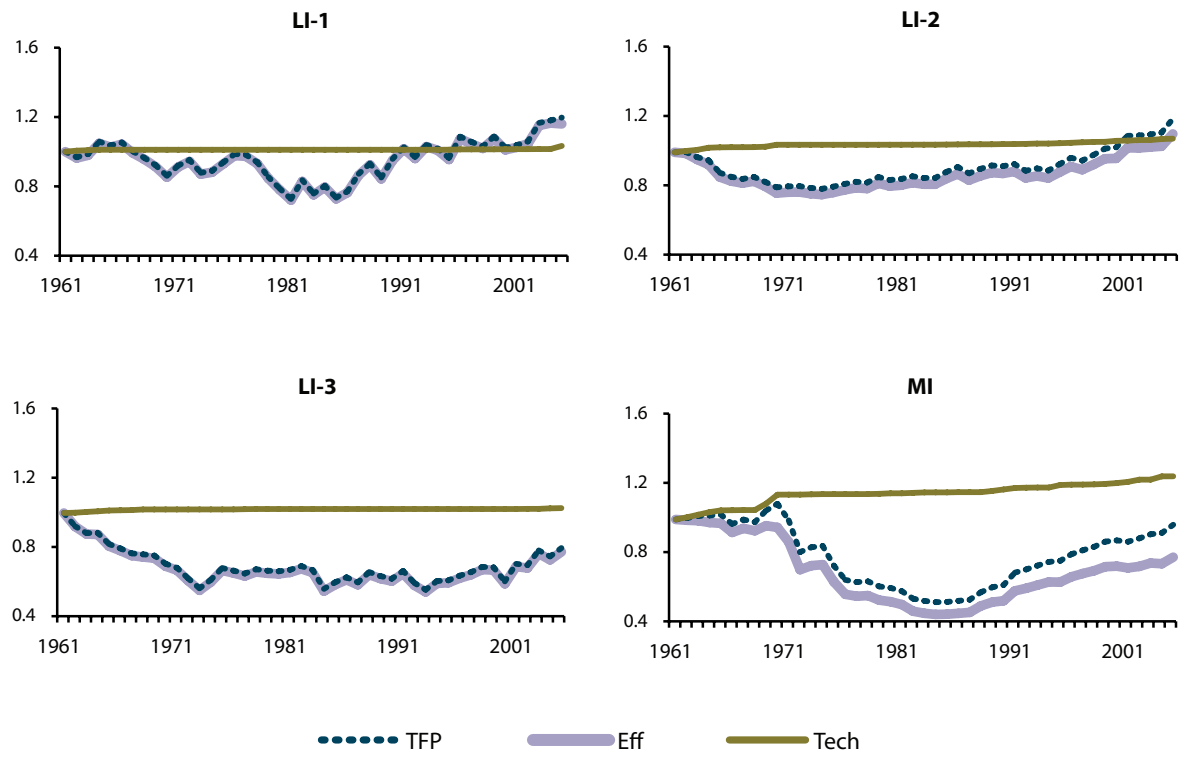


Source: Authors' calculation based on TFP model results.
Notes: TFP is total factor productivity; Eff is efficiency; and Tech is technical change.

all other regions except China. In the following decade, TFP growth in SSA was similar to that in Latin America and the Near East and above the average growth in a group of Asian countries and India.

Looking at the trends by sub-regional aggregates—specifically, geographic location (Figure 4.1) and economic classification (Figure 4.2)—we find some significant differences across different parts of Africa. For example, only southern Africa experienced a consistent increase in TFP over the entire 1961–2005 period, at 1.39 percent per year on average (Table 4.2). In general, we can distinguish three categories in terms of TFP growth: (1) consistent increase in TFP—southern Africa and EAC and SADC RECs; (2) TFP declined initially and is now catching up with the 1961 initial level—central and eastern Africa, LI-1, LI-2, and MI economic groups, and CEN-SAD, COMESA, ECCAS, and IGAD RECs; and (3) TFP declined initially and has stagnated or is catching up very slowly with the 1961 initial level—western Africa, LI-3 economic group, and ECOWAS REC.

FIGURE 4.2—TOTAL FACTOR PRODUCTIVITY, EFFICIENCY, AND TECHNICAL CHANGE BY ECONOMIC CLASSIFICATION (1961–2005: 1961=1)

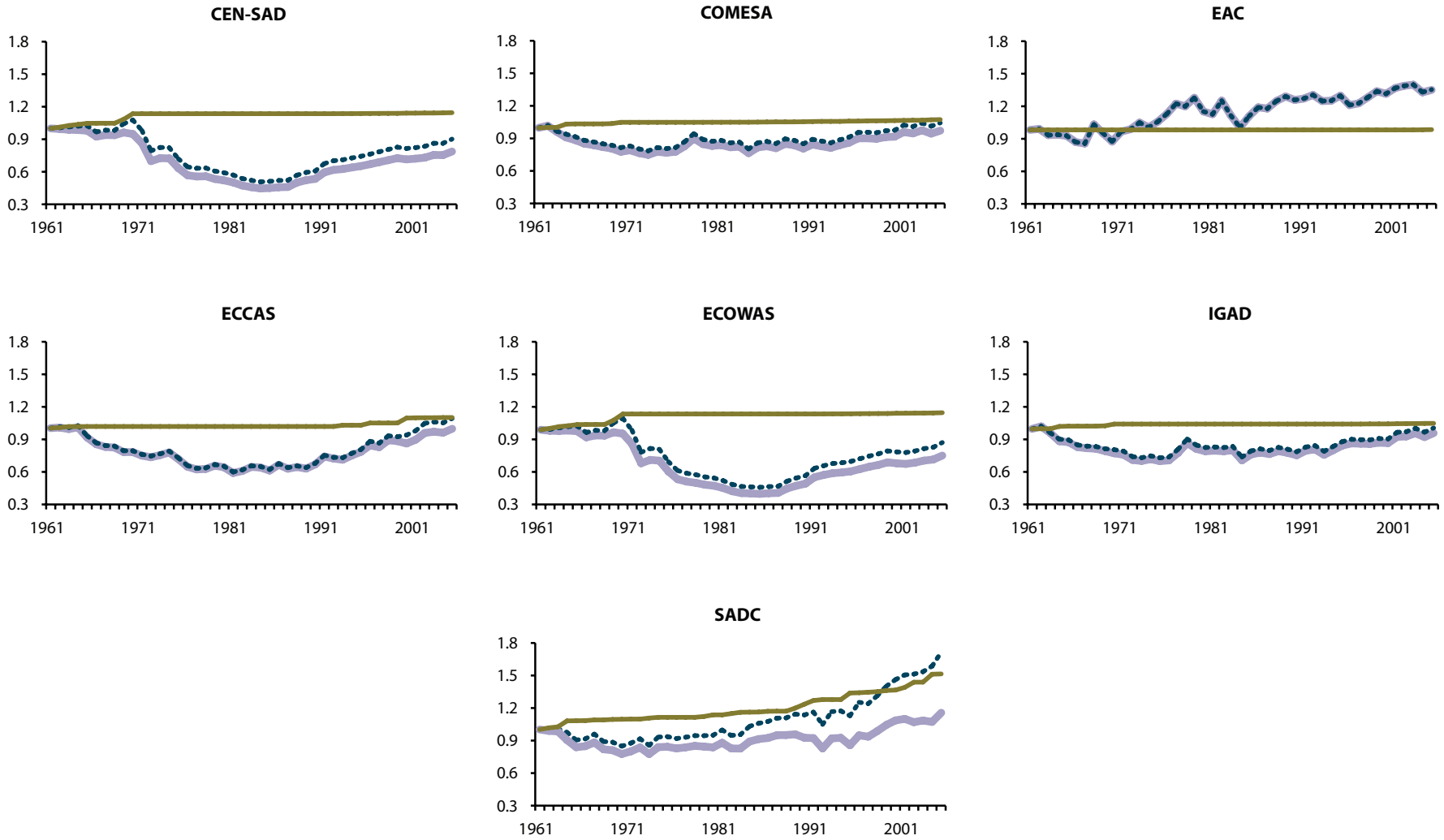


Source: Authors' calculation based on TFP model results.
Notes: TFP is total factor productivity; Eff is efficiency; and Tech is technical change.

TFP growth decomposition

Decomposition of TFP growth into efficiency and technical change shows that almost all of TFP growth is explained by changes in efficiency of agriculture, which is understandable given that the value of TFP in the most recent year (2005) remains below its value at the initial period. Efficiency gains in TFP has come primarily from reallocation of productive factors (land, labor, and the like), including using more of those factors; technical change or technological advancement, arising from investments in research and development, has been limited.

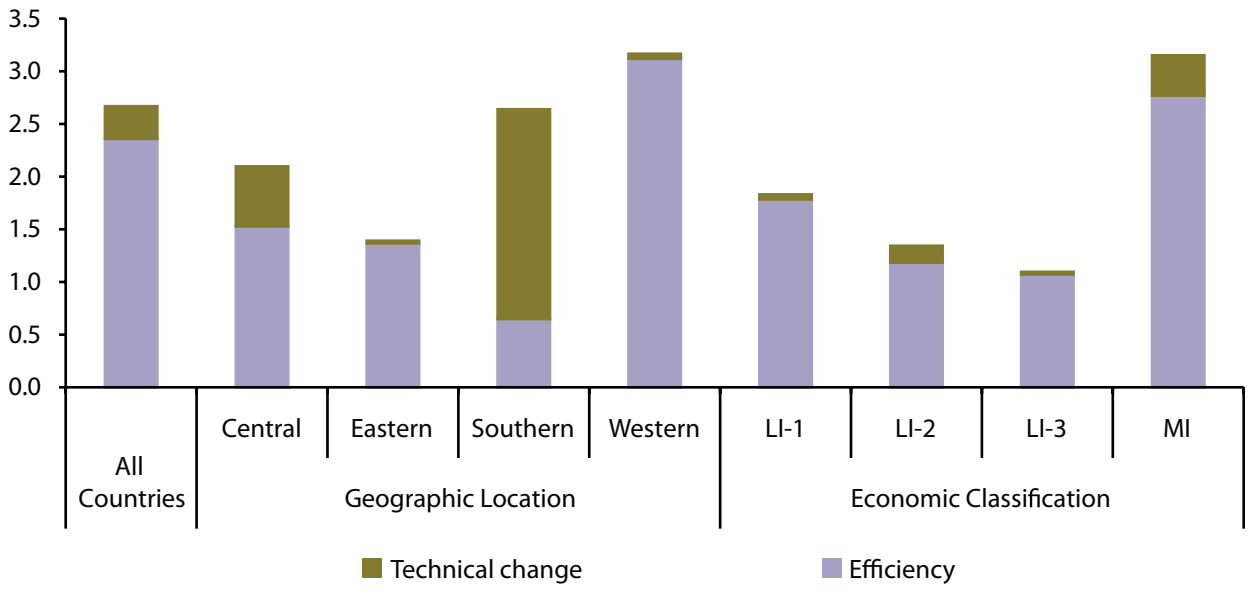
FIGURE 4.3—TOTAL FACTOR PRODUCTIVITY, EFFICIENCY, AND TECHNICAL CHANGE BY REGIONAL ECONOMIC COMMUNITY (1961–2005: 1961=1)



Source: Authors' calculation based on TFP model results.
Notes: TFP is total factor productivity; Eff is efficiency; and Tech is technical change.

Taking all the 29 countries together, technical change explains only 10–20 percent of the growth in TFP over the entire 1961–2005 period. There is substantial variation in the decomposition across the sub-regional aggregates. Considering the period of general recovery from the mid-1980s onward, for example, Figure 4.3 shows that western Africa, which experienced the largest average annual TFP growth of 3.17 percent, had very little technical change, accounting for only about 1.5 percent of its overall growth in TFP. Southern Africa (driven by South Africa) outperformed the other regions in terms of technical change, accounting for about 75 percent of its annual average TFP growth of 2.64 percent. Technical change in the central region was also high, accounting for nearly 30 percent of the average annual TFP growth of 2.10 percent. The performance of the eastern region was the lowest, achieving an average of 1.39 percent TFP growth per year with virtually no technical change. Looking at the trends by economic classification, the MI group was far ahead in average annual TFP growth, although technical change was relatively low (Figure 4.3); this reflects the dampening effect of Nigeria's low performance over South Africa's outstanding performance.

FIGURE 4.4—TOTAL FACTOR PRODUCTIVITY GROWTH DECOMPOSITION BY GROUP (%, annual average 1985–2005)

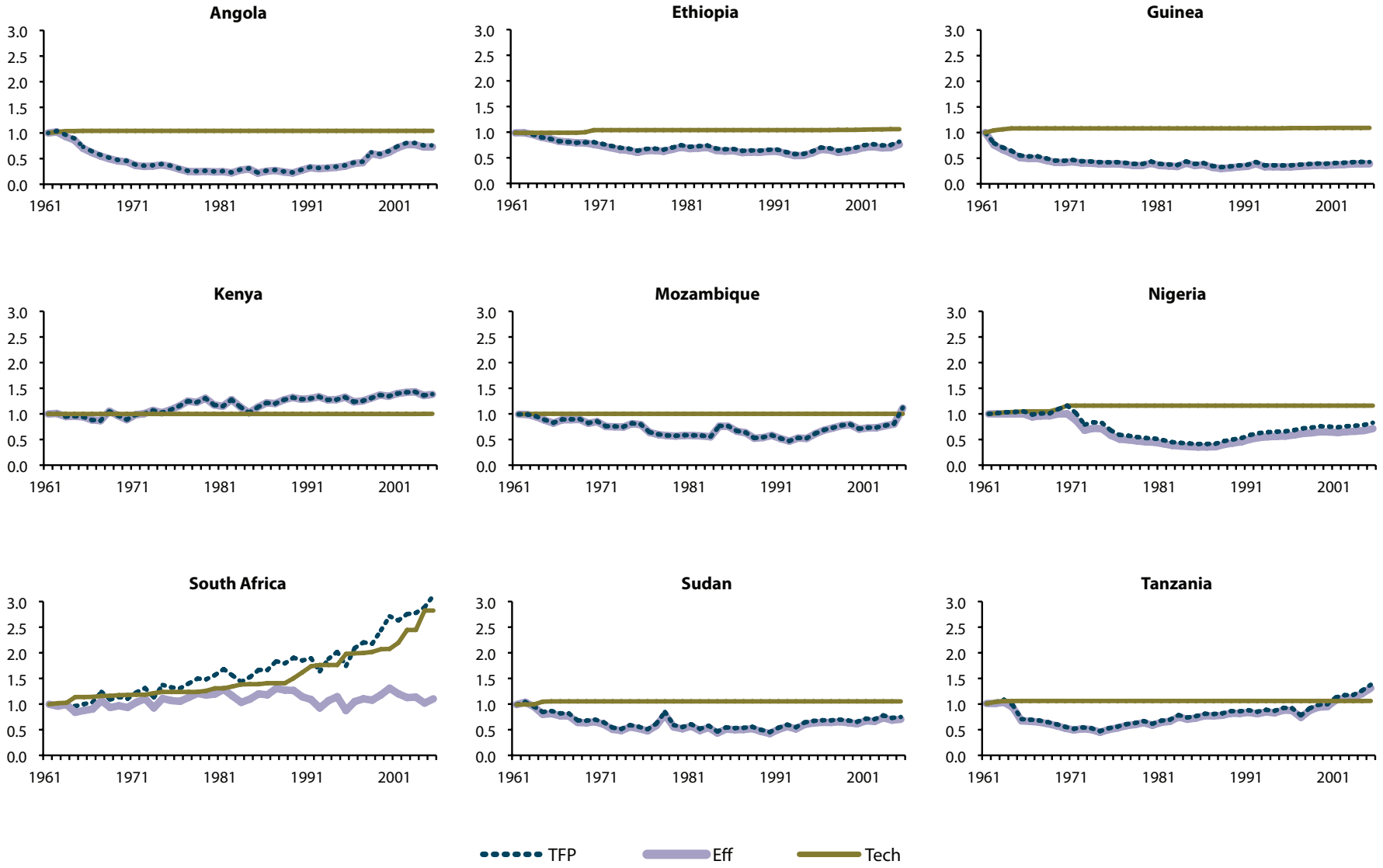


Source: Authors' calculation, based on TFP model results.

Trends in TFP at the Country Level

Figure 4.5 shows that there is considerable variation in the trends in TFP growth and decomposition across the selected countries, representing the six largest and the five fastest-growing agricultural economies among the 29 countries used in the TFP analysis. We can distinguish three categories of countries in terms of the patterns of TFP growth. Group 1 shows an increase in TFP over time, either with significant technical change (as in South Africa) or with little technical change (as in Kenya). Group 2 shows TFP declining substantially at first but now regaining the 1961 level (Angola, Mozambique, Nigeria, and others listed

FIGURE 4.5—TOTAL FACTOR PRODUCTIVITY, EFFICIENCY, AND TECHNICAL CHANGE FOR SELECTED (1961–2005: 1961=1)



Source: Authors' calculation, based on TFP model results.

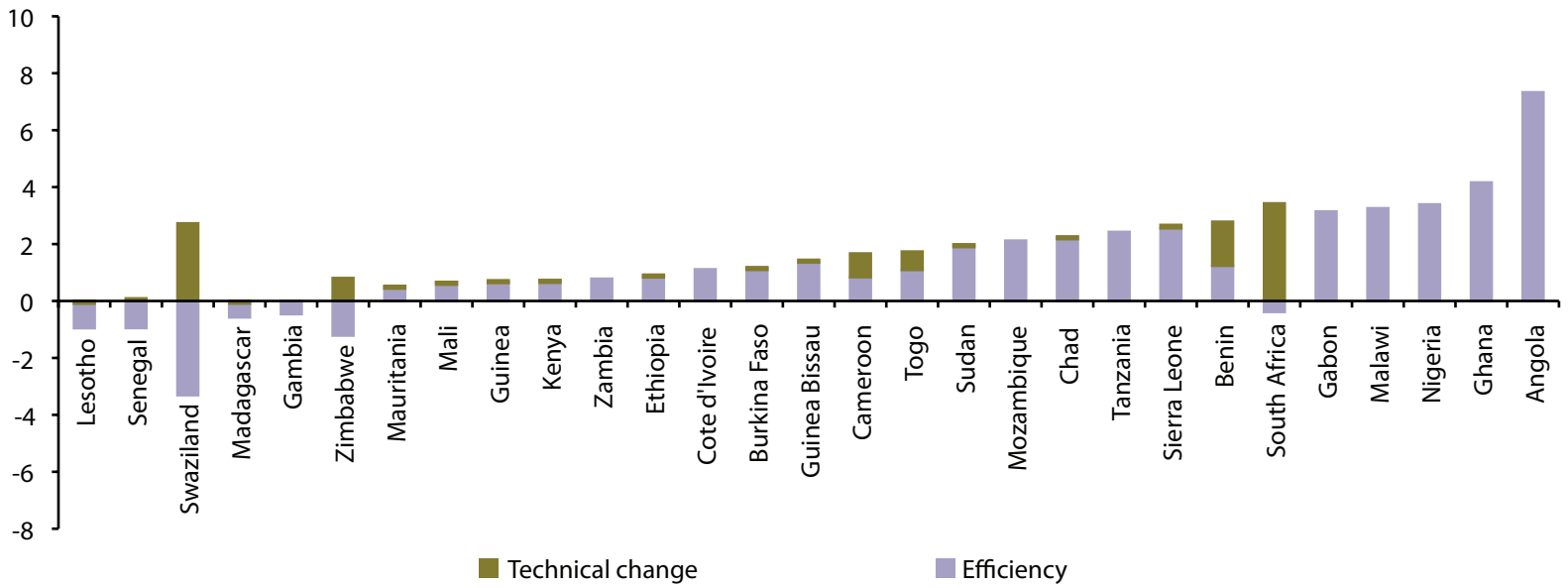
Notes: TFP is total factor productivity; Eff is efficiency; and Tech is technical change. The selected countries represent the largest agricultural economies (in terms of percentage share in total agriculture value added) and fastest-growing agricultural economies (those surpassing the CAADP agricultural growth rate target of 6 percent)

below). Group 3 shows TFP declining substantially at first, and currently either stagnating or very slowly regaining the 1961 level (Guinea, Ethiopia, Sudan, and others).

In the set of Group 1 countries where TFP has increased accompanied by significant technical change, South Africa is joined by Swaziland, Benin, Cameroon, and Togo. Most of the countries analyzed fall into Group 2, where TFP declined substantially initially and is now catching up with the 1961 level. In addition to Angola, Mozambique, and Nigeria, this group includes Burkina Faso, Chad, Cote d'Ivoire, Ghana, Guinea Bissau, Malawi, Mauritania, and Sierra Leone. The third group, where TFP declined substantially initially and is now either stagnating or catching up very slowly, poses the most difficult agricultural development challenge. In addition to Guinea, Ethiopia, and Sudan, this group includes Gabon, Gambia, Lesotho, Madagascar, Mali, and Senegal.

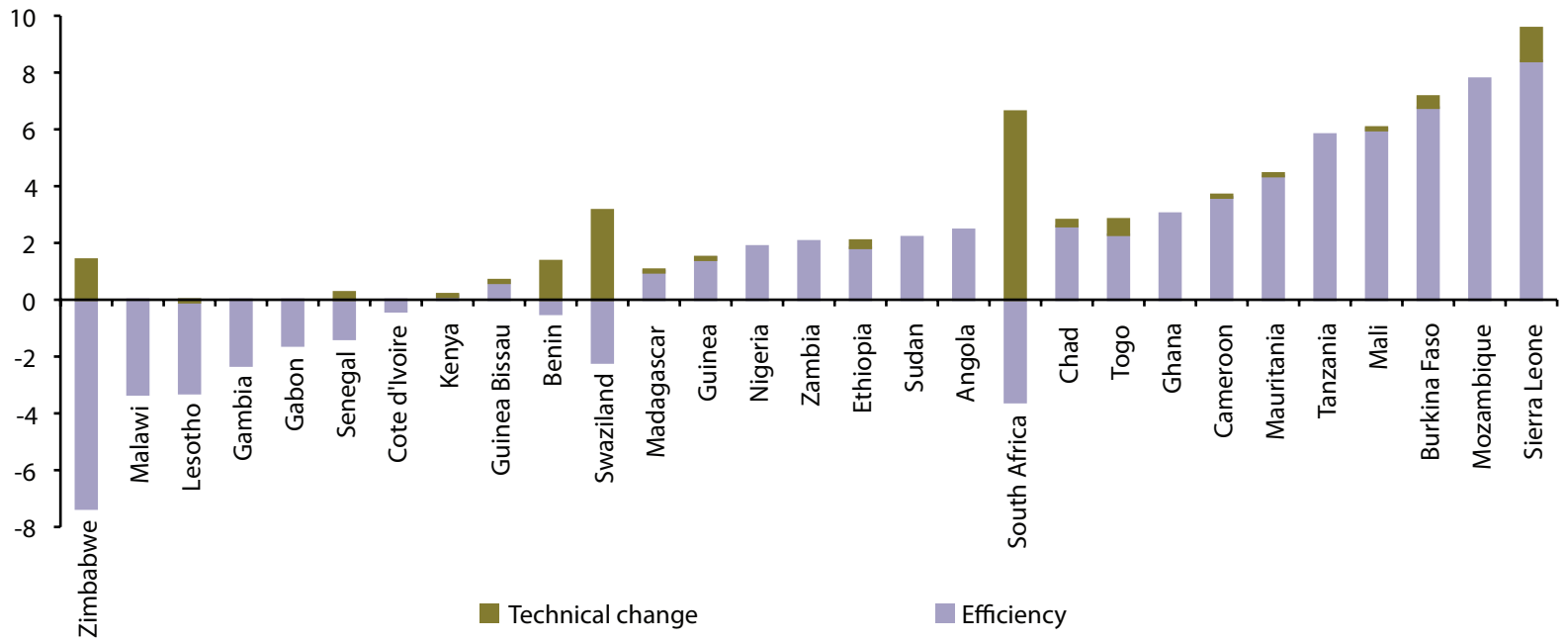
While the above analysis shows the patterns in TFP growth over the entire period considered here (1961 to 2005), the patterns in more recent years better reflect the current trajectory of countries in agricultural transformation. We analyze two sub-periods: 1985 to 2005 (Figure 4.6) and

FIGURE 4.6—TOTAL FACTOR PRODUCTIVITY GROWTH DECOMPOSITION AT COUNTRY LEVEL (%, annual average 1985–2005)



Source: Authors' calculation, based on TFP model results (2011).

FIGURE 4.7—TOTAL FACTOR PRODUCTIVITY GROWTH DECOMPOSITION AT COUNTRY LEVEL (%, annual average 2000–2005)



Source: Authors' calculation, based on TFP model results.

2000 to 2005 (Figure 4.7), in effect moving the base year forward. For the first sub-period, the starting year of 1985 represents a turnaround in the decline in TFP, for the majority of the countries. The year 2000, the start of the second sub-period, is when African countries signed the Millennium Declaration that defined the Millennium Development Goals (MDGs). In the period 1985 to 2005, Figure 4.6 shows that more than a third of the 29 countries achieved an annual average TFP growth rate of at least 2.0 percent, with Angola clearly in front (at 7.33 percent), followed by Ghana, Nigeria, Malawi, Gabon, and South Africa (between 3 and 4 percent). However, only a few countries—South Africa, Swaziland, Benin, Cameroon, Zimbabwe, and Togo—realized significant improvement in technical change. In South Africa and Swaziland, the results indicate that technical change accounted for the bulk (or possibly all) of TFP growth. For the period 2000–2005, Figure 4.7 shows that more than one-half of the countries achieved an average annual TFP growth rate of at least 2.0 percent. However, the ranking of countries shifts, with Sierra Leone, Mozambique, Burkina Faso, Mali, Tanzania, and Mauritania taking over the lead with at least 4.0 percent. Many more countries also show positive technical change.

Summary of Findings

Many parts of the continent showed a slight improvement in TFP growth in the early 1960s, followed by a rapid deterioration that stretched from the mid-1960s to the mid-1980s, and then a rapid recovery and improved performance extending through 2005 (the last year for which data are available). This pattern suggests a mere catching up with the efficiency levels achieved in the early 1960s, as almost all of the observed TFP growth is explained by improvement in efficiency of factor use rather than by technical change. While Nigeria dominates the trends at the Africa-wide level because of its sheer size, observed TFP growth trends vary across different sub-regions and countries. In a handful of countries, including South Africa, Swaziland, Benin, Cameroon, and Togo, we observe an overall increase in TFP over time, with significant technical change. There are also a few countries where TFP declined substantially initially and has since stagnated at low levels or is turning around at a very slow rate. These countries, particularly Gabon, Gambia, Lesotho, and Senegal, pose the most difficult challenge for raising and maintaining high agricultural productivity, because TFP has continued to decline even in the period 2000–2005, when most other countries seem to be recovering.

Conclusions and Implications: Raising and Maintaining High Agricultural Productivity in Africa

As the Comprehensive Africa Agriculture Development Programme (CAADP) approaches its tenth anniversary, many African countries are beginning to articulate an agricultural transformation or green revolution agenda. These two approaches—like previous agriculture-led development frameworks, priorities, and strategies—hinge on a fundamental issue: how to raise and maintain high agricultural productivity, and particularly technical change, given the limits to factor substitution. To help address that issue, this report analyzes inter-temporal trends and spatial patterns in both partial and total factor productivity. Here we summarize the main findings, with their implications for options for raising and maintaining high agricultural productivity across different parts of Africa.

Agricultural productivity in Africa has been increasing since the mid-1980s, but this represents catching up with the levels achieved in the early 1960s.

Trends in land, labor, and total productivity vary across different parts of the continent. Despite this large spatial variation, many parts of Africa have seen impressive agricultural productivity growth since the mid-1980s, which is especially significant when compared with agricultural productivity growth rates in other global regions, including Asia, Latin America, and the Near East. In the previous period, however, countries in those regions had better economy-wide and agricultural performance than those in Africa. The impressive performance in Africa in recent years, in both PFP and TFP growth, is in contrast to its previous rapid deterioration in agricultural productivity, stretching from the mid-1960s to the mid-1980s. For the 29 countries[6] and the span of periods (1980–2005) for which we have data on all three measures of productivity, we find that TFP has risen the fastest, at an average annual rate of 2.26 percent, followed by land productivity, at an average annual rate of 1.80 percent, and then labor productivity, at an average annual rate of 1.15 percent (Figure 5.1). Growth in labor productivity has remained fairly constant over these periods, while growth in labor productivity and TFP has been more variable.

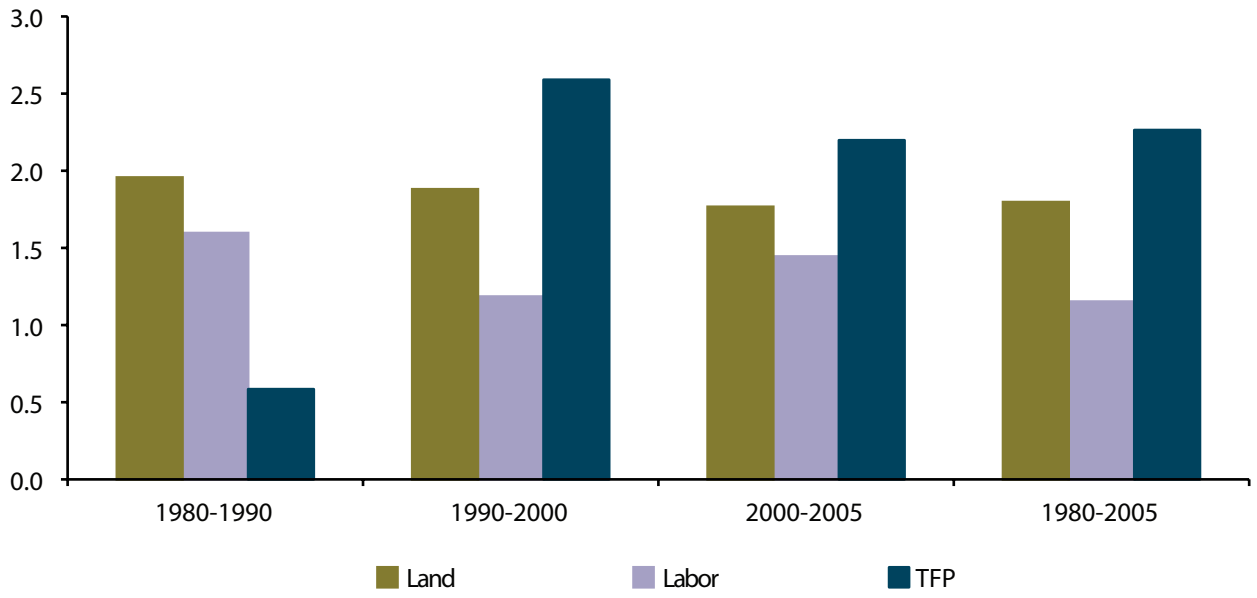
Nevertheless, the impressive performance in agricultural productivity in the majority of the countries since the mid-1980s represents merely catching up with the efficiency levels achieved in the early 1960s, as almost

6 These include 29 countries in central, eastern, southern, and western Africa; see footnote 5.

all of the observed TFP growth is explained by improvement in efficiency of factor use rather than by technical change. Only in a handful of countries, including South Africa, Swaziland, Benin, Cameroon, and Togo, was there an overall increase in TFP over time, accompanied by significant technical change. With the majority of the population living in rural areas and depending on agriculture for their livelihoods, and with typical household landholdings of only 1–3 hectares and household sizes of 5–8 family members, it is easy to understand why rural poverty is so prevalent and persistent—and why raising productivity in a sustainable manner remains a fundamental development goal for Africa.

Focusing on labor productivity, for example, sustaining the recent rate of agricultural growth faces the challenge of population growth and slowdown in land availability; in many countries, recent labor productivity gains have depended on their ability to incorporate more land into agricultural production. More rapid increases in labor productivity are essential to compensate for growth in rural population and to improve rural income and food and nutrition security—and this will require accelerating the expansion of Africa's technical frontier through a combination of policy improvements and significant investments in agricultural R&D, together with complementary investments in areas such as irrigation, market infrastructure, and institutions (Mogues and Benin 2012; Diao et al. 2012; Diao, Headey, and Johnson 2008; von Braun et al. 2008).

FIGURE 5.1—LAND, LABOR, AND TOTAL FACTOR PRODUCTIVITY GROWTH IN AFRICA (%, annual average 1980–2005)



Source: Authors' calculation, based on World Bank 2012 and TFP model results.

Agricultural investments and R&D infrastructure and capacities Africa-wide have eroded, driven by poor to moderate performance of the largest agricultural economies in the continent. Raising productivity requires not only appropriate technologies, but also sound policies to encourage farmers to adopt them and improve farming practices. However, agricultural research infrastructure and capacities in Africa have been eroded through years of neglect, primarily because of lack of

public funding for agricultural R&D (Beintema and Stads 2006, 2011). Table 5.1 shows that both growth in spending on agricultural R&D and number of researchers have slowed over time and only recently picked up, consistent with the trends in agricultural productivity growth summarized above. Thus, there is a desperate need to strengthen agricultural R&D systems in Africa, while ensuring that they become more cost-effective. Considering agricultural spending and investments in general, the 2003 Maputo Declaration set a target for agricultural financing by governments at 10 percent of total national expenditures. For Africa as a whole, the sector's percentage of total expenditures has barely surpassed 6 percent on average per year since 1995 (see Figure 5.2 and annex Table C.2)—well below the CAADP target of 10 percent.

TABLE 5.1—ANNUAL AVERAGE GROWTH RATES IN PUBLIC AGRICULTURAL R&D EXPENDITURE (2005 constant prices) AND NUMBER OF RESEARCHERS (full-time equivalents) IN SSA

Years	Expenditure	Researchers
1971-1981	1.7	5.4
1981-1991	0.6	3.8
1991-2001	1.0	1.3
2001-2008	2.4	2.8

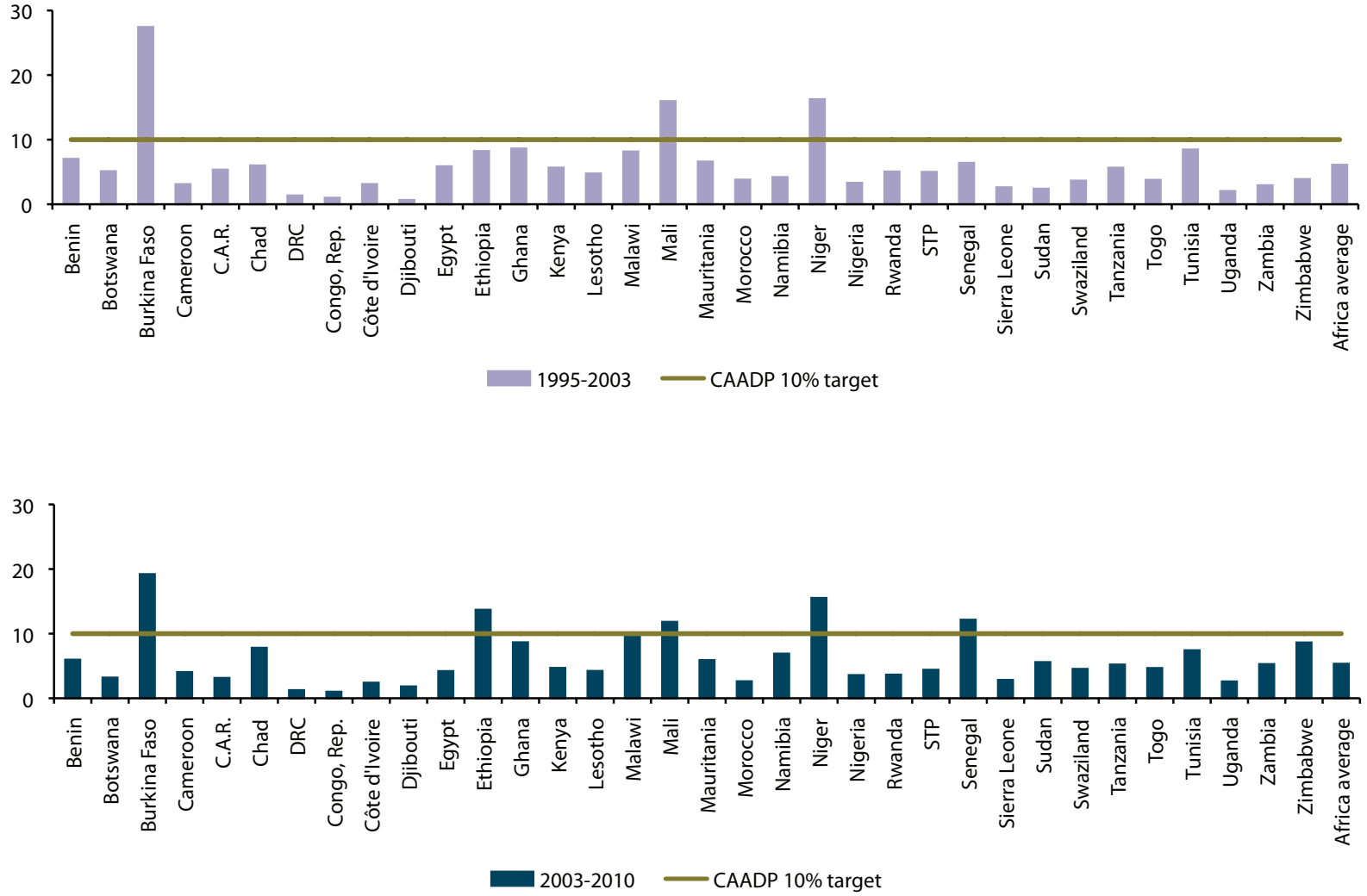
Source: Beintema and Stads 2011.

At the national level, while several countries have increased the share of total spending allocated to the agriculture sector, when we compare performance in the pre-CAADP (1995–2003) and post-CAADP (2003–2010) periods, only a handful of countries stand out as having achieved the target (Figure 5.2). These countries are Burkina Faso, Ethiopia, Mali, Niger, and Senegal. With the exception of Ethiopia, none of countries representing the largest ten agricultural economies in Africa have achieved this target. (The largest agricultural economies are Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia, Tanzania, and Cote d'Ivoire—see Figure 2.1.)[7] Most of these top ten countries spent less than 5 percent of their total expenditure budgets on agriculture, resulting in the low performance seen for Africa as a whole.

An important follow-on question is: How much of the total agricultural expenditure is allocated to agricultural R&D? Here, too, NEPAD has set a national agricultural R&D investment target of at least 1 percent of agricultural GDP. Most countries have spent far less than this level. In 2008, for example, the amount spent on agricultural R&D as a percentage of agricultural GDP is estimated at about 0.6 percent, with only 8 countries (out of 31 countries studied) meeting the 1 percent target (see Figure 5.3). With the exception of Kenya and South Africa, the big agricultural economies in SSA covered in this study (Nigeria, Sudan, Ethiopia, Tanzania and Cote d'Ivoire) spent less than 0.5 percent. The other high performers in spending on agricultural R&D (as a percentage of agricultural GDP) are Botswana, Burundi, Mauritania, Mauritius, Namibia, and Uganda (Figure 5.3). Together, however, these countries account for only 3.2 percent of Africa's total agricultural GDP, so their high performance has little impact on the performance for Africa or SSA as a whole. It cannot be overemphasized that there is desperate need to significantly increase African investments in agriculture, and particularly in agricultural R&D.

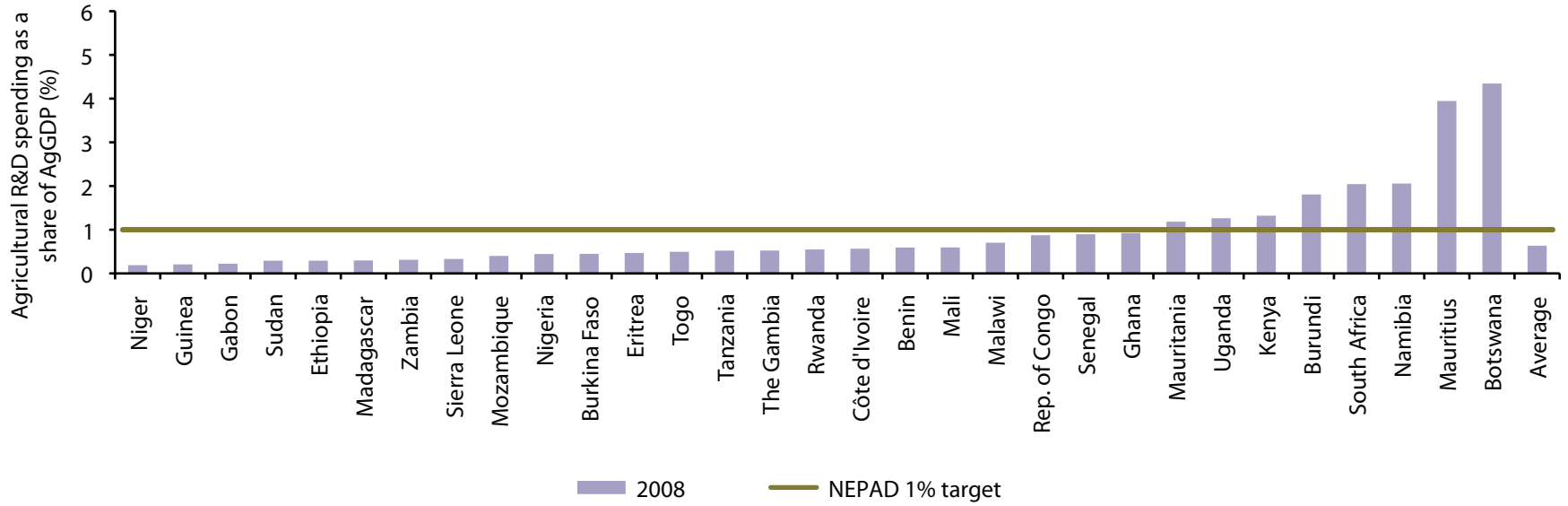
[7] These ten countries together account for about 73 percent of the total of Africa's agriculture value added. Sudan includes South Sudan because the data are not disaggregated by two countries.

FIGURE 5.2—SHARE OF PUBLIC AGRICULTURE EXPENDITURE IN TOTAL PUBLIC EXPENDITURE (annual average %)



Source: ReSAKSS compilation based on various sources: National sources, IFPRI 2011, IMF 2012, and AUC 2008.

FIGURE 5.3—SHARE OF PUBLIC AGRICULTURAL R&D EXPENDITURE IN AGRICULTURAL GDP (%), 2008



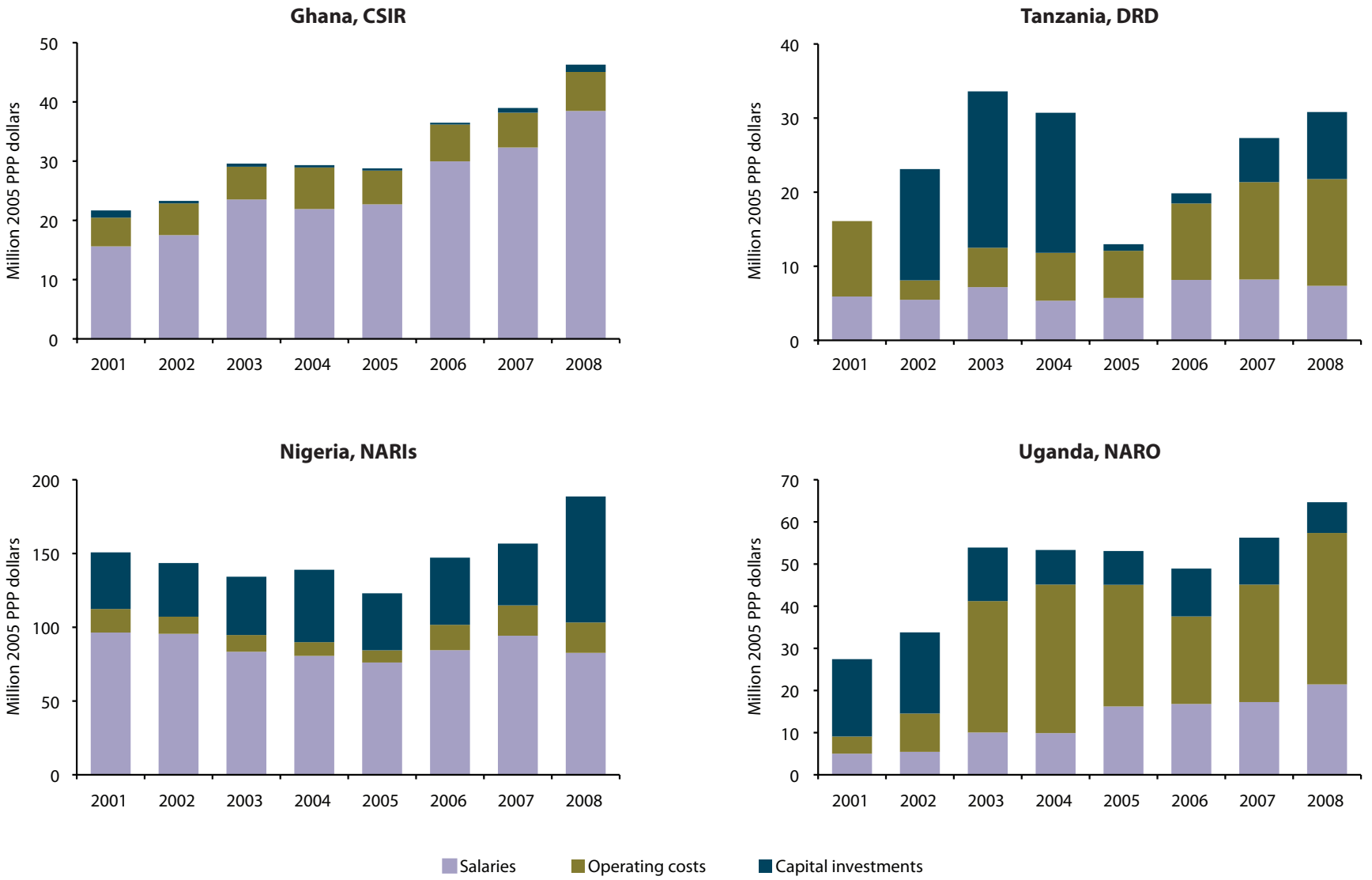
Source: Beintema and Stads 2011.

Large incremental agriculture expenditure and investment will be required to raise and maintain a high level of agricultural productivity and growth in Africa.

What is the magnitude of investment required to raise and maintain a high level of agricultural productivity and growth—for example, to attain the CAADP target of 6 percent annual average growth in agricultural GDP? This depends on the efficiency and effectiveness of investments (typically captured by elasticity of growth with respect to investment) as well as on the desired development objective. Suppose that the objective is to increase agricultural productivity by 50 percent by 2030. Assuming an elasticity of agricultural productivity with respect to agriculture investment in the range of 0.2–0.3 and using a simple calculation, the implication is that public agricultural investment needs to increase by 167 to 250 percent by 2030 in order to increase agricultural productivity by 50 percent in the same period.[8] With current total public agricultural spending at about 8 percent of agricultural GDP (see Annex Table C.3a), and assuming that about one-half of the total

[8] This is obtained by dividing the target, a 50 percent increase, by the elasticity. The low-end required growth in public agricultural investment is given by 50% ÷ 0.3 = 167% and the high-end by 50% ÷ 0.2 = 250%. See Benin et al. (2012) for a review of methods and formulas for estimating spending requirements as well as estimated elasticities in public investment analysis.

FIGURE 5.4—PUBLIC AGRICULTURAL R&D EXPENDITURE BY COST CATEGORY IN SELECTED COUNTRIES (annual average, 2001–2008)



Source: Beintema and Stads 2011.
Notes: CSIR is Council for Scientific and Industrial Research, DRD is Department of Research and Development, NARI is National Agricultural Research Institute, and NARO is National Agricultural Research Organization; these are the main agricultural R&D agencies in the respective countries.

amount is for investment, we can estimate the current public agricultural investment at about 4 percent of agricultural GDP. According to the calculation above, this would have to rise to 7–9 percent by 2030 in order to achieve the objective. (This requirement does not include recurrent spending, which presently constitutes the bulk of public spending on the sector.) If we account for the crowding-in effect of public spending on private spending with an elasticity of 0.2 (for example), then the required public agricultural investment share in agricultural GDP by 2030 is estimated to be lower, at 6–8 percent. In view of the current low levels of public agriculture expenditures, and the high shares that go to salaries and other nonproductive or short-term productive items, that level of agricultural investment requirement translates into total amounts higher than the 10 percent of total expenditures agreed to under the Maputo declaration.[9]

The types of agricultural investments and policies are important because they are not growth neutral; those that deliver location-specific technologies and that account for diversity of farmers will be critical.

Because different policies and types of investments are not growth neutral, the right focus has to be found for different contexts. The recent studies by Fan (2008) and Mogues and Benin (2012), as well as several earlier studies, show that different types of spending across different geographic areas deliver substantially different returns and impacts on different development objectives. Moreover, the returns and impacts vary over time, suggesting that prioritization and proper sequencing of policies and investments is essential if the policies and investments are to be effective. Table 5.1 reveals quite different dynamics for different countries, regarding the changes in various cost categories associated with the turnaround in agricultural research spending and capacities in the 2000s. In the case of Ghana, for example, Figure 5.4 shows that the rapid increase in agricultural R&D spending in 2001–2008 has been driven almost entirely by increased salary expenditures rather than expanded research activities or greater investment in equipment or infrastructure. In Tanzania and Nigeria, on the other hand, spending on salaries has remained relatively stable over time. Capital investments in Tanzania dominated in 2002–2004, with operating costs becoming dominant in the following years. In Nigeria, operating costs and capital investments have been stable, with operating costs remaining relatively smaller. In Uganda, operating costs have dominated, including investment in institutional development, research programs, rehabilitation of research infrastructure, and postgraduate training (Beintema and Stads 2011).

Without being able to know the impact of these dynamics on agricultural productivity, Ghana's case nevertheless raises concerns about the relatively paltry investment in equipment and infrastructure. With such heterogeneity in the production environment, as farmers face very different constraints in different places, investments and policy interventions need to deliver location-specific technologies, ones that are tailored to the relevant agroecological characteristics and production systems and that account for the considerable diversity of potentials and constraints faced by farmers. Case studies of several agricultural productivity investment projects suggest that there are very successful projects that are short-lived (three to five years) as well as thinly scattered across the continent. These have not been successfully scaled up and out. Tackling the issue of sustaining success is an aspect that cannot be overemphasized. There is a need for more

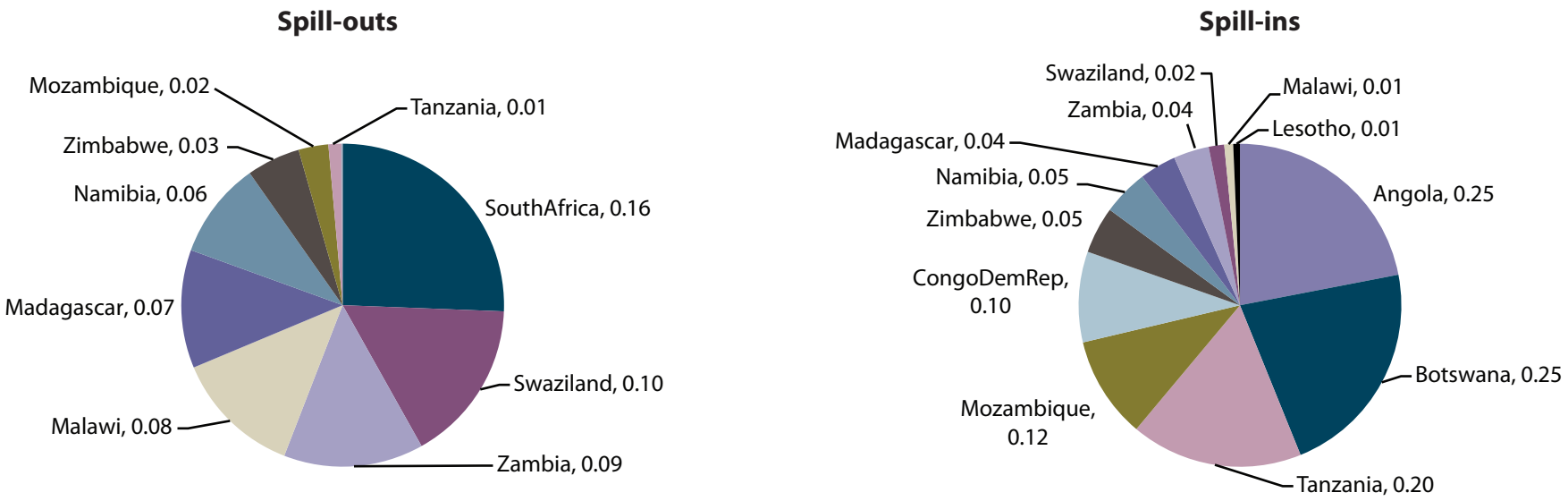
[9] Also see analysis in Diao et al. 2012.

commitments and actions by national governments and other stakeholders to ensure that good interventions are sustained.

Because many countries are small and have limited capacities, regional agricultural strategies will be helpful, emphasizing complementary policies and extension systems that maximize the spillovers of technologies.

Many countries in Africa have small economies and thus limited capacities and resources for developing effective agricultural R&D systems. Focusing on regional agricultural R&D strategies can help fill these gaps and facilitate scale economies. Studies such as those carried out by Omamo et al. (2006), Nin Pratt et al. (2011), and Johnson et al. (2011) shed light on the potential gains from implementing such regional agricultural R&D strategies. In the SADC region, for example, Johnson et al. (2011)—using the size of yield

FIGURE 5.5—TOTAL BENEFITS OF MAIZE R&D IN THE SADC REGION BY COUNTRY OF ORIGIN OF TECHNOLOGY (Spill-outs) AND BENEFICIARY COUNTRIES (Spill-ins)

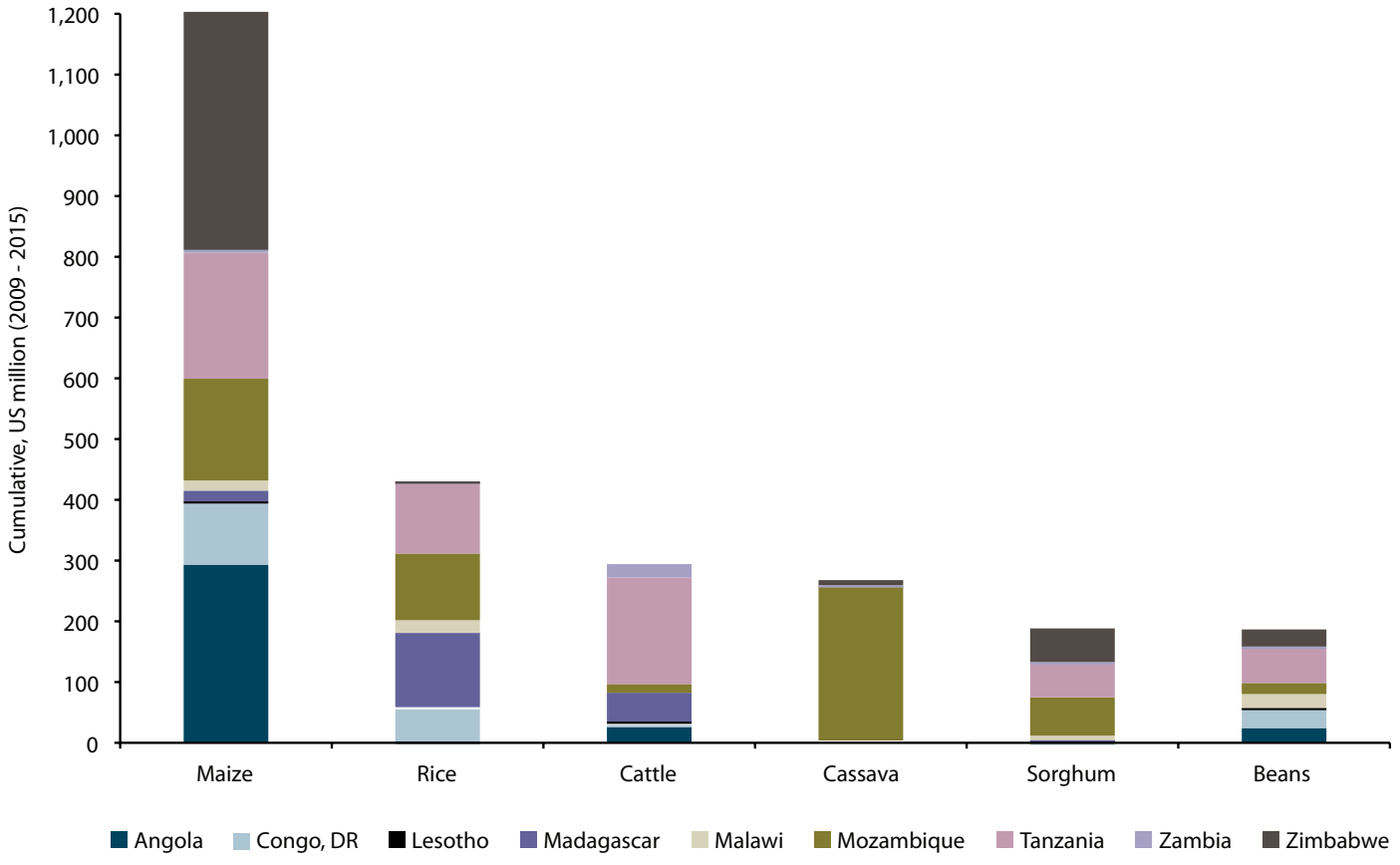


Source: Johnson et al. 2011.
Notes: Spill-outs (sources) measure the effect on average productivity in the rest of the SADC region due to the adoption of technologies generated in country y (the source country), relative to own-technology productivity effects in the other countries. In this example, South Africa generates the largest spillovers, i.e., effect on productivity in other countries, relative to its own effect. Spill-ins (beneficiaries) measure the average effect on productivity in country x due to the adoption of technologies generated in other SADC countries, relative to the productivity effect associated with adoption of country x's own technologies. In this example, Angola, Botswana, and Tanzania benefit the most from maize technologies generated elsewhere relative to those generated in-country.

gaps and research capacity between countries to capture the probability of successful spill-outs and spill-ins of agricultural R&D—show that the returns to agricultural R&D in the region differ by the country of origin of the technologies as well as by commodities (see Figures 5.5 and 5.6).

The assumptions of the study by Johnson et al. (2011), particularly those underlying the probabilities of successful spill-outs and spill-ins of agricultural R&D, highlight areas of the policy front that are important to enhance and maximize the benefits of cross-border cooperation in agricultural R&D. These ideas—cross-border collaboration, and enhancement of regional knowledge and technology spillover—are not new. Indeed, they constitute the fundamental rationale for regional economic institutions and agricultural research organizations. But they deserve re-emphasis to ensure that the core roles and responsibilities of cross-border institutions are persistently reaffirmed and acted upon. Cross-border institutions are more than platforms for the statement of national interests; they rather present real opportunities to add value that national entities otherwise could not, opportunities that could serve to fur-

FIGURE 5.6—TOTAL BENEFITS FROM TECHNOLOGY SPILLOVERS AMONG SADC COUNTRIES BY COMMODITY, 2009–15



Source: Johnson et al. 2011.

ther enhance and accelerate national productivity growth ambitions.

Of course, a regional strategy must overcome many institutional and administrative barriers to management and coordination across national boundaries, which can lead to high transaction costs, especially given different levels of development of national R&D systems and political economies. Inevitably, any cross-country collaboration will be affected by each country's own program needs, as well as the desire to maintain a bargaining position for domestic resources. Looking for ways to minimize the transaction costs will be critical. That is why the African centers of excellence initiatives are laudable. Notable recent efforts are two large subregional programs, the Eastern Africa Agricultural Productivity Program (EAAPP, implemented by ASARECA) and the West Africa Agricultural Productivity Program (WAAPP, implemented by CORAF/WECARD), developed with assistance from the World Bank. These two programs are in turn funding subregional centers of excellence for particular crops and commodities—maize and wheat in Ethiopia, dairy in Kenya, cassava in Uganda, roots and tubers in Ghana, and rice in Mali and Tanzania, to mention a few.[10] To be successful, these initiatives will require complementary polices and agricultural extension systems that enhance and maximize the spillovers of the targeted technologies to different parts of Africa.

Potential impact of climate change should be taken into account in the design and implementation of policies and strategies for raising and maintaining high agricultural productivity.

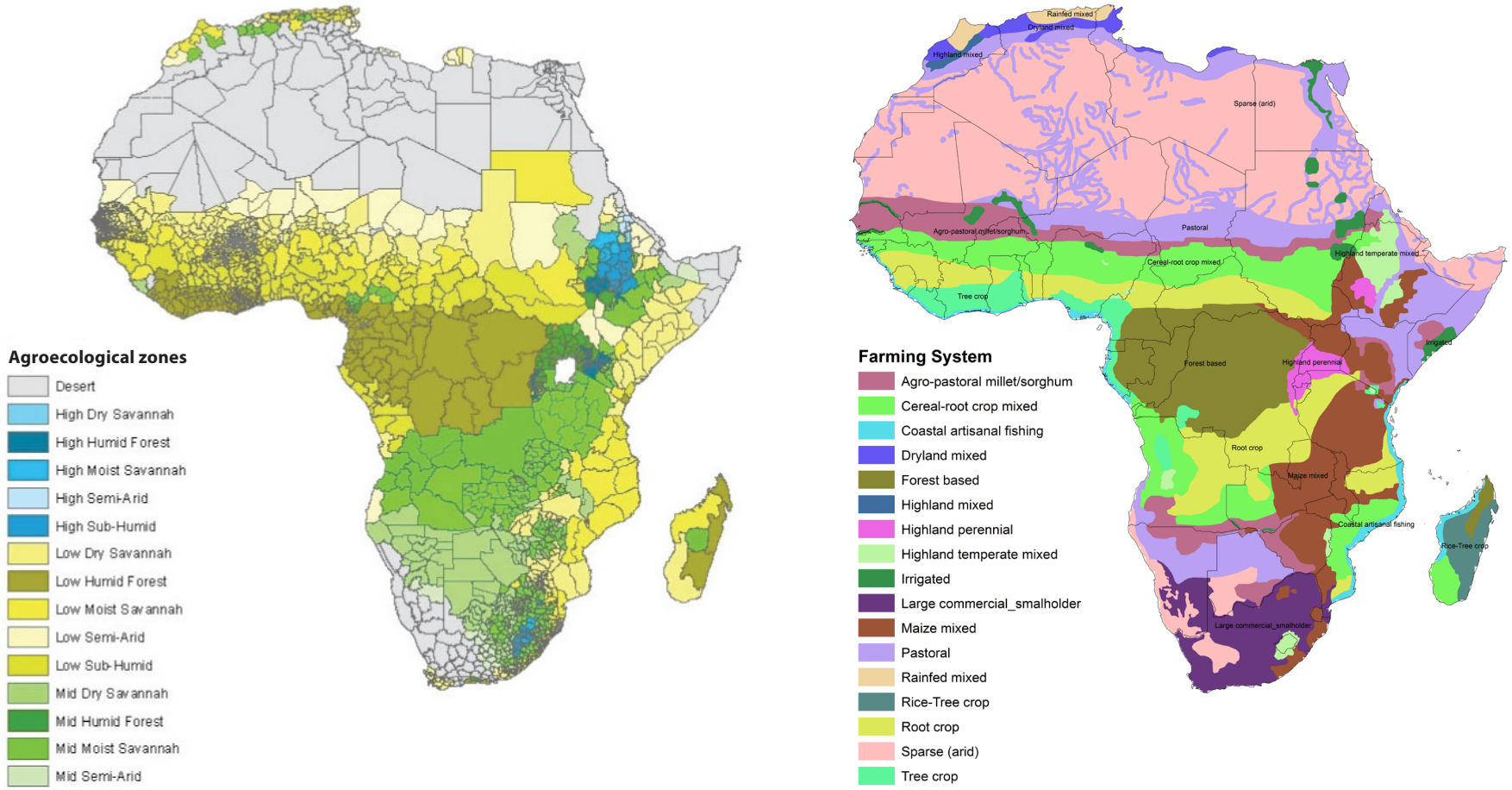
Several studies (for example, Kurukulasuriya et al. 2006, IPCC 2007, Seo et al. 2008, and Nelson et al. 2010) provide strong evidence that climate change or global warming due to accumulating greenhouse gases could impose serious costs for agricultural growth, and that the change is likely to have very different effects in different locations. Nelson et al. (2010), for example, show that the negative effect of climate change on crop yields will increase over time: compared to 2000, the world's average wheat yield will decline by 1–9 percent by 2030, 4–12 percent between 2030 and 2050, and by 14–29 percent between 2050 and 2080, with larger declines in developing than developed countries. Seo et al. (2008) show that the impacts of climate change will vary across different agroecological zones (AEZs) in Africa: farms in the savannah areas are seen most vulnerable to higher temperature and reduced precipitation, while those in the sub-humid or humid forest could gain even from a severe climate change.

The findings by Seo et al. (2008) have direct implications for this study, because the AEZs used by Seo et al. (shown in Figure 5.7a) to delineate the effects of climate change are closely associated with the farming systems used in this study (Figure 5.7b). Extrapolating from the detailed findings of Seo et al., households in the Cereal-Root Crop Mixed, Dryland Mixed, Agro-Pastoral, and Pastoral farming systems (common to the savannah AEZs) are likely to be the most vulnerable to climate change (see Figure 5.8). However, because climate warming is likely to increase livestock income while reducing crop income (Seo et al. 2008; Nelson et al. 2010), climate change may have a zero net effect on the total agricultural income of households engaging in both crop and livestock production in these systems, depending on the relative importance of the two subsectors in their livelihoods. Those engaging solely or mostly in crop production stand to lose the most, while those engaging solely or mostly in livestock stand

[10] See http://waapp.org.gh/ and http://www.eaapp.org/ for details.

to gain the most. Households in the Forest-Based and Tree-Crop farming systems (which characterize most of the sub-humid or humid forest AEZs) are predicted to gain even from a severe climate change. Therefore, the strategies for raising and maintaining high agricultural productivity should also be based on impact assessments of climate change, to identify the most attractive adaptation options and to develop location-specific implementation approaches.

FIGURE 5.7—AGROECOLOGICAL ZONES AND FARMING SYSTEMS IN AFRICA



Sources: Agroecological zones (FAO 1978) and farming systems (Dixon, Gulliver, and Gibbon 2001).

FIGURE 5.8—CLIMATE CHANGE IMPACTS ON LAND PRODUCTIVITY IN AFRICA BY AGROECOLOGICAL ZONE
(% change in USD/ha)

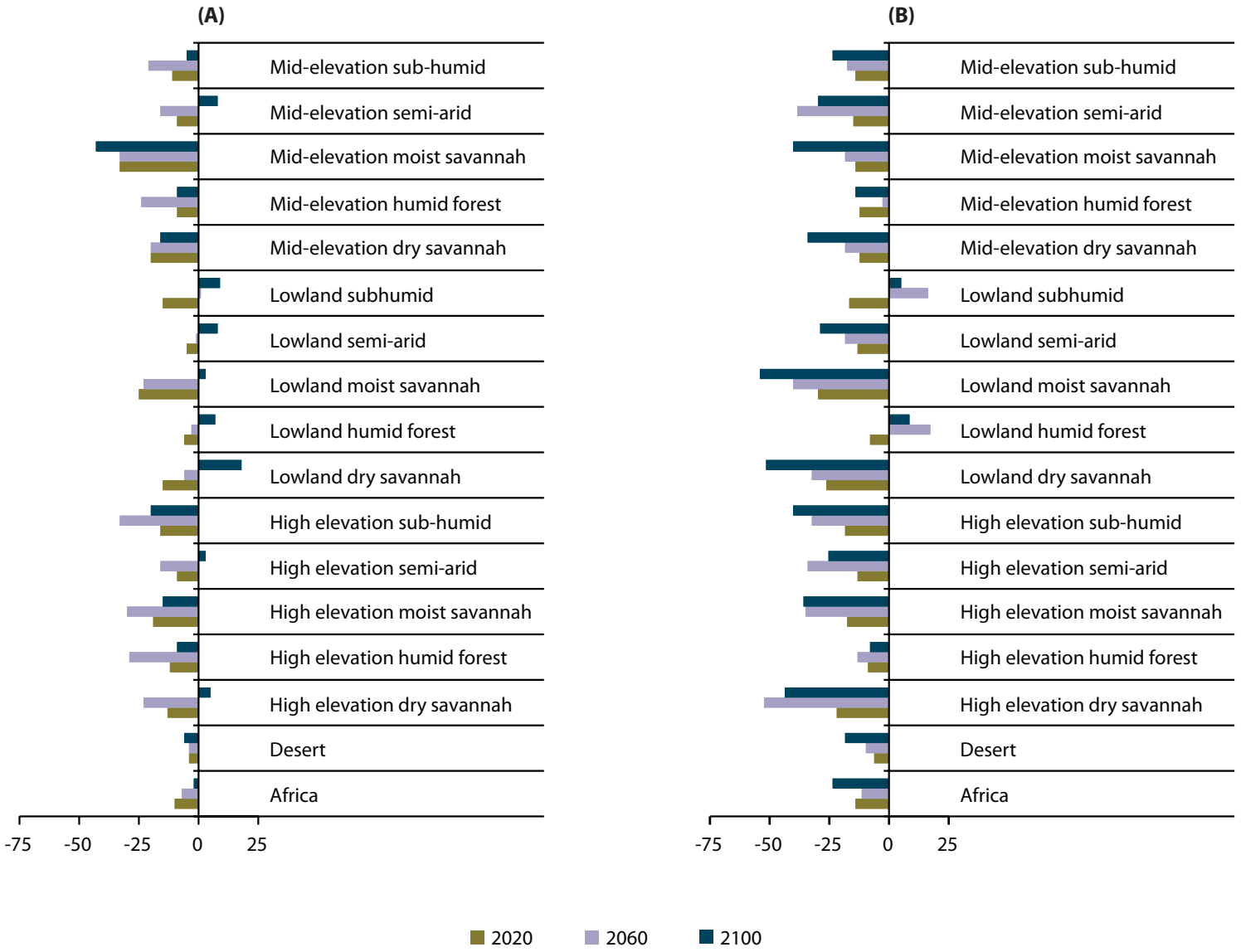
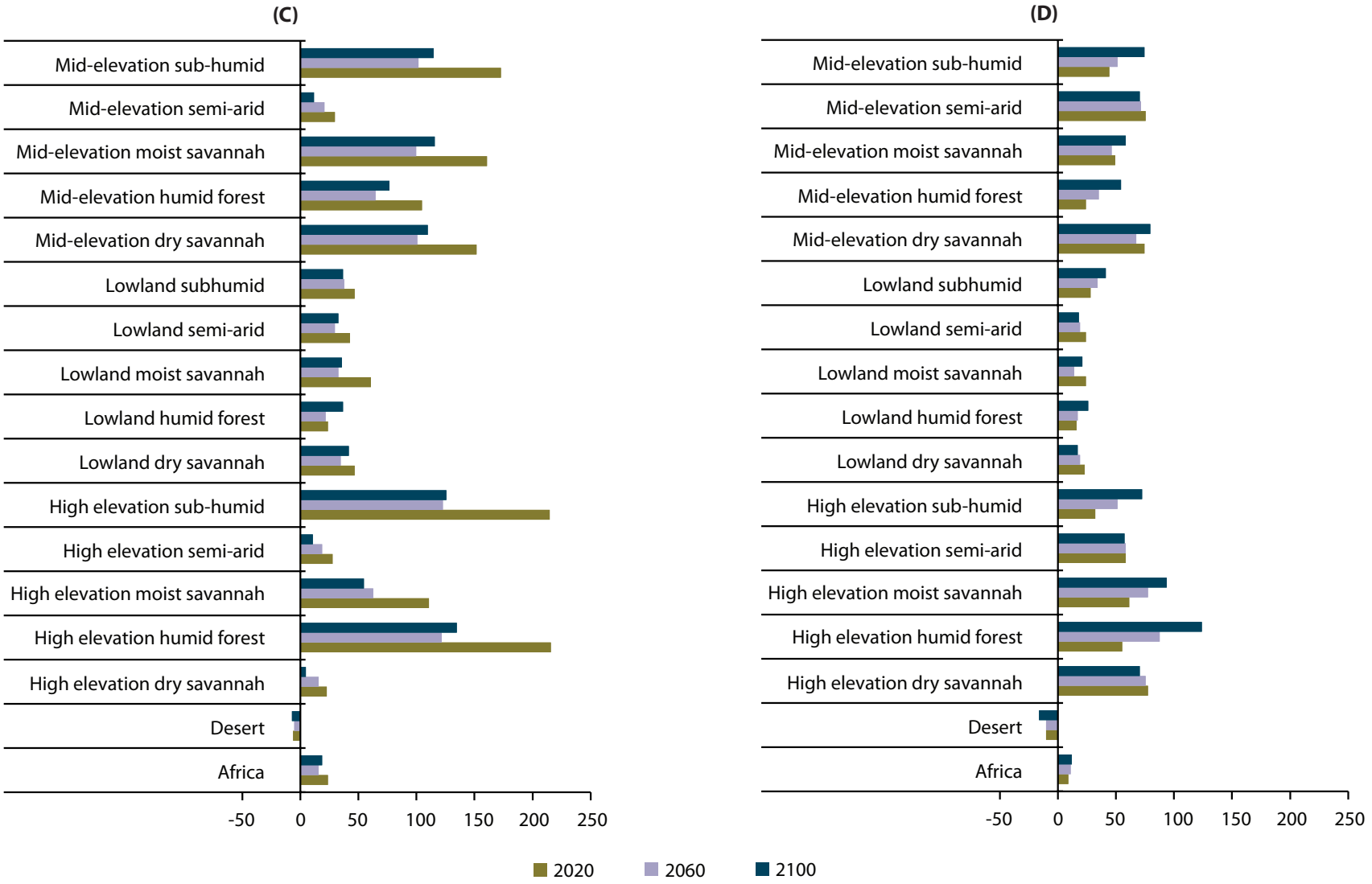


FIGURE 5.8—CLIMATE CHANGE IMPACTS ON LAND PRODUCTIVITY IN AFRICA BY AGROECOLOGICAL ZONE (% change in USD/ha)—Continued



Source: Authors' illustration, based on Seo et al. 2008.
Notes: A and B are based on the Canadian Climate Centre model, with and without country fixed effects, respectively. C and D are based on the Parallel Climate Model, with and without country fixed effects, respectively.

Overall Policy Implications

For most countries in Africa, especially those with large rural populations, there is no more pressing development objective than raising the level and rate of growth of agricultural productivity—because the majority of the population, and especially the poor, live in rural areas and depend on agriculture for their livelihoods. Moreover, as we have seen, almost all of the observed growth in agricultural productivity over the past several decades is explained by improvement in efficiency of factor use, rather than by technical change.

Accordingly, the core of a sustainable development strategy for Africa must be to make full use of its regional and sub-regional alliances, in order to promote and disseminate well-designed and appropriately targeted technological innovations in agriculture.

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Annexes: Core CAADP M&E Indicators

In the form of a statistical abstract, we present data and trends in the CAADP M&E core indicators (see Benin et al. 2010b). These are organized under enabling environment (which gives the context within which the CAADP process and related policies, investments, and outcomes have been taking place), progress in CAADP implementation process, agricultural spending, agricultural sector performance, and outcomes (MDG1 indicators).

The data are presented at the aggregate level for the entire continent (Africa), Sub-Saharan Africa (SSA), the five geographic regions of the African Union (central, eastern, northern, southern, and western), eight Regional Economic Communities (CEN-SAD, COMESA, EAC, ECCAS, ECOWAS, IGAD, SADC, and UMA),[11] and four economic categories that are classified according agricultural production potential, alternative nonagricultural sources of growth, and income level—see 2010 ATOR (Benin at al. 2010a) for details on data sources and methodology. Data for individual countries can be observed at www.resakss.org.

Technical Notes to Annex Tables

1. To control for year-to-year fluctuations, point estimates are avoided in the table. Therefore, the values under the column "2003" are simple averages over the years 2002 to 2004.

2. Annual average level and annual average change for 2003–2010 include data from 2003 up to the most recent year that is measured and available.

3. Annual average level is simple average over the years shown, inclusive of the years shown.

4. Annual average change for all indicators except GDP growth rates (and others with possible negative values) is annual average percent change from the beginning to the end years shown by fitting an exponential growth function to the data points (i.e., "LOGEST" function in excel).

5. Annual average change for GDP growth rates (and other indicators with possible negative values) is annual average percentage point change, which is a simple average of the difference in two consecutive years over the years specified in the range.

6. For indicators in which there are only a few measured data points over the years specified in the range (such as poverty, which is measured once every three to five years or so), a straight-line method was used to obtain missing values for the individual years between any two measured data points. Otherwise, estimated annual average change based on the measured values (see above) is used to obtain missing values either preceding or following the measured data point.

   6a. In cases where the missing values could not be interpolated, the data is reported as missing and excluded from the calculations for that time period. Any weights used for these indicators are adjusted to account for the missing data in the series of the indicator.

[11] CEN-SAD is the Community of Sahel-Saharan States (CEN-SAD 2011); COMESA is the Common Market for Eastern and Southern Africa (COMESA 2010); EAC is the East African Community (EAC 2011); ECCAS is the Economic Community of Central African States; ECOWAS is the Economic Community of West African States (ECOWAS 2010); IGAD is the Intergovernmental Authority for Development (IGAD 2011); SADC is the Southern Africa Development Community (SADC 2010) and UMA is the Union du Maghreb Arabe (UMA 2011).

7. Values for *Africa*, the regional aggregations (*SSA* and *central, eastern, northern, southern* and *western*), economic aggregations (*Less favorable agriculture conditions, More favorable agriculture conditions, Mineral-rich countries,* and *Middle income countries*—see introduction), and Regional Economic Communities (*CEN-SAD, COMESA, EAC, ECCAS, ECOWAS, IGAD, SADC,* and *UMA*) are calculated by weighted summation. The weights vary by indicator; if a weight was used, the specific weights used is listed under each table, and weights are based on each country's proportion in the total value of the indicator used for the weighing measured at the respective aggregate level. Each country *i*'s weight in region *j* (w_{ij}) is then multiplied by the country's data point (x_i) and then summed up for the relevant countries in the region to obtain the regional value (y_j) according to: $y_j = \Sigma_i \, w_{ij} x_i$.

8. Sub-Saharan Africa (SSA) excludes the northern Africa region and its constituent countries.

Annex A: Enabling Environment

TABLE A.1—TOTAL ODA PER CAPITA, GROSS DISBURSEMENTS (2009 USD)

Region/Subregion	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	36.16	49.74	2.13
SSA	38.88	54.44	1.93
Geographic Location			
Central	62.56	65.66	-0.83
Eastern	34.04	52.91	4.75
Northern	23.28	26.83	3.38
Southern	47.02	55.79	1.57
Western	30.50	50.97	2.34
Economic classification			
Less favorable agriculture	51.57	70.62	2.98
More favorable agriculture	41.93	58.77	4.06
Mineral-rich countries	72.44	73.48	-1.80
Middle-income countries	24.01	37.01	2.69
Regional Economic Community			
CEN-SAD	27.74	43.89	4.86
COMESA	37.82	48.81	1.28
EAC	36.82	58.35	7.18
ECCAS	60.52	63.08	-1.75
ECOWAS	30.50	50.97	2.34
IGAD	27.14	45.31	7.51
SADC	53.88	59.17	-1.57
UMA	23.46	32.47	6.62

Source: Authors' calculation based on World Bank 2012 and OECD 2012.

TABLE A.2—SHARE OF AGRICULTURAL OFFICIAL DEVELOPMENT ASSISTANCE IN TOTAL ODA

	Share in Total ODA			Share in Total Sector Allocatable ODA		
Region/Subregion	**2003**	**Annual average level (2003-2010)**	**Annual average percentage change (2003-2010)**	**2003**	**Annual average level (2003-2010)**	**Annual average percentage change (2003-2010)**
Africa	2.98	3.73	10.48	5.81	6.75	4.23
SSA	2.98	3.77	11.11	6.03	7.17	4.58
Geographic Location						
Central	1.52	1.89	11.54	4.46	5.40	3.87
Eastern	3.60	4.33	8.42	6.28	7.55	3.47
Northern	2.95	3.41	4.40	4.48	4.27	0.14
Southern	2.44	3.77	10.67	4.30	5.98	5.43
Western	4.21	4.52	11.26	7.67	8.16	4.90
Economic classification						
Less favorable agriculture	4.81	5.54	6.96	8.58	9.98	3.39
More favorable agriculture	3.88	5.10	7.47	6.42	8.28	4.04
Mineral-rich countries	1.10	1.82	16.03	3.59	4.65	6.01
Middle-income countries	2.72	2.92	11.82	4.95	4.94	4.83
Regional Economic Community						
CEN-SAD	3.75	3.94	8.46	6.54	6.87	3.89
COMESA	2.54	3.56	12.15	5.39	6.82	4.31
EAC	3.45	4.68	7.81	5.27	7.09	4.23
ECCAS	1.45	2.22	17.87	4.20	5.63	8.10
ECOWAS	4.21	4.52	11.26	7.67	8.16	4.90
IGAD	3.31	3.91	8.55	5.91	7.04	3.59
SADC	2.22	3.50	12.03	5.00	6.44	3.98
UMA	3.58	3.52	1.37	5.28	4.23	-2.75

Source: Authors' calculation based on OECD 2012.
Notes: Both agriculture ODA and total sector allocatable ODA are based on gross disbursements, for which data are available starting from 2003. Total sector allocatable ODA is total ODA minus total unallocatable ODA, which includes commodity aid and general program assistance, debt programs, humanitarian aid, administrative costs, funds to NGOs, refugee programs, and other unallocatable aid.

TABLE A.3—SHARE OF EMERGENCY FOOD AID IN TOTAL ODA (%)

Region/Subregion	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	3.31	4.21	2.66
SSA	3.67	4.64	2.69
Geographic Location			
Central	1.47	3.19	19.37
Eastern	8.56	10.36	-1.87
Northern	0.32	0.47	3.35
Southern	2.78	2.41	1.93
Western	0.88	0.82	-1.51
Economic classification			
Less favorable agriculture	3.91	6.33	5.92
More favorable agriculture	4.53	5.40	0.50
Mineral-rich countries	1.80	2.24	4.91
Middle-income countries	3.00	3.50	1.21
Regional Economic Community			
CEN-SAD	2.57	4.34	9.60
COMESA	5.48	7.73	2.84
EAC	3.67	4.36	-2.15
ECCAS	2.78	3.13	6.42
ECOWAS	0.88	0.82	-1.51
IGAD	13.90	15.65	-4.04
SADC	1.80	2.08	7.34
UMA	0.58	0.74	0.93

Source: Authors' calculation based on World Bank 2012 and OECD 2012.
Notes: Both *emergency food aid* and *total ODA* are based on gross disbursements, for which data are available starting from 2003.

TABLE A.4—GDP GROWTH (annual %)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage point change (1990-1995)	Annual average level (1995-2003)	Annual average percentage point change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage point change (2003-2010)
Africa	1.92	0.17	3.86	0.22	4.61	5.14	-0.07
SSA	1.37	0.49	3.72	0.07	4.76	5.24	0.06
Geographic Location							
Central	-1.77	1.21	3.65	0.22	6.41	5.08	-0.04
Eastern	2.79	0.57	4.74	-0.15	4.75	6.47	0.21
Northern	2.74	-0.32	4.04	0.44	4.40	4.99	-0.25
Southern	0.85	0.60	3.28	-0.08	3.98	4.33	0.09
Western	2.73	-0.17	3.89	0.48	5.72	6.06	-0.11
Economic classification							
Less favorable agriculture	1.18	1.76	5.30	-0.18	6.92	5.56	-0.03
More favorable agriculture	2.68	0.07	3.99	-0.24	3.77	5.93	0.55
Mineral-rich countries	-3.50	0.95	2.03	0.41	4.55	4.82	0.28
Middle-income countries	2.03	0.11	3.86	0.28	4.66	5.04	-0.15
Regional Economic Community							
CEN-SAD	3.19	-0.35	4.07	0.42	4.58	5.56	-0.14
COMESA	3.00	0.15	3.99	0.01	3.57	5.58	0.09
EAC	3.58	-0.14	4.50	-0.05	4.49	5.30	-0.01
ECCAS	-1.99	1.60	4.75	-0.17	7.26	7.34	-0.06
ECOWAS	2.73	-0.17	3.89	0.48	5.72	6.06	-0.11
IGAD	3.01	0.89	4.62	-0.28	4.49	6.71	0.33
SADC	0.71	0.55	3.28	-0.01	4.13	4.53	0.08
UMA	2.10	-0.40	3.79	0.84	5.17	4.73	-0.61

Source: Authors' calculation based on World Bank 2012.
Notes: Data includes GDP data imputed via growth rates derived from the log estimate of the five years following or preceding the missing values. See Technical Notes for other calculation details.

TABLE A.5—GDP PER CAPITA (constant 2000 USD)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	685.32	-0.96	718.79	1.21	759.36	841.23	2.94
SSA	503.40	-1.70	511.12	0.78	534.22	591.86	2.99
Geographic Location							
Central	342.98	-5.43	312.07	0.49	328.06	354.68	1.98
Eastern	250.52	-0.42	270.27	1.51	288.32	331.88	4.33
Northern	1466.39	0.57	1666.68	2.38	1824.82	2060.47	3.42
Southern	1424.14	-1.72	1450.68	0.76	1515.66	1686.94	3.24
Western	338.06	-0.60	349.88	0.88	369.26	412.16	2.86
Economic classification							
Less favorable agriculture	169.82	-1.73	173.00	1.32	186.80	204.56	1.98
More favorable agriculture	239.03	-1.06	252.60	0.86	260.74	292.59	3.61
Mineral-rich countries	208.74	-7.40	168.36	-1.03	166.44	178.41	2.10
Middle-income countries	1072.05	-0.54	1148.66	1.55	1230.00	1374.30	3.16
Regional Economic Community							
CEN-SAD	624.17	0.43	684.51	1.61	729.38	816.22	3.21
COMESA	519.64	0.15	566.10	1.26	588.65	658.91	3.49
EAC	489.54	0.42	532.49	1.36	562.92	621.68	2.93
ECCAS	372.39	-6.16	348.33	1.09	374.81	446.77	5.39
ECOWAS	338.06	-0.60	349.88	0.88	369.26	412.16	2.86
IGAD	219.81	0.10	241.67	1.42	256.72	299.56	4.88
SADC	894.02	-2.44	888.09	0.60	919.95	1010.24	2.83
UMA	1711.34	-0.14	1893.61	2.24	2086.92	2356.55	3.03

Source: Authors' calculation based on World Bank 2012.
Notes: Data includes GDP data imputed via growth rates derived from the log estimate of the five years following or preceding the missing values.

TABLE A.6—ANNUAL INFLATION (GDP deflator) (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	55.68	17.46	26.42	-19.74	10.37	8.79	-1.11
SSA	83.15	25.95	39.44	-21.01	11.59	9.11	-5.08
Geographic Location							
Central	459.19	14.28	59.33	-13.06	4.90	7.47	1.63
Eastern	33.21	2.05	12.47	-3.07	7.65	9.49	-0.13
Northern	15.71	-0.59	7.95	-1.13	8.67	8.36	0.51
Southern	57.47	16.50	56.18	-10.97	12.58	8.82	-0.11
Western	29.45	6.28	17.40	-3.69	14.86	9.92	-0.32
Economic classification							
Less favorable agriculture	10.17	2.04	6.51	-1.06	6.90	7.38	-0.14
More favorable agriculture	17.18	1.22	9.28	-1.50	6.67	8.34	-0.08
Mineral-rich countries	878.87	25.42	133.33	-24.90	13.95	15.76	0.68
Middle-income countries	33.36	6.73	25.98	-5.16	10.79	8.70	0.23
Regional Economic Community							
CEN-SAD	19.89	1.78	10.71	-1.96	10.60	8.71	0.27
COMESA	95.09	1.64	17.24	-3.19	11.54	10.63	0.40
EAC	11.93	-0.41	6.75	-0.54	4.24	5.65	-0.05
ECCAS	533.59	90.11	259.50	-56.35	26.29	13.59	-1.53
ECOWAS	29.45	6.28	17.40	-3.69	14.86	9.92	-0.32
IGAD	40.15	1.99	12.80	-3.46	7.55	10.20	-0.02
SADC	122.96	16.57	58.38	-11.62	12.17	8.94	-0.08
UMA	17.06	-0.08	9.53	-1.49	9.66	7.35	0.52

Source: Authors' calculation based on World Bank 2012.
Notes: Data includes GDP data imputed via growth rates derived from the log estimate of the five years following or preceding the missing values.

TABLE A.7—GENERAL GOVERNMENT GROSS DEBT AS SHARE OF GDP (%)

Region/Subregion	Annual average level (2000-2003)	Annual average percentage change (2000-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	74.32	-5.19	67.39	48.91	-12.60
SSA	71.29	-5.90	63.77	43.59	-15.70
Geographic Location					
Central	108.87	-7.12	96.66	57.54	-18.41
Eastern	98.66	-0.06	94.81	64.78	-11.01
Northern	78.49	-4.29	72.40	56.39	-8.09
Southern	47.42	-7.95	41.68	33.77	-4.42
Western	86.87	-8.51	73.76	41.91	-14.40
Economic classification					
Less favorable agriculture	111.46	-7.80	97.34	58.91	-13.97
More favorable agriculture	81.83	-1.08	78.68	54.97	-11.52
Mineral-rich countries	209.51	-6.30	188.54	120.40	-17.57
Middle-income countries	69.23	-5.59	62.36	46.20	-8.13
Regional Economic Community					
CEN-SAD	87.24	-3.82	80.45	60.05	-8.63
COMESA	98.00	-1.45	93.90	71.18	-9.22
EAC	71.42	3.66	70.79	52.16	-9.03
ECCAS	102.75	-8.90	88.06	51.50	-15.81
ECOWAS	86.87	-8.51	73.76	41.91	-14.40
IGAD	107.21	1.66	104.24	70.19	-11.16
SADC	54.27	-7.39	48.19	38.19	-5.79
UMA	58.19	-9.15	48.12	31.53	-10.43

Source: Authors' calculation based on World Bank 2012 and IMF 2012.
Notes: "Gross debt consists of all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future. This includes debt liabilities in the form of SDRs, currency and deposits, debt securities, loans, insurance, pensions and standardized guarantee schemes, and other accounts payable. Thus, all liabilities in the GFSM 2001 system are debt, except for equity and investment fund shares and financial derivatives and employee stock options. Debt can be valued at current market, nominal, or face values" (IMF 2010, paragraph 7.110). All data weighted by real GDP (with imputed values where GDP data was missing). They are calculated using GDP as weight. See Technical Notes for exact calculations.

TABLE A.8—GENERAL GOVERNMENT REVENUE AS A SHARE OF GDP (%)

Region/Subregion	Annual average level (2000-2003)	Annual average percentage change (2000-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	26.53	-0.23	26.79	29.38	4.09
SSA	24.09	-1.79	23.91	26.04	3.89
Geographic Location					
Central	19.75	1.03	19.96	26.26	4.90
Eastern	17.56	4.16	19.06	20.21	-0.34
Northern	29.90	1.53	30.77	34.09	1.36
Southern	24.81	-0.29	24.97	28.20	2.34
Western	29.07	-7.51	26.79	26.36	-3.66
Economic classification					
Less favorable agriculture	19.98	3.70	21.02	25.76	2.98
More favorable agriculture	16.65	4.18	17.86	19.86	1.85
Mineral-rich countries	15.01	3.85	15.72	19.93	5.30
Middle-income countries	28.15	-0.67	28.25	30.85	0.76
Regional Economic Community					
CEN-SAD	27.20	-0.39	27.52	29.76	0.36
COMESA	25.21	4.27	27.06	30.31	1.29
EAC	23.71	0.73	24.19	25.10	1.42
ECCAS	25.32	-4.49	24.15	31.29	4.35
ECOWAS	29.07	-7.51	26.79	26.36	-3.66
IGAD	18.04	5.24	19.86	20.42	-1.68
SADC	23.58	0.05	23.86	27.08	2.49
UMA	33.04	1.06	34.09	39.05	1.96

Source: Authors' calculation based on IMF 2012.
Notes: Revenue consists of taxes, social contributions, grants receivable, and other revenue. Revenue increases government's net worth, which is the difference between its assets and liabilities (IMF 2001, paragraph 4.20). See Technical Notes for exact calculations.

Annex B: CAADP Implementation Processes

TABLE B:1—PROGRESS IN CAADP ROUNDTABLE PROCESS AT END OF MARCH 2012

Country/ Region	Focal point appointed	Government and REC launch process	Steering and technical committee instituted	Stocktaking, growth and investment analysis undertaken	Compact drafted	Roundtable held and compact Signed	Investment plan drafted, reviewed and validated	Business meeting held	Country SAKSS established†
*Africa**	41	35	33	32	28	30	23	20	6
*Central Africa**	8	4	3	3	3	3	1	1	0
Burundi						24-Aug-09	31-Aug-11	15-Mar-12	
Cameroon									
Central African Republic						15-Apr-11			
Chad									
Congo, Dem. Rep.						18-Mar-11			
Congo, Rep.	Early Stages.								
Equatorial Guinea	Not launched.								
Gabon									
Sao Tome and Principe		8-Feb-12							
*Eastern Africa**	13	11	10	10	7	7	5	5	2
Comoros									
Djibouti						19-Apr-12			
Eritrea									
Ethiopia						28-Sep-09	10-Sep-10	7-Dec-10	
Kenya						24-Jul-10	14-Sep-10	27-Sep-10	
Madagascar									
Mauritius									
Rwanda						31-Mar-07	7-Dec-09	9-Dec-09	
Seychelles						16-Sep-11			
Somalia	Early Stages.								
Sudan									
Tanzania						8-Jul-10	31-May-11	10-Nov-11	
Uganda						30-Mar-10	16-Sep-10	17-Sep-10	

TABLE B:1— PROGRESS IN CAADP ROUNDTABLE PROCESS AT END OF MARCH 2012—Continued

Country/ Region	Focal point appointed	Government and REC launch process	Steering and technical committee instituted	Stocktaking, growth and investment analysis undertaken	Compact drafted	Roundtable held and compact Signed	Investment plan drafted, reviewed and validated	Business meeting held	Country SAKSS established†
*Northern Africa**	4	1	1	1	1	1	1	1	0
Algeria	Early Stages.								
Egypt									
Libya									
Mauritania						4-Aug-11	16-Feb-12	21-Mar-12	
Morocco	Not launched.								
Tunisia	Not launched.								
*Southern Africa**	8	7	7	6	6	4	1	1	2
Angola	Not launched.								
Botswana	Not launched.								
Lesotho									
Malawi						19-Apr-10	10-Oct-10	29-Sep-11	
Mozambique						12-Dec-11			
Namibia	Early stages.								
South Africa	Early Stages.								
Swaziland						3-Mar-10			
Zambia						18-Jan-11			
Zimbabwe									
*Western Africa**	15	15	15	15	15	15	15	12	2
Benin						16-Oct-09	25-Sep-10	7-Jun-11	
Burkina Faso						22-Jul-10	17-Jan-12	26-Mar-12	
Cape Verde						11-Dec-09	25-Sep-10	17-Nov-10	
Cote d'Ivoire						27-Jul-10	1-Apr-12		
Gambia, The						28-Oct-09	25-Sep-10	5-Nov-10	
Ghana						28-Oct-09	9-Jun-10	17-Jun-10	
Guinea						6-Apr-10	25-Sep-10		
Guinea Bissau						18-Jan-11	3-Jun-11		
Liberia						16-Oct-09	9-Jun-10	17-Jun-10	
Mali						13-Oct-09	25-Sep-10	5-Nov-10	

TABLE B:1— PROGRESS IN CAADP ROUNDTABLE PROCESS AT END OF MARCH 2012—Continued

Country/ Region	Focal point appointed	Government and REC launch process	Steering and technical committee instituted	Stocktaking, growth and investment analysis undertaken	Compact drafted	Roundtable held and compact Signed	Investment plan drafted, reviewed and validated	Business meeting held	Country SAKSS established†
Niger						30-Sep-09	25-Sep-10	15-Dec-10	
Nigeria						30-Oct-09	9-Jun-10	17-Jun-10	
Senegal						10-Feb-10	9-Jun-10	17-Jun-10	
Sierra Leone						17-Sep-09	9-Jun-10	17-Jun-10	
Togo						30-Jul-09	4-Feb-10	17-Jun-10	
*RECs***	3	3	3	3	3	1	1	1	3
CEN-SAD									
COMESA					In progress.				
EAC									
ECCAS									
ECOWAS						11-Nov-09	9-Jun-10	17-Jun-10	
IGAD					In progress.				
SADC									
UMA									

Sources: Authors' calculations based on compilation from CAADP 2012 and other reports.
Notes: * The items in this row are number of countries in Africa or subregion that have achieved milestone.
** The items in this row are number of RECs that have achieved milestone. See Technical Notes for more information on compilation process.

† For the RECs, this refers to ReSAKSS regional nodes and the following country assignments

ReSAKSS-ECA		ReSAKSS-SA	ReSAKSS-WA	
Burundi (COMESA, EAC, ECCAS)	Rwanda (COMESA, EAC, ECCAS)	Angola (ECCAS, SADC)	Benin (CEN-SAD, ECOWAS)	Mauritania (CEN-SAD, UMA)
Central Afr. Rep. (CEN-SAD, ECCAS)	Seychelles (COMESA, SADC)	Botswana (SADC)	Burkina Faso (CEN-SAD, ECOWAS)	Niger (CEN-SAD, ECOWAS)
Comoros (CEN-SAD, COMESA)	South Sudan ()	Lesotho (SADC)	Cameroon (ECCAS)	Nigeria (CEN-SAD, ECOWAS)
Congo, D.R. (COMESA, ECCAS, SADC)	Sudan (CEN-SAD, COMESA, IGAD)	Madagascar (COMESA, SADC)	Cape Verde (ECOWAS)	Senegal (CEN-SAD, ECOWAS)
Congo, R (ECCAS)	Tanzania (SADC)	Malawi (COMESA, SADC)	Chad (CEN-SAD, ECCAS)	Sierra Leone (CEN-SAD, ECOWAS)
Djibouti (CEN-SAD, COMESA, IGAD)	Uganda (COMESA, EAC, IGAD)	Mauritius (COMESA, SADC)	Côte d'Ivoire (CEN-SAD, ECOWAS)	Togo (CEN-SAD, ECOWAS)
Egypt (CEN-SAD, COMESA)		Mozambique (SADC)	Gambia (CEN-SAD, ECOWAS)	
Eritrea (COMESA, IGAD)		Namibia (SADC)	Ghana (CEN-SAD, ECOWAS)	
Ethiopia (COMESA, IGAD)		South Africa (SADC)	Guinea (CEN-SAD, ECOWAS)	
Gabon (ECCAS)		Swaziland (COMESA, SADC)	Guinea Bissau (CEN-SAD, ECOWAS)	
Kenya (CEN-SAD, COMESA, EAC, IGAD)		Zambia (COMESA, SADC)	Liberia (CEN-SAD, ECOWAS)	
Libya (CEN-SAD, COMESA, UMA)		Zimbabwe (COMESA, SADC)	Mali (CEN-SAD, ECOWAS)	

Notes: For reporting at the continental level, ReSAKSS-AW is responsible for the information on Algeria (UMA), Morocco (CEN-SAD, UMA), and Tunisia (CEN-SAD, EAC, UMA).

Annex C: Agricultural Financing

TABLE C.1—PUBLIC AGRICULTURE EXPENDITURE, ANNUAL GROWTH RATE (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage point change (1990-1995)	Annual average level (1995-2003)	Annual average percentage point change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage point change (2003-2010)
Africa	1.45	0.32	7.04	-1.08	1.01	5.90	3.05
SSA	-2.65	0.26	7.82	-0.31	14.57	14.83	2.56
Geographic Location							
Central	-2.06	-7.71	10.13	2.88	25.28	5.38	0.52
Eastern	-2.32	5.30	13.17	-0.95	13.77	19.93	2.42
Northern	4.69	0.38	6.45	-1.67	-9.32	-0.99	3.26
Southern	-4.41	-3.94	-3.55	-1.40	8.74	8.91	4.00
Western	-0.22	-2.84	12.94	1.84	20.67	16.48	1.29
Economic classification							
Less favorable agriculture	-2.20	-5.41	6.35	2.44	6.71	9.92	1.97
More favorable agriculture	-4.41	4.67	10.94	-1.03	13.42	18.64	2.19
Mineral-rich countries	6.66	-2.26	15.84	0.42	4.50	5.23	0.78
Middle-income countries	3.52	-0.84	5.45	-1.28	-3.65	1.01	3.31
Regional Economic Community							
CEN-SAD	1.29	1.76	2.10	-0.70	-4.58	0.04	1.30
COMESA	-0.10	2.29	5.89	-0.65	-1.72	8.55	2.55
EAC	-4.53	7.00	12.94	-2.15	-2.40	3.32	1.52
ECCAS	-2.06	-7.71	10.13	2.88	25.28	5.38	0.52
ECOWAS	-0.22	-2.84	12.94	1.84	20.67	16.48	1.29
IGAD	-0.91	4.36	13.20	-2.85	11.49	19.36	4.51
SADC	-5.34	-1.43	-0.93	0.84	12.10	11.09	1.31
UMA	5.97	-0.05	11.75	-3.12	-5.94	-2.38	4.56

Source: Authors' calculations based on national sources, IFPRI 2011, IMF 2012, and AUC 2008.
See Technical Note for calculation details.

TABLE C.2—SHARE OF PUBLIC AGRICULTURE EXPENDITURE IN TOTAL PUBLIC EXPENDITURE (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	6.82	-0.02	6.01	-1.82	5.58	5.33	-3.49
SSA	8.65	-0.03	6.47	-3.71	6.35	7.20	-0.66
Geographic Location							
Central	4.53	3.44	3.10	0.35	3.56	4.22	6.51
Eastern	7.86	1.66	6.02	-2.96	5.98	7.22	-0.70
Northern	5.13	-0.61	5.57	0.57	4.87	3.52	-13.48
Southern	6.85	-13.54	4.67	2.41	6.61	7.77	5.16
Western	12.14	-0.33	9.17	-6.13	7.98	8.03	-1.82
Economic classification							
Less favorable agriculture	32.83	-5.33	15.95	-13.89	9.98	11.78	2.65
More favorable agriculture	8.68	0.87	6.94	-2.46	7.11	7.81	-2.00
Mineral-rich countries	2.75	-3.67	2.93	-6.34	2.73	4.99	8.93
Middle-income countries	4.99	0.06	5.21	0.25	4.67	3.70	-7.15
Regional Economic Community							
CEN-SAD	6.63	0.57	6.25	-1.55	5.43	4.43	-5.79
COMESA	5.94	0.59	5.83	-0.08	5.56	5.52	-2.85
EAC	6.57	1.45	5.56	0.95	5.25	4.71	-5.50
ECCAS	4.53	3.44	3.10	0.35	3.56	4.22	2.57
ECOWAS	12.14	-0.33	9.17	-6.13	7.98	8.03	-1.57
IGAD	7.57	5.24	6.05	-2.83	6.09	8.19	1.19
SADC	7.99	-8.99	5.38	-1.34	6.02	5.51	-7.89
UMA	5.69	-0.81	5.00	-1.02	4.46	3.43	-5.46

Source: ReSAKSS compilation based on various sources: national sources, IFPRI 2011, IMF 2012, and AUC 2008.
Notes: Data collected by the ReSAKSS regional networks from national sources were first used, and then gaps were filled by data obtained from CAADP publications and then IFPRI's SPEED database and the IMF.

TABLE C.3—PUBLIC AGRICULTURE EXPENDITURE AS SHARE OF AGRICULTURE GDP AND GDP (%)

3a—PUBLIC AGRICULTURE EXPENDITURE AS SHARE OF AGRICULTURE GDP (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	3.51	-9.15	4.64	15.84	7.10	7.75	5.12
SSA	3.39	-9.91	4.43	15.70	6.82	7.73	5.61
Geographic Location							
Central	3.66	-4.57	2.46	3.86	3.36	3.39	2.90
Eastern	1.83	-15.38	2.98	13.76	3.75	3.87	-0.51
Northern	6.26	1.00	9.06	17.26	13.25	8.03	-4.22
Southern	6.05	-16.41	7.65	16.48	11.57	11.72	3.91
Western	6.09	-6.39	5.57	9.69	7.46	10.52	11.99
Economic classification							
Less favorable agriculture	6.91	-6.23	4.84	6.11	6.00	8.03	11.44
More favorable agriculture	1.86	-13.60	3.01	13.29	4.01	4.50	2.19
Mineral-rich countries	8.82	-23.82	7.84	15.45	11.74	11.82	3.75
Middle-income countries	4.25	-2.80	5.13	13.83	7.32	6.81	2.82
Regional Economic Community							
CEN-SAD	6.46	-5.17	5.44	7.08	6.91	9.44	11.15
COMESA	2.02	-10.67	4.37	21.16	7.11	7.62	3.93
EAC	1.05	-12.88	2.03	33.61	3.32	2.67	-1.00
ECCAS	3.66	-4.57	2.46	3.86	3.36	3.39	2.90
ECOWAS	6.09	-6.39	5.57	9.69	7.46	10.52	11.99
IGAD	0.88	-12.31	2.11	35.75	3.50	2.84	-0.89
SADC	5.65	-13.50	7.05	9.55	9.28	10.05	3.76
UMA	7.17	0.49	10.14	17.06	14.73	8.95	-3.98

Source: Authors' calculation based on national sources, IFPRI 2011, IMF 2012, AUC 2008, and World Bank 2012.

TABLE C.3—PUBLIC AGRICULTURE EXPENDITURE AS SHARE OF AGRICULTURE GDP AND GDP (%)—Continued

3b—PUBLIC AGRICULTURE EXPENDITURE AS SHARE OF GDP (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	0.52	-7.77	0.62	12.96	0.88	0.90	2.79
SSA	0.50	-8.32	0.60	12.74	0.85	0.91	3.24
Geographic Location							
Central	0.50	-7.29	0.29	-0.35	0.32	0.24	-5.02
Eastern	0.55	-15.40	0.61	5.41	0.61	0.61	-1.85
Northern	0.73	-2.20	0.97	16.00	1.38	0.75	-6.23
Southern	0.79	-6.33	1.50	20.80	2.37	2.27	1.23
Western	0.46	-8.05	0.38	7.40	0.47	0.54	5.60
Economic classification							
Less favorable agriculture	1.94	-4.70	1.26	2.88	1.35	1.56	7.03
More favorable agriculture	0.51	-12.62	0.62	6.25	0.68	0.74	1.02
Mineral-rich countries	0.25	17.77	0.94	26.56	1.66	1.62	1.10
Middle-income countries	0.33	-7.79	0.32	11.02	0.41	0.29	-3.25
Regional Economic Community							
CEN-SAD	0.50	-6.02	0.39	4.92	0.45	0.50	4.81
COMESA	0.74	-12.85	1.15	15.17	1.63	1.65	1.46
EAC	0.49	-13.20	0.59	23.24	0.81	0.62	-3.16
ECCAS	0.48	-7.21	0.27	-0.85	0.29	0.21	-6.55
ECOWAS	0.46	-8.05	0.38	7.40	0.47	0.54	5.60
IGAD	0.43	-13.25	0.63	25.03	0.88	0.70	-2.22
SADC	0.77	-13.69	1.06	10.79	1.42	1.50	1.98
UMA	0.80	-2.59	1.05	15.84	1.48	0.80	-6.01

Source: Authors' calculation based on national sources, IFPRI 2011, IMF 2012, AUC 2008, and World Bank 2012.

Annex D: Agricultural Output, Productivity and Growth

TABLE D.1—AGRICULTURE, VALUE ADDED AS SHARE OF GDP (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	17.09	-1.42	16.10	-1.40	15.05	13.99	-1.20
SSA	18.11	-0.72	16.98	-1.64	15.74	14.77	-1.08
Geographic Location							
Central	27.74	2.46	24.82	-2.03	21.85	18.49	-3.33
Eastern	38.73	-0.24	35.51	-3.00	31.19	28.98	-1.99
Northern	15.60	-2.46	14.86	-0.93	14.10	12.92	-1.40
Southern	6.80	-3.91	6.12	-1.37	5.81	5.53	0.47
Western	32.21	-1.90	30.91	-0.45	30.40	29.25	-1.19
Economic classification							
Less favorable agriculture	39.53	1.83	38.85	-2.40	34.49	30.78	-2.41
More favorable agriculture	37.83	0.09	34.41	-2.99	30.98	30.77	-0.44
Mineral-rich countries	36.47	4.94	37.15	1.36	37.17	34.52	-2.89
Middle-income countries	12.89	-2.64	12.27	-0.79	11.65	10.50	-1.57
Regional Economic Community							
CEN-SAD	22.03	-2.15	21.33	-0.76	20.22	18.15	-2.72
COMESA	25.03	-0.73	23.81	-1.47	21.88	20.23	-2.07
EAC	27.26	-1.49	22.90	-3.97	19.41	17.82	-3.47
ECCAS	25.00	0.09	21.59	-2.24	19.14	16.26	-3.43
ECOWAS	32.21	-1.90	30.91	-0.45	30.40	29.25	-1.19
IGAD	41.20	-0.14	38.64	-2.55	33.54	30.86	-2.15
SADC	10.79	-1.62	9.35	-2.17	8.76	8.34	-0.26
UMA	14.30	-2.84	13.20	-1.42	12.52	11.63	-0.65

Source: Authors' calculation based on World Bank 2012.

TABLE D.2—LAND AND LABOR PRODUCTIVITY

2a—LAND PRODUCTIVITY (2004-2006 International dollars per ha agricultural land)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	103.15	1.77	123.58	2.74	137.67	148.53	2.09
SSA	92.93	2.02	110.47	2.71	122.48	131.34	1.91
Geographic Location							
Central	99.16	0.38	100.86	0.83	104.40	109.38	1.23
Eastern	85.45	0.47	98.94	2.95	111.90	120.18	2.36
Northern	172.56	0.91	213.76	3.04	243.38	268.92	2.78
Southern	49.20	-0.31	57.70	2.87	62.72	67.88	2.85
Western	160.01	4.53	200.38	2.64	221.66	234.97	1.09
Economic classification							
Less favorable agriculture	35.66	-1.03	41.37	3.34	46.53	50.49	2.89
More favorable agriculture	116.75	0.52	137.16	2.68	152.50	164.23	2.53
Mineral-rich countries	137.47	-0.15	133.27	0.38	136.31	143.61	1.44
Middle-income countries	118.71	2.78	147.06	2.95	165.07	178.74	1.95
Regional Economic Community							
CEN-SAD	119.10	3.06	148.33	2.89	165.80	178.41	1.78
COMESA	130.49	0.98	150.76	2.39	164.27	176.39	2.36
EAC	164.78	-1.03	185.35	3.01	206.82	218.26	1.16
ECCAS	74.51	-0.12	78.80	2.08	85.31	91.65	2.37
ECOWAS	160.01	4.53	200.38	2.64	221.66	234.97	1.09
IGAD	70.04	1.30	83.93	3.25	94.60	100.56	1.91
SADC	73.44	-0.41	79.77	1.95	86.15	93.17	2.73
UMA	87.00	-1.76	101.04	2.75	116.15	127.68	1.91

Source: Authors' calculation based on FAO 2012.

TABLE D.2— LAND AND LABOR PRODUCTIVITY—Continued

2b—LABOR PRODUCTIVITY (2004-2006 international dollars per agricultural worker)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	735.15	0.24	791.64	1.14	830.77	856.85	0.50
SSA	630.85	0.39	670.73	1.04	698.73	714.68	0.22
Geographic Location							
Central	498.49	-1.63	457.96	-0.56	445.84	445.62	-0.27
Eastern	430.71	-1.19	433.57	0.71	451.55	455.79	0.18
Northern	1856.62	0.48	2207.81	2.41	2456.06	2689.48	2.62
Southern	740.52	-2.29	776.06	1.37	798.88	826.37	1.30
Western	971.59	3.55	1144.34	1.91	1235.12	1288.74	0.24
Economic classification							
Less favorable agriculture	503.27	-1.05	525.59	0.66	534.21	544.25	0.72
More favorable agriculture	367.27	-1.86	375.84	0.93	390.72	397.80	0.63
Mineral-rich countries	430.94	-2.53	373.91	-0.81	364.99	367.77	-0.13
Middle-income countries	1426.95	2.12	1678.53	2.22	1840.29	1961.07	1.31
Regional Economic Community							
CEN-SAD	1020.16	1.95	1177.51	1.83	1267.10	1326.66	0.73
COMESA	569.84	-0.30	592.16	0.64	603.38	614.54	0.53
EAC	589.91	-2.77	567.49	0.55	581.71	576.51	-0.90
ECCAS	457.50	-1.57	428.65	-0.05	427.39	433.38	0.51
ECOWAS	971.59	3.55	1144.34	1.91	1235.12	1288.74	0.24
IGAD	435.48	-0.49	449.44	0.85	465.13	466.54	-0.14
SADC	569.13	-2.72	549.07	0.47	557.52	568.25	0.78
UMA	1780.57	-3.29	1892.41	1.91	2120.82	2304.52	1.73

Source: Authors' calculation based on FAO 2012.

TABLE D.3—CEREAL YIELDS (kilograms per ha)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	944.97	-0.37	1072.11	2.43	1165.79	1279.76	0.89
SSA	939.69	0.04	1070.07	2.41	1152.72	1279.22	1.62
Geographic Location							
Central	785.08	0.84	852.05	1.17	884.37	932.10	1.37
Eastern	978.52	-1.60	985.91	2.00	1061.36	1110.34	0.78
Northern	980.68	-3.03	1086.19	2.54	1256.70	1283.22	1.06
Southern	960.16	1.02	1237.02	3.77	1367.66	1612.86	5.51
Western	926.65	0.84	1054.65	1.62	1106.50	1220.01	2.24
Economic classification							
Less favorable agriculture	614.52	-1.76	688.43	2.09	687.51	728.17	2.80
More favorable agriculture	1224.17	0.67	1312.57	1.09	1355.42	1464.32	2.33
Mineral-rich countries	1245.90	0.77	1273.48	0.24	1324.61	1507.47	3.21
Middle-income countries	931.32	-0.68	1101.76	3.38	1251.69	1389.30	2.96
Regional Economic Community							
CEN-SAD	842.75	-1.20	901.92	2.00	976.42	1010.95	0.77
COMESA	1099.76	-0.69	1108.99	1.10	1170.81	1268.05	1.45
EAC	1514.50	0.70	1467.71	1.80	1560.27	1555.06	-0.29
ECCAS	632.00	0.54	764.86	1.64	784.32	812.01	1.50
ECOWAS	926.65	0.84	1054.65	1.62	1106.50	1220.01	2.24
IGAD	842.54	-2.14	835.67	2.27	893.85	892.87	-0.74
SADC	1057.97	0.79	1307.42	3.19	1440.92	1694.62	5.22
UMA	874.33	-4.16	944.77	2.47	1102.10	1129.26	1.30

Source: Authors' calculation based on World Bank 2012.

TABLE D.4—AGRICULTURE PRODUCTION INDEX (API) (net base 2004-2006)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	69.14	1.74	83.31	2.87	93.62	102.83	2.58
SSA	72.31	1.65	85.18	2.71	94.25	102.85	2.57
Geographic Location							
Central	69.66	2.23	83.89	2.50	92.50	101.86	2.98
Eastern	66.82	2.76	82.56	3.20	94.10	102.53	2.73
Northern	64.72	1.82	80.56	3.13	92.70	102.77	3.13
Southern	76.02	0.27	88.66	2.55	94.89	103.43	3.09
Western	83.77	0.62	89.02	1.86	95.14	103.77	2.69
Economic classification							
Less favorable agriculture	68.25	-0.37	81.61	4.13	94.39	105.89	4.07
More favorable agriculture	67.23	2.07	83.53	3.00	93.56	102.74	3.09
Mineral-rich countries	66.37	2.77	81.60	2.90	92.32	102.47	3.28
Middle-income countries	70.23	1.72	83.52	2.71	93.67	102.63	2.78
Regional Economic Community							
CEN-SAD	69.24	1.88	83.76	3.01	94.37	103.30	2.81
COMESA	65.03	2.75	82.17	3.25	93.00	103.37	3.40
EAC	72.30	0.26	81.13	3.60	94.70	102.18	2.63
ECCAS	68.04	1.94	82.19	3.08	92.48	103.39	3.85
ECOWAS	83.77	0.62	89.02	1.86	95.14	103.77	2.69
IGAD	62.80	3.41	79.59	3.71	92.58	102.42	3.00
SADC	74.88	1.35	88.76	2.28	95.54	102.94	2.73
UMA	67.67	-0.28	78.51	3.04	92.24	100.80	2.27

Source: Authors' calculation based on World Bank 2012.
Notes: Calculations are weighted summations, where a country's agricultural GDP as a share in the regional total GDP is used as a weight.

TABLE D.5—TOTAL FERTILIZER USE (kilograms per ha)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	14.83	-1.97	14.92	1.20	15.88	15.45	-3.37
SSA	12.29	-1.74	12.34	0.08	12.33	11.87	-3.16
Geographic Location							
Central	2.49	3.14	4.86	8.90	5.80	5.19	-4.22
Eastern	5.98	-3.18	7.14	-0.40	7.04	6.70	-2.99
Northern	30.50	-2.51	31.40	4.40	39.11	39.16	-3.59
Southern	25.21	-1.41	23.34	-0.83	23.15	23.27	-1.46
Western	8.48	-2.03	7.82	0.46	6.92	5.89	-8.93
Economic classification							
Less favorable agriculture	5.22	-2.52	5.05	0.71	4.21	3.30	-7.51
More favorable agriculture	9.21	0.54	11.42	0.70	10.91	10.60	-3.04
Mineral-rich countries	6.27	4.53	5.23	-0.23	7.32	7.89	11.21
Middle-income countries	20.71	-2.54	20.05	1.30	21.84	21.52	-3.59
Regional Economic Community							
CEN-SAD	12.84	-2.77	13.35	3.01	15.28	14.54	-5.66
COMESA	13.78	-1.60	14.96	1.23	16.55	16.54	-1.21
EAC	12.26	-3.10	15.73	3.74	18.36	20.29	-4.44
ECCAS	2.63	1.61	3.71	7.32	4.57	4.42	-0.96
ECOWAS	8.48	-2.03	7.82	0.46	6.92	5.89	-8.93
IGAD	6.27	-3.90	7.75	0.54	7.85	7.24	-4.05
SADC	21.87	-1.28	20.41	-0.97	20.26	20.32	-1.30
UMA	23.07	-3.85	21.49	4.15	25.97	25.17	-1.96

Source: Authors' calculation based on FAO 2012.
Notes: Calculations are weighted summations, where a country's area harvest (ha) as a share of the regional total area is used as a weight.

TABLE D.6—AGRICULTURE, VALUE ADDED GROWTH RATE (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage point change (1990-1995)	Annual average level (1995-2003)	Annual average percentage point change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage point change (2003-2010)
Africa	2.80	0.20	4.71	0.69	4.00	4.23	-0.54
SSA	2.26	0.98	4.05	-0.15	2.63	3.82	0.11
Geographic Location							
Central	3.15	1.50	2.60	-0.67	1.58	2.67	0.09
Eastern	2.10	1.17	4.21	-0.77	2.01	3.84	0.64
Northern	3.34	-0.95	5.49	1.88	5.87	4.75	-1.42
Southern	0.63	0.11	3.86	0.48	2.68	3.86	0.25
Western	3.01	0.87	4.76	1.12	4.64	4.44	-1.26
Economic classification							
Less favorable agriculture	2.44	1.90	4.38	-0.04	2.35	3.52	-0.38
More favorable agriculture	2.83	0.28	3.77	-0.68	2.12	4.38	0.65
Mineral-rich countries	4.49	2.52	3.24	0.15	5.58	3.10	-1.77
Middle-income countries	2.52	-0.27	5.17	1.40	4.73	4.27	-0.91
Regional Economic Community							
CEN-SAD	3.05	-0.46	5.06	1.34	4.26	4.17	-0.91
COMESA	2.67	0.86	3.62	-0.57	1.91	3.28	0.37
EAC	2.10	-1.34	4.30	0.30	3.22	2.23	-0.84
ECCAS	2.11	2.01	3.97	-0.92	3.06	4.43	0.32
ECOWAS	3.01	0.87	4.76	1.12	4.64	4.44	-1.26
IGAD	1.99	1.32	4.16	-0.79	1.37	3.83	0.71
SADC	1.93	0.53	3.18	-0.08	2.71	3.70	0.25
UMA	3.26	-2.37	6.95	4.05	8.55	6.16	-2.94

Source: Authors' calculation based on World Bank 2012.

Annex E: Agricultural Trade

TABLE E.1—RATIO OF THE VALUE OF TOTAL AGRICULTURAL EXPORTS TO TOTAL AGRICULTURAL IMPORTS

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	0.70	-1.41	0.72	-1.29	0.71	0.64	-4.81
SSA	1.24	-2.04	1.21	-3.21	1.05	0.89	-5.31
Geographic Location							
Central	1.01	-1.16	0.90	-8.46	0.63	0.52	-6.55
Eastern	1.70	-1.28	1.45	-7.34	1.15	1.01	-4.55
Northern	0.19	-0.91	0.20	2.18	0.25	0.27	0.03
Southern	1.21	-4.54	1.20	-0.40	1.04	0.91	-5.03
Western	1.08	-1.08	1.17	-1.97	1.11	0.89	-6.04
Economic classification							
Less favorable agriculture	1.12	-2.59	0.90	-7.12	0.65	0.51	-12.24
More favorable agriculture	1.83	-0.92	1.87	-4.89	1.48	1.31	-3.81
Mineral-rich countries	0.36	-4.54	0.37	-0.28	0.40	0.40	-2.73
Middle-income countries	0.56	-2.20	0.58	0.07	0.61	0.55	-5.29
Regional Economic Community							
CEN-SAD	0.65	-0.10	0.68	0.14	0.75	0.66	-5.95
COMESA	0.74	2.18	0.72	-2.51	0.71	0.66	-4.38
EAC	1.48	-3.18	1.25	-3.47	1.12	1.24	-1.03
ECCAS	0.66	-1.30	0.57	-8.55	0.38	0.32	-6.92
ECOWAS	1.08	-1.08	1.17	-1.97	1.11	0.89	-6.04
IGAD	1.73	1.74	1.60	-8.88	1.21	1.06	-4.51
SADC	1.24	-4.13	1.16	-1.44	0.99	0.85	-5.30
UMA	0.20	-3.14	0.21	-0.87	0.21	0.24	-2.32

Source: Authors' calculation based on World Bank 2012.

TABLE E.2—PER CAPITA AGRICULTURAL TRADE (USD)

2a—PER CAPITA AGRICULTURAL EXPORTS (USD)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	17.83	1.80	19.42	-2.47	20.36	26.32	8.35
SSA	18.99	1.66	20.59	-2.85	21.01	26.09	6.79
Geographic Location							
Central	10.77	-2.66	9.40	-6.89	8.38	9.41	3.80
Eastern	15.33	5.14	15.62	-6.12	13.72	19.29	10.55
Northern	12.84	2.40	14.10	-0.30	17.29	27.50	15.90
Southern	37.41	1.09	39.19	-2.77	39.27	50.56	7.41
Western	16.25	0.65	20.36	0.35	23.95	27.37	4.69
Economic classification							
Less favorable agriculture	14.34	-2.39	12.69	-5.72	11.21	10.97	-4.18
More favorable agriculture	17.24	5.15	18.74	-4.74	16.77	23.50	10.86
Mineral-rich countries	3.85	-1.80	3.80	-2.93	4.62	6.11	5.88
Middle-income countries	21.04	0.97	23.55	-1.18	26.58	34.01	8.26
Regional Economic Community							
CEN-SAD	17.26	1.96	20.00	-0.84	22.54	28.76	8.33
COMESA	15.75	2.59	15.72	-4.72	14.80	20.24	11.16
EAC	25.19	8.66	26.17	-6.10	24.04	38.95	13.74
ECCAS	9.37	-3.65	7.92	-7.02	6.95	8.18	5.33
ECOWAS	16.25	0.65	20.36	0.35	23.95	27.37	4.69
IGAD	13.77	7.13	14.94	-6.44	13.24	19.80	12.39
SADC	25.87	0.87	25.90	-3.53	24.96	31.24	6.63
UMA	17.55	1.67	18.47	-2.55	20.18	31.60	11.80

Source: Authors' calculation based on World Bank 2012 and FAO 2012.

TABLE E.2— PER CAPITA AGRICULTURAL TRADE (USD)—Continued

2b—PER CAPITA AGRICULTURAL IMPORTS (USD)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	25.40	3.26	26.78	-1.20	28.69	42.48	13.83
SSA	15.48	3.78	16.97	0.38	20.01	30.22	12.78
Geographic Location							
Central	10.58	-1.52	10.61	1.72	13.42	18.64	11.07
Eastern	9.08	6.50	10.84	1.31	11.99	19.75	15.81
Northern	68.05	3.35	71.37	-2.42	69.78	102.37	15.87
Southern	31.87	5.91	32.76	-2.37	37.91	57.26	13.11
Western	15.11	1.75	17.42	2.36	21.54	31.93	11.42
Economic classification							
Less favorable agriculture	12.85	0.20	14.35	1.50	17.04	22.63	9.18
More favorable agriculture	9.60	6.12	10.03	0.15	11.33	18.40	15.26
Mineral-rich countries	10.83	2.87	10.42	-2.66	11.33	15.57	8.85
Middle-income countries	37.94	3.24	40.61	-1.25	43.30	64.26	14.31
Regional Economic Community							
CEN-SAD	26.52	2.06	29.26	-0.98	29.97	45.34	15.17
COMESA	21.21	0.40	21.85	-2.28	20.71	31.77	16.25
EAC	17.53	12.24	20.90	-2.73	21.25	31.83	14.92
ECCAS	14.14	-2.37	13.98	1.68	18.20	26.44	13.16
ECOWAS	15.11	1.75	17.42	2.36	21.54	31.93	11.42
IGAD	8.06	5.29	9.49	2.68	11.03	19.25	17.71
SADC	21.33	5.22	22.35	-2.13	25.32	37.77	12.60
UMA	86.94	4.97	88.52	-1.69	93.84	135.53	14.46

Source: Authors' calculation based on World Bank 2012 and FAO 2012.

TABLE E.3—AGRICULTURAL TRADE AS A SHARE IN MERCHANDISE TRADE (%)

3a—AGRICULTURAL EXPORTS AS A SHARE OF TOTAL MERCHANDISE EXPORTS (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	12.11	4.95	11.82	-5.35	9.62	7.46	-5.28
SSA	15.68	3.07	15.39	-4.53	12.72	9.71	-6.51
Geographic Location							
Central	12.23	2.11	9.99	-11.43	5.99	3.88	-9.26
Eastern	56.48	-0.04	45.91	-7.60	32.64	28.72	-3.75
Northern	4.98	8.77	4.66	-6.02	3.97	3.55	0.62
Southern	10.27	0.79	10.10	-3.34	8.38	6.61	-6.45
Western	16.35	5.39	17.47	-2.80	16.41	11.80	-8.19
Economic classification							
Less favorable agriculture	42.74	-2.78	37.61	-3.25	27.53	14.79	-18.48
More favorable agriculture	56.52	0.79	53.53	-2.71	45.12	42.70	-1.86
Mineral-rich countries	8.24	7.57	10.25	-1.57	10.60	8.82	-10.59
Middle-income countries	8.72	4.27	8.53	-4.86	7.29	5.55	-5.54
Regional Economic Community							
CEN-SAD	14.44	5.97	14.42	-4.25	12.55	9.50	-5.97
COMESA	20.59	7.36	19.79	-6.46	14.65	11.00	-4.98
EAC	27.28	1.27	22.94	-6.20	18.15	20.27	1.79
ECCAS	8.43	0.69	6.31	-12.70	3.53	2.11	-13.65
ECOWAS	16.35	5.39	17.47	-2.80	16.41	11.80	-8.19
IGAD	68.59	0.50	55.32	-8.87	36.95	31.32	-4.88
SADC	12.07	1.20	11.48	-4.16	9.22	7.25	-6.44
UMA	4.07	9.76	3.78	-8.43	2.81	2.45	-2.63

Source: Authors' calculation based on FAO 2012.

TABLE E.3—AGRICULTURAL TRADE AS A SHARE IN MERCHANDISE TRADE (%)—Continued

3b—AGRICULTURAL IMPORTS AS A SHARE OF TOTAL MERCHANDISE IMPORTS (%)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	17.31	1.44	15.85	-2.03	14.47	12.88	-0.85
SSA	13.79	1.93	13.21	-0.57	12.86	11.66	-1.13
Geographic Location							
Central	19.70	7.62	18.50	-4.08	15.93	13.88	-4.46
Eastern	16.90	4.68	17.17	0.47	17.02	15.31	-1.87
Northern	23.07	1.13	20.18	-3.51	17.34	15.18	-0.70
Southern	10.08	1.98	8.75	-2.92	8.13	7.34	0.00
Western	17.59	0.54	18.30	1.22	19.07	17.53	-2.31
Economic classification							
Less favorable agriculture	22.53	0.46	24.05	-0.40	23.11	21.43	-4.44
More favorable agriculture	16.80	4.87	16.05	0.84	17.00	16.17	-1.48
Mineral-rich countries	25.33	9.30	24.39	-3.96	20.84	18.19	-3.74
Middle-income countries	16.95	0.83	15.34	-2.44	13.70	12.06	-0.49
Regional Economic Community							
CEN-SAD	19.70	0.47	18.23	-1.81	16.67	15.18	-0.10
COMESA	22.02	-0.67	19.27	-0.97	18.26	16.10	-0.48
EAC	11.72	7.08	11.71	-2.97	10.92	10.76	1.71
ECCAS	21.81	3.90	18.67	-4.98	16.44	13.19	-6.71
ECOWAS	17.59	0.54	18.30	1.22	19.07	17.53	-2.31
IGAD	19.64	2.30	17.55	0.94	17.88	16.17	-1.04
SADC	10.80	2.59	9.86	-2.67	9.07	8.20	-0.30
UMA	20.84	3.40	19.20	-3.19	16.53	14.76	-0.82

Source: Authors' calculation based on FAO 2012.

Annex F: Poverty and Hunger

TABLE F.1—HEADCOUNT POVERTY RATE (% of population below international poverty line, $1.25/Day)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	20.42	-1.35	18.65	-1.43	17.58	16.86	-1.48
SSA	26.05	-1.51	23.51	-1.62	22.00	20.92	-1.62
Geographic Location							
Central	23.56	-2.84	19.07	-3.51	16.45	19.46	10.09
Eastern	23.88	-1.16	22.16	-1.13	21.14	20.25	-1.23
Northern	1.08	-1.97	0.94	-2.41	0.84	0.78	-1.75
Southern	25.88	-2.91	21.04	-3.42	18.17	15.72	-4.43
Western	28.15	-1.06	26.15	-1.18	24.91	23.92	-1.17
Economic classification							
Less favorable agriculture	38.18	-2.09	31.84	-3.18	27.81	24.31	-4.04
More favorable agriculture	28.57	-2.20	24.64	-2.36	22.30	20.38	-2.63
Mineral-rich countries	42.20	-3.20	32.98	-4.31	27.20	22.19	-6.28
Middle-income countries	12.67	0.16	12.84	0.26	12.99	13.47	1.55
Regional Economic Community							
CEN-SAD	18.40	-0.75	17.46	-0.85	16.87	16.54	-0.39
COMESA	18.38	-1.79	16.46	-1.64	15.35	14.33	-2.00
EAC	19.37	-0.90	18.63	-0.34	18.35	18.81	1.46
ECCAS	24.23	-1.61	22.06	-1.17	21.03	24.38	8.06
ECOWAS	28.15	-1.06	26.15	-1.18	24.91	23.92	-1.17
IGAD	18.78	-1.98	16.35	-2.27	14.85	13.53	-2.76
SADC	29.34	-1.81	25.93	-1.97	23.93	22.31	-2.05
UMA	1.65	-2.05	1.43	-2.33	1.29	1.23	-0.36

Source: Author's calculation based on World Bank 2012.
Notes: Calculations are weighted summations, where each country's population as a share of the regional population is used as a weight. See technical notes for exact method of calculation.

TABLE F.2—HEADCOUNT POVERTY RATE (% of population below national poverty line)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	42.93	0.22	43.04	-0.01	43.05	42.52	-0.43
SSA	49.70	-0.04	49.03	-0.25	48.59	47.61	-0.66
Geographic Location							
Central	55.27	2.95	55.48	-1.05	53.26	51.62	-0.90
Eastern	48.71	-1.16	45.41	-1.05	43.45	41.64	-1.24
Northern	18.50	1.23	20.01	1.19	20.97	21.85	1.17
Southern	51.15	-0.84	48.47	-0.74	47.27	42.38	-4.13
Western	48.98	0.68	51.17	0.68	52.57	53.78	0.64
Economic classification							
Less favorable agriculture	61.86	1.11	60.39	-0.96	58.14	56.33	-0.91
More favorable agriculture	49.33	-0.57	47.55	-0.59	46.37	43.94	-1.89
Mineral-rich countries	68.73	-1.30	63.35	-1.21	60.31	57.61	-1.35
Middle-income countries	35.16	0.59	36.59	0.66	37.64	38.57	0.71
Regional Economic Community							
CEN-SAD	39.39	0.66	41.15	0.69	42.31	43.38	0.71
COMESA	43.02	0.41	42.66	-0.38	41.92	39.80	-1.85
EAC	45.50	0.87	43.61	-1.26	41.36	39.26	-1.54
ECCAS	57.01	1.82	56.43	-0.92	54.42	52.84	-0.84
ECOWAS	48.98	0.68	51.17	0.68	52.57	53.78	0.64
IGAD	47.82	-1.32	43.67	-1.46	41.09	38.78	-1.70
SADC	50.31	-0.74	48.08	-0.62	47.04	43.72	-2.68
UMA	19.97	0.98	21.35	1.05	22.27	23.16	1.13

Sources: Author's calculation based on World Bank 2012 and UNSD 2012 and various country reports.
Notes: Calculations are weighted summations, where each country's population as a share of the regional population is used as a weight. See technical notes for exact method of calculation.

TABLE F.3—PREVALENCE OF CHILD MALNUTRITION (% of children under five years of age)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	24.68	-1.66	22.06	-1.75	20.53	19.27	-1.84
SSA	20.66	-0.88	19.48	-0.90	18.79	18.21	-0.93
Geographic Location							
Central	17.74	-1.56	15.93	-1.70	14.85	13.91	-1.93
Eastern	19.59	-0.86	18.33	-1.09	17.53	16.82	-1.20
Northern	41.65	-2.97	33.56	-3.63	28.64	24.31	-5.01
Southern	18.55	-1.52	16.81	-1.50	15.80	14.91	-1.70
Western	23.99	-0.40	23.47	-0.30	23.19	23.05	-0.02
Economic classification							
Less favorable agriculture	19.85	2.15	22.05	1.46	23.37	24.51	1.33
More favorable agriculture	19.29	-1.16	17.87	-1.18	17.03	16.36	-1.02
Mineral-rich countries	18.40	-2.20	15.98	-2.20	14.54	13.24	-2.75
Middle-income countries	29.16	-1.97	25.47	-2.15	23.29	21.45	-2.41
Regional Economic Community							
CEN-SAD	29.39	-1.21	27.20	-1.16	25.97	25.00	-1.01
COMESA	26.98	-2.11	23.27	-2.36	21.08	19.24	-2.69
EAC	18.68	1.93	20.61	1.37	21.75	22.76	1.28
ECCAS	18.51	-0.75	17.36	-1.02	16.67	16.04	-1.11
ECOWAS	23.99	-0.40	23.47	-0.30	23.19	23.05	-0.02
IGAD	22.49	-0.97	21.01	-1.10	20.08	19.27	-1.18
SADC	16.83	-2.14	14.52	-2.38	13.12	11.85	-3.05
UMA	31.63	-3.23	24.84	-4.16	20.66	16.98	-6.09

Source: Authors' calculations based on World Bank 2012, UNSD 2012, and FAO 2012.
Notes: Child malnutrition prevalence includes children whose weight-for- age is below 2 standard deviations. Calculations are weighted summations, where each country's population as a share of the regional population is used as a weight. See technical notes for exact method of calculation.

TABLE F.4—PREVALENCE OF ADULT UNDERNOURISHMENT (% of population)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	26.19	-1.72	23.28	-1.92	21.46	19.87	-2.27
SSA	31.51	-1.90	27.62	-2.14	25.23	23.20	-2.48
Geographic Location							
Central	42.38	-1.40	38.36	-1.62	35.89	33.80	-1.76
Eastern	43.18	-1.60	38.73	-1.75	35.99	33.59	-2.02
Northern	5.34	-0.30	5.23	-0.31	5.17	5.11	-0.32
Southern	31.27	-1.36	28.25	-1.68	26.41	24.88	-1.79
Western	19.11	-3.23	15.15	-3.91	12.74	10.71	-4.95
Economic classification							
Less favorable agriculture	42.84	-1.92	37.76	-1.97	34.74	32.04	-2.41
More favorable agriculture	42.25	-1.54	37.89	-1.79	35.14	32.72	-2.08
Mineral-rich countries	33.86	-0.38	33.70	0.18	33.98	34.22	0.18
Middle-income countries	15.32	-2.38	12.84	-3.00	11.28	9.91	-3.72
Regional Economic Community							
CEN-SAD	18.63	-2.19	15.96	-2.57	14.29	12.84	-3.01
COMESA	33.98	-1.39	30.88	-1.57	28.89	27.08	-1.90
EAC	28.20	-0.42	28.35	0.32	28.66	28.88	0.22
ECCAS	48.69	-1.75	42.95	-2.07	39.39	36.28	-2.44
ECOWAS	19.11	-3.23	15.15	-3.91	12.74	10.71	-4.95
IGAD	46.88	-2.00	40.68	-2.33	36.85	33.49	-2.83
SADC	31.10	-0.77	29.39	-0.92	28.37	27.60	-0.80
UMA	5.64	-0.55	5.44	-0.55	5.32	5.21	-0.59

Source: Authors' calculations based on World Bank 2012, UNSD 2012, and FAO 2012.
Notes: Calculated are weighted summations, where each country's population as a share of the regional population is used as a weight. See technical notes for exact method of calculation.

TABLE F.5—MORTALITY RATE, CHILDREN UNDER FIVE YEARS OF AGE (Per 1000)

Region/Subregion	Annual average level (1990-1995)	Annual average percentage change (1990-1995)	Annual average level (1995-2003)	Annual average percentage change (1995-2003)	2003	Annual average level (2003-2010)	Annual average percentage change (2003-2010)
Africa	149.26	-1.00	134.64	-2.01	123.53	113.08	-2.55
SSA	167.13	-0.65	152.93	-1.88	140.97	129.20	-2.51
Geographic Location							
Central	171.71	0.11	170.62	-0.27	168.57	163.99	-1.00
Eastern	150.44	-0.72	132.96	-2.70	118.21	106.03	-3.15
Northern	72.51	-5.20	51.32	-5.29	41.00	34.44	-4.98
Southern	131.60	-0.49	128.45	-0.63	123.47	110.21	-3.84
Western	199.28	-0.92	177.76	-2.29	161.25	147.54	-2.55
Economic classification							
Less favorable agriculture	211.22	0.06	188.30	-2.44	170.31	156.76	-2.36
More favorable agriculture	160.32	-1.14	141.72	-2.65	126.14	112.63	-3.34
Mineral-rich countries	191.54	-0.48	181.52	-0.97	174.76	166.27	-1.68
Middle-income countries	127.84	-1.28	115.02	-1.90	105.95	96.83	-2.68
Regional Economic Community							
CEN-SAD	151.93	-1.26	134.74	-2.26	122.48	112.75	-2.36
COMESA	138.69	-1.15	122.99	-2.30	111.57	101.84	-2.70
EAC	133.82	1.46	124.79	-2.58	110.94	98.78	-3.36
ECCAS	181.69	0.59	175.89	-0.92	169.37	161.83	-1.46
ECOWAS	199.28	-0.92	177.76	-2.29	161.25	147.54	-2.55
IGAD	148.69	-1.21	133.33	-2.17	121.37	111.57	-2.41
SADC	146.55	-0.42	139.56	-1.16	132.18	120.36	-3.09
UMA	65.73	-3.84	51.66	-3.60	44.49	39.51	-3.39

Source: Authors' calculation based on World Bank 2012.

TABLE F.6—GLOBAL HUNGER INDEX

Region/Subregion	1990	2011
Africa	22.21	20.01
SSA	25.36	20.57
Geographic Location		
Central	25.53	32.68
Eastern	29.54	22.69
Northern	7.73	6.57
Southern	20.84	15.78
Western	23.85	16.15
Economic classification		
Less favorable agriculture	31.72	25.28
More favorable agriculture	28.92	21.74
Mineral-rich countries	24.70	33.06
Middle-income countries	17.08	14.29
Regional Economic Community		
CEN-SAD	20.32	16.65
COMESA	24.12	26.00
EAC	22.24	19.91
ECCAS	27.93	30.70
ECOWAS	23.85	16.15
IGAD	31.73	23.36
SADC	22.04	22.65
UMA	7.64	6.57

Source: Author's calculated based upon Von Grebmer et al. 2011.
Notes: Calculations are weighted summations, where each country's population as a share of the regional population is used as a weight. Blank cells indicate missing values.

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